Environmental and Social Impact Assessment for Sewage Treatment Plant in Bally

Ganga STP Project Private Limited

Final Report

15 October 2020

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Acronyms and Abbreviations

AP	Anaerobic Pond
BOD	Biological Oxygen Demand
C&D	Construction and Demolition
CMP	Contractor Management Plan
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CTE	Consent To Establish
CTO	Consent To Operate
DPR	Detail Project Report
DTCP	Department of Town and City Planning
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering Procurement Construction
ERM	Environmental Resources Management
ERP	Emergency Preparedness and Response Plan
ESIA	Environment and Social Impact Assessment
E&S	Environment and Social
ESAP	Environmental and Social Action Plan
ESDD	Environment and Social Due Diligence
FC	Fecal Count
FI	Financial Institute
FP	Facultative Pond
GAP	Ganga Action Plan
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GSPPL	Ganga STP Projects Private Ltd.
HAM	Hybrid-Annuity Model
HSE	Health, Safety and Environment
I&D	Interception and Diversion
IFC	International Finance Corporation
IFC PS	International Finance Corporation Performance Standard
IIT	Indian Institute of Technology
KMC	Kolkata Municipal Corporation
KMDA	Kolkata Metropolitan Development Authority
LMP	Labour Management Plan
LS	Lifting Station
MDWS	Ministry of Drinking water & Sanitation

MLD	Million-Liter per Day
MoEF&CC	Ministry of Environment, Forests & Climate Change
MP	Maturation Pond
MPS	Main Pumping Station
NEERI	National Environmental Engineering Research Institute
NGT	National Green Tribunal
NH	National Highway
NMCG	National Mission for Clean Ganga
NOC	No Objection Certificate
OHS	Occupational Health and Safety
O&M	Operation and Maintenance
PAP	Project Affected Person
PWD	Public Works Department
PPP	Public Private Partnership
RAP	Resettlement Action Plan
QHSE	Quality, Health, Safety and Environment
ROW	Rights Of Way
SBR	Sequencing Batch Reactor
SEP	Stakeholder Engagement Plan
SOP	Standard Operating Procedure
SPMG	State Program Management Groups
SOP	Standard Operating Procedures
SPV	Special Purpose Vehicle
SR	Safeguard Requirements
SS	Suspended Solids
STP	Sewage Treatment Plant
TSS	Total Suspended Solids
ULB	Urban Local Bodies
WBPCB	West Bengal Pollution Control Board
WSP	Wastewater Stabilization Pond

EXECUTIVE SUMMARY

A) Introduction

1. Over the years, the river Ganga has been subject to pollution from various sources which include discharge of urban liquid wastes and sewage, industrial liquid wastes, large scale wallowing and bathing of cattle, throwing of carcasses and dead bodies in the river, surface run-off from agricultural fields using pesticides and insecticides and leachate from60 solid and industrial waste dumps. Government of India identified cleaning of the river Ganga as one of its key priorities, and recognizing the need, National Mission for Clean Ganga (NMCG) has been constituted under Ministry of Water Resources, River Development & Ganga Rejuvenation and has set an objective to ensure effective abatement of pollution and conservation of the river Ganga and its tributaries by adopting a river basin approach for comprehensive planning and management. Under NMCG an Integrated Ganga Conservation Mission namely “Namami Gange” has been approved as ‘Flagship Programme’ set up in June 2015 to accomplish effective abatement of pollution, conservation and rejuvenation of the river. The overall scheme aims at preventing the discharge of untreated industrial and municipal waste into the River Ganga through a number of water treatment projects.

2. The Government of India had accorded Cabinet approval to Hybrid Annuity- Public Private Partnership (PPP) model for creation and maintenance of sewage treatment infrastructure under the Namami Gange Programme. Under this model, the development, operation and maintenance of the STPs will be undertaken by a Special Purpose Vehicle (SPV) to be created by the winning bidder at the local level. As per this model, 40% of the Capital cost quoted would be paid on completion of construction while the remaining 60% of the cost will be paid over the life of the project as annuities along with operation and maintenance (O&M) cost. As the most important features of this model is that, the Annuity and O&M payments are linked to the performance of the STP, which will ensure continued performance of the assets created. Based on better accountability, ownership and optimal performance.

3. Under the flagship program of Namami Gange, NMCG in association with Kolkata Metropolitan Development Authority, has conceived to implement the project titled “Development of Sewage Treatment Plants – Kolkata City Area”, under sub-project pertaining to Bally STP. The existing Bally WSP Site is located at Chamrail Gram Panchayat area under Bally-Jagacha Block and the linked project components are spread across Howrah Municipal Corporation area in district of Howrah, West Bengal and is one of the sub-projects under the project titled “Development of Sewerage Treatment Plants – Kolkata City Area” of KMDA. The proposed scenario involves construction of a new STP of 40 MLD capacity and reduction of capacity of existing WSP to 22 MLD within the existing WSP area.

4. M/s Ganga STP Projects Private Ltd (GSPPL) has been selected as the successful bidder for the project. M/s GSPPL (the “Concessionaire”) has been incorporated by M/s VA Tech Wabag Limited as a 100% equity funded entity to fulfil the requirement towards Hybrid-Annuity based Public Private Partnership (PPP) model. GSPPL is the developer of the project and will hold the ownership of the project assets till the end of concession period of fifteen (15) years. M/s GSPPL in turn will subcontract the Design, Build as well as Operation and Maintenance (O&M) scope for the project to M/s VA Tech Wabag Limited (Wabag). The Concession Agreement includes three components i.e. Bally, Baranagar and Arupara and this ESIA is only focused on Bally and separate ESIAs have been completed for Baranagar and Arupara.

5. GSPPL has therefore initiated an environmental and social impact assessment (ESIA) study to comply with the requirements of the Concession Agreement. GSPPL is also seeking finance from international lenders for setting up of the Project and subsequent operation and maintenance

during the concession period hence the ESIA also needs to conform to the guidelines and requirements of the International Finance Corporation (IFC).

B) Policy, Legal & Administrative Framework

Environment

6. The proposed project activity involves construction of new Bally STP at sludge drying pond area used during pervious STP operation, renovation, rehabilitation and installation linked sewerage infrastructure. The proposed project does not qualify for obtaining statutory Environmental Clearance under the listed project as per EIA Notification, 2006 under the Environment (Protection) Rules, 1986.

Land Acquisition

7. The existing project does not require any fresh land acquisition. The proposed STP will be developed within the existing land owned by KMDA at all the three locations. The proposed rehabilitation or laying of sewer pipelines will be carried out within the RoW of existing government roads. Hence, the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 will not be applicable.

International Safeguard Requirements

8. Financing support for the Project will be sought from multi-lateral financial institutions, such as the IFC. This support from the multi-lateral financial institutions requires adherence of international best practices and environmental and social safeguard requirements of the lenders. The major relevant guidelines and policies considered for this project are as included in paragraph nos. 9 to 12.

9. **IFC's Performance Standard, 2012** – IFC's Environmental and Social Performance Standards define IFC clients' responsibilities for managing their environmental and social risks. It applies to all investment and advisory clients whose projects go through IFC's initial credit review process after January 1, 2012.

10. This **Project** has been classified as Category B project as per IFC PS, 2012 framework. The project will also confirm to the requirements under IFC PS, 2012 in respect of consultation, disclosure requirements and safeguard documentation to meet safeguard principles and requirements of the lenders.

11. **Applicable EHS Standards** – All relevant national and state-specific EHS and Social regulations in India will be applicable for this Project. In addition to that IFC General EHS Guidelines, 2007 and Industry Sector Guidelines: Water and Sanitation, 10 December 2007 will apply. The Project will conform to National Mission for Clean Ganga Environmental and Social Management Framework for Navami Gange Program.

C) Description of the Project

12. The existing waste stabilization ponds of capacity 40 MLD at Bally and linked infrastructures i.e. underground I&D sewer, six (6) Lift Stations (LS), one (1) Main Pumping Station (MPS) were reportedly installed and commissioned during 1995 under jurisdiction of local Panchayat Authority. During project site visit conducted during June 2019, it has been learnt that the existing Bally WSP is functioning at bare minimum capacity due to non-functionality of pumps at Kona MPS. All the lifting station were reported to be partially working, however in the present condition, the raw sewage is being released to the river Hooghly through the outfall points along the river banks.

13. The existing Bally Waste Stabilization Pond Site is located at Chamrail Gram Panchayat area under Bally-Jagacha Block and the linked project components are spread across Howrah Municipal Corporation area in district of Howrah. Bally Municipality, which was formed in 1883, and was responsible for the civic infrastructure and administration on the northern suburbs of the city of Howrah, was merged into Howrah Municipal Corporation in 2015. So, the entire sewer line network passes through the eastern part of the Howrah municipality area.

14. Wastewater from surrounding areas (wards under jurisdiction of HMC) of LS-2, LS-3, LS-4, LS-5 and LS-6 are diverted into gravity sewer line from individual LS. The gravity sewer line originates at Bally Khal and flows along G.T.Road, Belur Math Road and G.K.Bhaduri Road, taking wastewater from LS-3,LS-2 and LS-4 respectively. Similarly wastewater from LS-5 and LS-6 are pumped into gravity sewer line which runs along J.N.Mukherjee road. Wastewater from these LS are collected at LS-1 which is located on Girish Ghosh Road. From LS-1 wastewater is pumped through raising main and diverted into Pacha Khal, which flows till MPS and WSP at Kona located at Bhattanagar.

15. The proposed project will utilise the existing land and infrastructure of the sewage treatment facility and linked sewerage infrastructure. The new 40 MLD STP will be built on the reclaimed area after partial filling up of two ponds. The gravity sewer lines, rising main and effluent discharge lines are within the ROW of the public roads under the ownership of PWD (Government of West Bengal) and Municipal roads therefore no additional ROW/ land acquisition in the project scenario will be involved.

Resource Requirement

16. **Manpower**: During construction period, labour will be required for construction work for STP, and for laying and excavation work of the sewer pipelines. Reportedly, the man power requirement for the construction phase is approximately 100-150 workers, who will be mobilized for the construction and civil work. These include unskilled, semi-skilled and skilled workers. Reportedly, 80% of the labour is expected to be sourced from outside the district and only 20% will be sourced locally.

17. **Water:** During construction period, water will be required for mainly dust suppression and drinking water purpose at the labour camp. The source of water during construction phase will be arranged by KMDA through the existing municipal water supply pipeline in the locality. Concessionaire has not estimated the water requirement for this phase. During operational phase, water will be required for preparation of caustic solution for biogas scrubber and chlorine gas neutralization scrubber operation as well as for chlorination tank operation. Raw water will be also required for drinking purpose for the workers during the operational phase. The main source water is pipe water supply and the amount of required during this phase is 0.5 m^3/day. Another 0.1 m^3/day of water will be required to maintain the present greenbelt within the facility. The source of water during operational phase will be arranged by KMDA through the existing municipal water supply pipeline in the locality.

18. **Land:** Reportedly the land for the proposed STP is under the jurisdiction of the Kolkata Municipal Development Authority (KMDA). Along with STP land specification, the trunk sewer lines, effluent discharge lines are within the ROW of the public roads under the ownership of PWD (Government of West Bengal) and Municipal roads. The existing land of WSP is 20.13 ha. The area required for the construction of new STP is 1.85 ha. The renovation work at the MPS and LS will be done within the MPS and LS facility respectively, so no land will be required for proposed activity at MPS and LS. Temporarily 60 to 75 m2 (30m of length and 2 to 2.5 m width) of land will be

required for laying of new pipeline or raising main. The area requirement may change with the depth at which the new pipelines or raising main will be laid.

19. As reported in the Land Ownership Declaration letter pertaining to KMDA's ownership of the land area for the Bally WSP and linked facilities, there are no land issues or disputes, grievances or court cases raised against the land area for the STP and its linked facilities. Moreover, during execution of the project, if necessary for land acquisition, this will be carried out as per the direction of the Government of West Bengal.

20. **Power:** During construction phase of the project portable back-up Diesel Generator (DG) sets shall be used along with the existing grid as this common practice in India. During operational phase, existing grid will be used as the primary electricity source for STP and linked facilities. Whereas, a back-up DG sets of 800 KVA will also be installed for emergency purpose during the operational phase of the project. As proposed an 800 kW capacity biogas engine will be installed and the power generated from it will be utilized for day to day operations of STP. The power requirement for construction phase has not been estimated by concessionaire. The total power requirement for both construction and operation phase will be available after the finalization of detailed project engineering design.

Pollution Sources and Characterisation

21. The Project will have following potential effects on the environment:
    a) **Air Emissions:** Construction activities will generate emission of fugitive dust caused by demolition activity, on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind. DG sets will be used during construction period which will generate exhaust gas. Biogas will be generated during the operation phase. During operational phase DG set will be operated as backup electricity source and biogas will be generated during the operation phase, which may be required to be flared under certain circumstances resulting in flare combustion products comprising of Carbon Monoxide, Total Volatile Organic Carbon (VOC) and Oxides of Nitrogen).

    b) **Liquid Discharges:** During construction phase, the source of liquid discharge will be the wastewater stored within the two ponds which will be reclaimed. As the WSP is barely-functional over two to five years, the stored wastewater has more or less similar characteristics of rainwater that is collected in these open structures over the period. Hence, this liquid discharge was not considered as a potential source of pollution. During operational phase of the proposed project activity, treated water due to operation of the proposed 62 MLD treated water from STP and WSP will be discharged into adjacent canal. The qualitative discharge characteristics will be maintaining stipulated regulatory limits for the STP operation under Environment (Protection) Amendment Rules, 2017 by Ministry of Environment, Forests and Climate Change, Government of India and as stipulated under the Concession Agreement. Hence, the discharge of the treated water from the proposed STP operation was not considered as a potential source of pollution.

    c) **Solid Waste:** Waste shall be generated during construction phase activities i.e. packaging materials, cement bags, ready mix concrete discards, excavated materials, empty barrels etc. These waste can be hazardous and non-hazardous in nature and are categorized as Construction and Demolition (C&D) wastes governed by Construction and Demolition Waste Rules, 2016 for the proposed project site and linked faculties. As reported, at the end of days' work de-silted materials or sludge from renovation or de-slitting jobs for identified sewer line stretch shall be stored temporarily at respective location and then disposed to designated landfill sites assigned by KMDA as per Concession Agreement. During operation phase,

periodic maintenance of the sewer line will generate de-silted sludge. De-watered sludge will be generated due to treatment of sewage water. Solid wastes from grit chambers and screens will be generated at the pumping stations. Used oil and grease and cotton waste (contaminated with oil) generated from maintenance activities at the LS, PS and STP equipment are the sources of hazardous wastes during operation phase.

d) **Hazardous Wastes:** Construction activities may pose the potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. Dedicated areas will be earmarked for temporary storage of hazardous wastes on impervious surface at the project site. All construction and operation phase hazardous wastes will be disposed through authorized recycler/ disposal agency as per the regulatory requirements.

e) **Noise Emissions:** During construction activities, noise and vibration will be caused by the operation of pile drivers, earthmoving and excavation equipment, concrete mixers, cranes and the transportation vehicle. High noise equipment and machineries like hydraulic pumps, mixing pit pump, digestor loading pump, HGV movement, material tipping, air blower and compressors will be the main noise sources during the operational phase of the STP.

D) Description of Environment

22. A 1 km radial buffer zone around the STP site and one hundred meter area around the proposed sewer network line (50m on both side of the sewer network line) has been considered as study area based on the Area of Influence of the proposed project activity.

Physical Environment

23. **Topography:** The study area is a part of lower gangetic deltaic plain. The entire district has flat topography with average elevation from MSL (mean sea level) varies from 9 to 11m near the river ganga and varies from 5 to 9 m near the WSP. The overall slope of the district is towards the South.

24. **Geology:** The study area is a part of lower Gangetic Deltaic plain of Bengal basin. Presently, the configuration of Bengal basin can be inferred by the presence of Gangetic-Brahmaputra delta system in the north and the Bengal Deep Sea Fan on the south. The study area is characterized by thick quaternary alluvium deposit, laid down by Bhagirathi-Hooghly River system. The alluvial sediments in the form of flood plain deposits consist of the sands of various grades, silt and clay with occasional gravel beds. Immediately below the land surface a thick layer of sticky clay ranging in thickness between 30-70 m.

25. **Landuse:** The study area is located in predominantly urban settings. The broad landuse classes identified in the study area are settlements, water bodies, industry, drainage channels, low marshy land, railway track and green cover. The sewer pipeline network passes through the main load with settlements on both side of the road.

26. **Drainage:** The main rivers of Howrah district are Rupnarayan River, Mundeswari River Bhagirathi and Hooghly River. The boundaries of the district are naturally defined by these three (3) rivers - Rupnarayan River flows along the West and South-west part of the district; Bhagirathi-Hooghly River flows along East and South-east part of the district and Damodar River flows from north-west boundary of the district. Apart from rivers there is an artificial canal called Bally Khal present along the north-eastern boundary of the district. The Bally Khal meets the Hooghly River at the North-eastern part of the district. In addition to Bally Khal, there are so many khals and channel like, Howrah Drainage Channel, Mahishdhara khal, Barjola khal, Rajapur khal, Medinipur Main

khal, Champa khal, Rampur khal, Gaighata khal etc. which play very important role in respect to flood and irrigation control. Besides the above, other small rivers like Saraswati, Maza Damodar, Kana Damodar etc. serves drainage purpose in the district.

27. Howrah drainage channel flows from the eastern side of the STP facility. The channel drains gravitational flows from its basin area. Howrah drainage channel flows in south direction before it meet the Hooghly River at Mourigram. The Howrah drainage channel covers almost entire district through its distributary channels. The entire drainage load of the channel is discharged into the Hooghly River. The channel is used to drain both storm and sewage water from its basin area. The drainage system of the study area is controlled by the Howrah Drainage Channel.

28. **Inland Surface Water Quality**: Surface water has been monitored at four locations within the study area. The sampling locations have been designed to capture the water quality of the water bodies within the study area that could be impacted due to the operation of STP. Due to higher concentration of Total coliform and BOD in SW-2, SW-3 and SW-3 samples, surface water cannot be classified as A, B and C category as per CPCB guideline. The total coliform is less in SW-1 compared to other samples but due to higher concentration of BOD, the sample cannot be classified as A, B, C category as per CPCB.

29. **Groundwater Quality:** The shallow and deeper aquifers in Howrah district are classified as Sodium-Bicarbonate facies. Presence of brackish water in the aquifers up to a depth of 150 m are reported from some part of the district. Groundwater throughout the district is slightly alkaline with pH varies from 7.90 to 8.40. Arsenic is mainly present in the shallow aquifers to deeper aquifers up to a depth of 50m in some parts of the district. The groundwater of the district is suitable domestic use except few pockets of contaminated groundwater.

30. In order to establish the groundwater quality in the area surrounding to STP, monitoring was conducted at two stations near the study area. The ground water sampling has been conducted from dug wells adjacent to the project site to capture the existing quality of the ground water. The Concentration of majority of the parameters analysed were within the permissible limit of IS 10500, 2012 standard. pH values of groundwater samples were found to be below drinking water standard of IS 10500, 2012. The high values of Chloride, Nitrate, Faecal Coliform and Total Coliform as detected in both the samples indicate mixing of waste water with groundwater.

31. **Soil Quality**: Soil quality was monitored at two (2) different locations within the study area near Kona WSP. The soil samples were collected from the top-soil within 15cm depth. The soil samples are collected and analysed to estimate the extent of soil pollution due to previous operation of WSP. Soil samples in the study area were found to be clay and clay loam with pH values indicating slightly alkaline soil. Nitrogen status was less to good, phosphorus status was very less and potassium status was very less. The heavy metal concentration in soil samples were found to be below remediation intervention values as per Dutch Soil Remediation Circular.

32. **Climate and Meteorology:** The climate of Howrah district is tropical, like the rest of the Gangetic West Bengal. It is characterized by hot summer, high humidity nearly all around the year and well distributed monsoon season. The winter season starts from December and continues till end of February, followed by the summer from March to May. Rainfall occurs primarily during the south-west monsoon months i.e. June to September and constitutes of more than 70% of the total annual rainfall. Mean temperature for most period of the year besides winter season remains around 24.1 to 30.4 ºC with May being the hottest at 38 ºC (mean maximum temperature). The relative humidity of Howrah district is reported to be high (71% to 85%) throughout the year. The average annual rainfall of the district is about 1579 mm.

33. **Ambient Air Quality:** Ambient air quality was monitored at three locations around the study area. The parameters studied were Particulate Matter (PM_{10} and $PM_{2.5}$), NOx, SO_2, CO, NH_3, Hydrocarbon and H_2S. The result of the parameters monitored were compared with the National Ambient Air Quality Standards (NAAQS) stipulated for residential, commercial and industrial area as well as with the WHO air quality values. All the parameter were in compliance with the NAAQS standards. $PM_{2.5}$ values in all station and PM_{10} value in two stations were not in compliance with WHO air quality values.

34. **Ambient Noise Quality:** Ambient noise monitoring was conducted at four stations within the study area to understand prevailing noise levels in the project area and its vicinity involving 24 hours Sound Pressure Level and Noise Level. The results so obtained were compared with ambient noise standards specified for respective category under the Noise Pollution (Regulation & Control) Rules, 2000 as well as WHO limits. The equivalent noise level as measured at the residential areas range between 56.6 -59.5 dB (A) at day time and between 47.8-50.3 dB (A) at night time. The equivalent day time noise values in all the locations were exceed the NAAQS day time standard of 55 dB(A) for residential areas and WHO day time standard of 55 dB(A) for outdoor living area. The equivalent night time noise values in all the locations (same locations as mentioned for day time) were exceed the NAAQS night time standard of 45 dB (A) for residential areas but all the station except station near Bhattanagar Railway station comply with WHO night time standard of 50 dB(A) for outdoor living area. The noise monitoring stations were close to Bhattanagar Railway station and other communication roads. Railways and vehicles in the roads are the major source Noise in the area.

35. **Natural Hazards:** The Project site is located in Earthquake Zone –III classified as Moderate Risk Zone (MSK VII) as per India earthquake hazard zoning map. The study area is characterized by low-lying areas of alluvium deposits of Hooghly River. However, extensive man-made alterations of natural drainages in Howrah district has been carried out through the building of drainage systems (canals) and embankments making the area a highly modified watershed. As a result, the vulnerability of these area to flooding events has been significantly reduced. The area within 1 km of proposed STP facility experience water-logging situation during heavy rainfall as expressed by the local people. The area has good drainage, as the local people do not experience prolonged water-logging after heavy rainfall. Based on the report prepared by Climate Central on 29th October 2019 referring to the peer-reviewed paper published by Nature Communications, it is estimated that 237 million people in six Asian countries are at risk due to coastal flooding by 2050. West Bengal and coastal Odisha are projected to be particularly vulnerable, as is the eastern city of Kolkata. It is estimated that by 2050, a major part of Kolkata urban area and its surroundings could lie in the annual coastal flood risk zone.

Ecological Environment

36. **Terrestrial ecosystem:** The vegetation including mature trees were recorded along the periphery bunds of the AP, FP and MP ponds. The predominant tree species recorded during site visit were Lagerstroemia speciose, Eucalyptus spp., Leucaena leucocephala, Caryota urens, Trema orientalis, Putranjiva roxburghii, Moringa oleifera, Ficus racemose, Swietenia macrophylla, Dalbergia sissoo, Bombax ceiba, Polyalthia longifolia, Azadirachta indica, Albizia lebbeck, Ficus benghalensis, Ficus religiosa, Magnolia champaca, Delonix regia, Peltophorum pterocarpum, Swietenia macrophylla, Phoenix dactylifera, Cocos nucifera, Lagerstroemia speciose, Terminalia cattapa, Tamarindus indica, etc. The shrubs and herbs species recorded during site visit were Caesalpinia pulcherrima, Calotropis procera, Amaranthus spinosus, Boerhavia repens, Cassia sophera, Cassia tora, Ervatamia divaricate, Jatropha curcas, Hibiscus rosa-sinensis, Tabernaemontana divaricate, Pennisetum purpureum etc. No protected floral species were recorded.

37. There is no natural forests in the entire study area. The diversity of fauna (native population of mammals, birds, reptiles and amphibian) species recorded in the modified habitat was low. A total of 9 species of terrestrial mammals, 29 species of avi-fauna, 2 amphibian species and 7 reptilian species are reported from the study area. Apart from Black Kite (*Milvus migrans*) Schedule I species under Indian Wildlife Protestation Act 1972, no other falunal species recorded/ reported from the study area are not protected under Indian regulation Wildlife Protestation Act 1972 or IUCN Red List.

38. **Aquatic Ecosystem:** Aquatic macrophytes are mainly recorded in the surface waterbodies and marshy land in the study area. Major species recorded in these habitats were Ipomea aquatica, Ipomoea carnea, Alternanthera sessilis, Enhydra fluctuens, Typha angustifolia, Lemna perpusilla, Phragmites karka, Pistia stratiotes, Typha angustifolia, Wolffia arrhizal etc. The canal system in the study area are mostly used for discharge of untreated sewage from the urban area and drainage of surface runoff during monsoon season. The canals are not suitable habitat for aquatic fauna, especially for fishes. Fishes are mostly reported from the surface water bodies (ponds) in the study area involving mostly local species *Anguilla bengalensis bengalensis (Ban), Amblypharyngodon mola (Morala), Anabas testudineus (Koi), Catla (Catla), Channa punctatus (Lata), Channa striatus (Shol), Cirrhina mrigala (Mrigel), Clarius batrachus (Magur), Glossogobius giuris (Beley)* etc. The aquatic birds were recorded in the study area Alcedo atthis, Amaurornis phoenicurus, Egretta garzetta, Egretta intermedia, Phalacrocorax niger, Halcyon smyrnensis, Ceryle rudis etc.

Socioeconomic Environment

39. The study area for the primary socio-economic survey includes receptors who are situated within 100 meters i.e. 50 meters on each side of the sewer pipelines, where the proposed pipeline laying or replacement work will take place, as these receptors may potentially be directly impacted by the project activities. In addition, receptors who are situated within the vicinity of the locations for the proposed laying or replacement of the sewer pipelines, have also been considered for the primary socio-economic survey, as these receptors may potentially be indirectly impacted by the project activities. Available primary information through site assessments as well as secondary data from the 2011 Census of India reports were analysed to ascertain the socio-economic parameters and trends of the study area.

40. The main settlements in the vicinity of the Bally WSP site are Chamrail, Chakpara and Khaliya, which are census towns. Since a proportion of Chakpara falls outside the defined radius of one-kilometre from the STP, the proportion for the study has been defined accordingly, based on google imagery analysis. Therefore, 80% of the population in Chakpara settlement was considered for the study, while 100% of both Chamrail and Khaliya populations, was considered for the study.

41. As per the 2011 Census of India, Bally has a total population of 293,373 individuals residing in 55,619 households and constitutes approximately 6% of the district's population. Out of the total population, men constitute 156,911 while women constitute 136,462. The population density is 24,841 individuals per square kilometre, which is much higher than the district average i.e. 3,306 individuals per square kilometre. The average annual growth of the population in Bally Municipality was 1.24% as the population was 260,906 numbers in 2001 and increased to 293,373 numbers in 2011.

42. Analysis on the demographic profile indicates that there are approximately 49,126 HHs and a population of 241,787 persons, collectively, within the defined buffer zone. Out of 241,787 persons, 54% (131,581) are male, and 46% (110206) are female and the average HH size is 4.9.

It is observed that ward number 13 of HMC has the highest population density with 23,177 persons, followed by ward number 1, also in HMC, with 21,685 persons. It is observed that ward number 20 in Bally Municipality has the lowest population density within the buffer zone, with 479 persons, followed by ward number 7, also in Bally Municipality, with 640 persons.

43. Based on the analysis on the occupational profile of the surveyed local population, Out of 122 surveyed persons, 51 individuals are presently working. Over 47% (24 numbers) of the surveyed population are working as daily labourers, out of which 17 persons are male and 7 are female. Over 16% (8 numbers) are shop owners and all of them are male. Over 6% (3 numbers) are tea and food stall owners, 4% (2 numbers) are engaged in trading and 10% (5 numbers) are engaged in private service and all of them are male. 18% (9 numbers) are engaged in other activities which include two (2) drivers, two (2) female domestic workers, one (1) rickshaw puller, three (3) in small scale household industries and one (1) watchman.

E) Potential Impacts and Mitigation Measures

44. The impacts have been identified based on the information presently available from the project proponent on the Project configuration through stakeholder consultations with government officials, local community members, reconnaissance visit and broad assessment of the high power satellite imagery. The potential environmental and social impacts have been assessed for each phase of the Project – construction (including pre-construction and operational).

Potential Impacts on Aesthetics and Visual Quality

45. The construction activity will be a short term activity. The sources of aesthetic and visual impacts can result from storage of the construction and demolition waste due to construction activity; filling of ponds; storage of construction materials; continuous stacking builds heaps of C&D wastes, physical presence of labour camps; movement of transportation construction and demolition waste through trucks, tippers and dumpers, earth work along the pipeline route etc. The aesthetics and visual impact is assessed to be **negligible**.

Potential Impact on Air Quality

46. During construction phase, the sources of emission are fugitive emission from storage and handling of construction waste and emission from machinery and vehicles. Stack emissions from these portable DG sets and vehicular emissions will increase the HC, NOx, PM and CO pollutant load in the air, however this activity will be continuing during the construction phase only. The impact is assessed to be of **minor** significance.

47. During the operation phase, the main source of air pollution from proposed project will be from the emergency bio-gas flaring on non-operational condition of bio-gas engine during STP operation. The emissions from the biogas flaring will primarily be Carbon Monoxide, Total Volatile Organic Carbon (VOC) and Oxides of Nitrogen.

48. Impacts due to the operation of STP facility of the project were assessed by modelling projected emission through using the AMS/EPA Regulatory Model (AERMOD).

49. The results from the predictive modelling exercise revealed that maximum ground level concentration in the Project AOI with biogas as fuel will be well within the applicable standards for air quality. The additional pollution load of PM_{10} and NO_x from proposed project activity against the baseline condition may not cause major changes in the existing baseline conditions or exceed the National Ambient Air Quality Standard (NAAQS), 2009. The emissions from the plant will

however be long term, i.e. will occur for entire life of the plant. The potential impact on air quality due to emissions from the plant is assessed to be **moderate**.

Potential Impact on Noise Quality

50. Current noise sources at the site of the project are due to natural sources and homebased or micro scale industrial operation i.e. grinding machine, lathe machines, stamping mills etc. Manmade sources include DG set operation, traffic noise, which was negligible in the project site due to low traffic volumes on nearby roads apart of Kona Expressway which is at an aerial distance of 500 m. The construction of STP will produce significant noise. The cumulative level of noise generated during this phase will be ~70-80 dB(A).This intensity of noise is higher than the standard set by central pollution control board i.e. 55 dB for residential area during day time and 45dB for night time. Minimum distance of receptors from the STP site is ~10 m, the intensity of noise from sources i.e. backhoe, Front loader, Generator, tractors, dozers and concrete vibrators is envisaged to exceed 55 dB by the time it reaches to the receptors. This may cause discomfort for the construction workers and nearby receptors. The potential impact on noise quality during construction stage is assessed to be **moderate**.

51. In construction phase, the Equivalent Sound Pressure Level (Leq) from different equipment and vehicle operation was calculated to be 100.2 dB.

52. Noise during operations will be primarily generated from pumps and air compressor having noise range of 60-90dB or DG set operation for providing back up for administrative building and noise generated from it with enclosure is within range of 60-70dB.

53. In operation phase, the Leq from 800 KW Biogas plant and 800 KVA DG set is calculated to be 90.14 DB.

Potential Impact due to odour

54. Odour dispersion has been predicted using AERMOD steady-state plume model in area source mode resulting in estimation of ground level odour concentrations (GLC) as odour units / m^3 at specific receptor locations and as contours of specified odour levels within 1 km radius around plant.

55. The dispersion of odour concentrations based on emissions from source of origin shows that the highest concentrations 9.676 OU/m^3 at a point located within 100 m from the source. As per guidance available in the UK, it is generally accepted that odour concentrations of 5 – 10 OU/m^3 give rise to a faint odour which may just exceed the annoyance threshold of human receptors and distinct odour which can give rise to a nuisance results from a concentration of > 10 OU/m^3.

56. Low impacts will be caused by the operation of the STP for the residents of Bhattanagar. As these residential houses are within ~50 m from STP southern boundary.

Potential Impact on Drainage

57. During project life-cycle potential scenarios impacting the surrounding drainage system are, firstly, storm water from surrounding low marshy lands entering into the proposed STP complex, secondly, flood scenario developed due to heavy rainfall. Lastly, daily operation of STP resulting in discharge of treated wastewater.

58. Under all scenarios discussed above, discharge will happen into Howrah drainage channel through pacha khal. As discussed in baseline the carrying capacity of Howrah drainage channel is

7968 MLD. Hence we infer that excess load of 62 MLD from STP operation will not have any impact on the drainage of the surrounding. The potential impact scenarios as discussed above will also have negligible impact on the drainage due to buffer carrying capacity of ~7000 MLD. Therefore the impact significance is assessed to be negligible.

Potential Impact on Surface Water Quality

59. No adverse impact on surface water quality is envisaged as no discharge into surface water is proposed during construction phase and all proposed phase activities will happen within the WSP area as result the there is no interaction with surface water resource other than the Anaerobic, Facultative and Maturation ponds.

60. During operational phase of the proposed project activity, treated water due to operation of the proposed 62 MLD treated water from STP and WSP will be discharged into Howrah Drainage Channel through Pocha Khal. The qualitative discharge characteristics will be maintaining stipulated regulatory limits for the STP operation under Environment (Protection) Amendment Rules, 2017 by Ministry of Environment, Forests and Climate Change, Government of India and as stipulated under the Concession Agreement. Howrah Drainage Channel, the surface water stream that would receive the discharge is already significantly polluted by untreated sewage and waste water load from upstream areas in it catchment and the downstream Howrah Drainage system has also been observed to be having similar conditions with the average observed BOD concentration in the range of 50 – 60 mg/l. So the treated effluent discharge which is to be having BOD levels (design) of 20 mg/l is unlikely to cause any incremental adverse impact to the receiving surface water environment. Therefore, both during construction and operational phases of the proposed project activity will have negligible impact on surface water quality.

Potential Impact on Ground Water Quality

61. There will be no groundwater extraction during project life-cycle, as per site observation, there exist a borewell near the entrance gate along the eastern boundary or west of existing MPS within the STP complex, which is used for drinking and domestic purpose presently. All water during construction and will be sourced through water tankers and during operation phase water will sourced from municipal supply with daily withdrawal rate of 0.5 m3/day as mentioned in Consent to Established (CTE) applied by Wabag. Hence there will no impact on ground water resource. Potential sources of impact for ground water contamination are minor oil and grease spillage, during maintenance of construction machinery, repair of pumps and compressors during operational phase.

Potential Impact on Soil Quality

62. During construction phase, impact scenario envisaged for the project phase are firstly wastewater generated during suppression of fugitive emission during this phase and secondly, chances of oil spills and oil/grease mixed cotton waste not properly disposed after maintenance/repairing activities of construction equipment.

63. Contamination of soil can happen only due to accidental spillage of fuel, lubricants and paints from storage areas and during the transfer of fuels and chemicals. The above mentioned soil quality impacts will be localized within the project site or immediate vicinity. The potential impact on soil quality is assessed to be **minor**.

Potential Impact on Road Traffic

64. The site has only one access road which is used by residents for daily activities.The STP site is connected through one major route i.e. Bhattanagar Road .To understand the baseline condition and traffic influx, baseline monitoring was undertaken on Bhattanagar Road, which would be predominantly used during the construction phase for trucks, tippers, and other heavy machinery that will be mobilized. During construction phase, additional 10-15 PUC/day carrying construction material, disposal of construction waste and transportation of plant machineries and raw materials using the Bhattanagar Road. Based on the baseline traffic survey conducted. The average peak hourly traffic on this route was 3.92 PCU/Hr (up) and 3.77 PCU/hr (down) number of vehicles per hour and maximum traffic load was 10.5 PCU/Hr (up) and 11 PCU/Hr (down).

65. Additionally, another cause of traffic congestion is the excavation works that will take place during the laying of the sewer lines, along the main roads. This will cause disturbance to traffic movement, which may cause some inconvenience to inhabitants, especially during the peak hours. As observed during site visit, the line passes through busy roads such as the G.T. road. These traffic and access disruption impacts will arise due to transportation of construction materials, movement of machinery and equipment, as well as excavation work. The potential impact on road and traffic due to operational traffic is assessed to be **minor**.

Potential Impact on Community Health & Safety

66. During the construction stage of the project, there will be an influx of workmen and labours, with some of them being from different socio-cultural settings as compared to the residential settlement around site. In the case that hygienic conditions are not maintained at the project site, there may be a vector borne and other ailments in the immediate vicinity. Unless proper sensitization of neighboring communities is undertaken and appropriate safeguards are adopted, there is a possibility for increase in sexually transmitted diseases, though the possibility appears quite remote.

67. Very few people living near the site, no significant health related impacts are expected to the communities in the area. The increase in vehicular movements as a result of plying of construction vehicles on the adjoining roads and the site access road would add to the risk of accidents in which local residents may be involved. Although there is a public concern over the potential health effects linked with the exposure to noise, odour and fugitive emissions, empirical data is insufficient to demonstrate adverse health impacts from typical STP projects. Considering good construction practices and planned embedded measures for mitigating these impacts, the overall significance of community health and safety impacts can be rated to be minor.

Potential Impact on Occupational Health & Safety

68. During construction phase, the sources of impact are waste handling and storage, material handling and storage, welding and gas cutting activities, use of earth moving equipment, Installation of electrical equipment, Installation of chlorination unit. Personal Protective Equipments (PPE) such as Protective footwear and protective goggles, Welder's protective eye-shields shall be provided to workers who are engaged in welding works, earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. Workers deployed for renovation of brick sewer line will work in confined space, with low oxygen availability is another aspect which cannot be neglected. The overall impact with considering the embedded control systems is **minor**.

69. During operational a number activity i.e. regular maintenance of STP equipment resulting in discharge of lube oils and grease, change over chlorine tonners , sample collection for quality

analysis, planned shutdown of STP for cleaning purpose, handling and storage of sludge from sludge digester etc. All of these activity pose potential health and safety risk for employees involved during these activities as well as to the environment. Due to embedded control measures impact from above mentioned activities is estimated to be minor.

Potential Social Impact due to Access Disruption

70. During construction phase, the proposed project will entail temporary access disruption during renovation and replacement of the sewer lines involving laying of raising main and replacement of gravity sewer line. These will involve, excavation work, removal of debris and piling up of mud earth along replacement of raising main. The proposed project will entail access disruption during the laying of gravity sewer line of 2617m as identified during the joint site visit. Movement of large construction machinery and vehicular movement for transportation of construction materials will also likely to cause access disruption.

71. The potential receptors that will be impacted due to access disruption are detailed out along every stretch of proposed replacement work, near the RoW of the project footprint. The access towards these shops will be disrupted during the construction work, particularly if there is excavation work involved. Similarly, it has been observed that one college is located near the alignment of the proposed work. As observed, the roads along where the sewer line traverses through are very narrow to wide and congested areas. Reportedly, the alignment of the pipeline is along the middle of the road.

72. Construction work along the raising main pipeline will consider the necessary safeguarding measures to minimize the durations and extend of the impacts, the concessionaire will carry out excavation through machine (backhoe excavator). Additionally during excavation works, safety measures such as used of danger lighting, sight rails, safety barricades, signage of retro-reflective sheet of high intensity grade will be used for avoiding any kinds of mishaps and incident to the commuters and pedestrians.

73. As reported by the project concessionaire, the number of days for the construction will be carried out in stretches and the excavation, replacement and backfilling of a 25 m stretch, will take approximately three days. Therefore the estimated time period that will cause access disruption for the local communities and commuters along these stretches is estimated to be three days. Moreover, as reported by the project concessionaire, the design of the sewers will be laid based on the depth of existing sewer line. The width of the trench excavation along the roads will vary from 0.8 m to 1.5 m and the depth varies from a minimum of 1.5 m to 2 m or as per the existing pipe line. Thus taking into consideration the diameter of the pipeline, the exaction work for replacement of sewer line will affect approximately 5 ft of the total width of the road which comprises of 2.5 m on the left hand side (LHS) and 2.5 m on the right hand side (RHS).The excavation work for replacement will be carried out in stretches.

Potential Social Impact due to temporary Loss of Income

74. Road side vendors and shops who are operating their businesses as squatters within the RoW of existing government roads; the trunk sewer pipelines will be laid within the RoW of existing roads. The excavation work may potentially lead to road blockage and access disruption, and as a result the commercial establishments and vendors located near the RoW of the project footprint (sewer line) will face some disturbance in operating their businesses on daily basis. On the basis of screening and site visits along the road stretches through which sewer lines are likely to be laid/replaced reveal that there will be temporary disruption to on-going commercial and vending activities thus leading to temporary income loss during the period of construction period (which is assessed to be around 3 days).

75. Construction work along the sewer line will consider the necessary safeguarding measures to minimize the durations and extend of the impacts. Since the resulting impact will be temporary therefore, overall impact due to access disruption with considering the embedded control systems is assessed to be **minor**.

Permanent Livelihood Loss for Fishermen Groups at Bally Waste Stabilisation Pond

76. The proposed Bally Sewage Treatment Plant is to be constructed in the reclaimed area from the existing WSP at Kona utilising part of the Facultative and Anaerobic ponds. As reported by GSPPL, the Concessionaire for the proposed 62 MLD sewage treatment facility (40 MLD STP and 22 MLD WSP), has the strict mandate to ensure the treated discharge water quality from both 40 MLD STP and 22 MLD WSP, complying the standard stipulated under the Concession Agreement with KMDA in place. The treated discharge quality per Concession Agreement has to meet the presently enforced effluent discharge standards for Sewage Treatment Plants as outlined under Environment (Protection) Amendment Rules, 2017. GSPPL is of the opinion that continuing fish farming activity in the WSP ponds will increase and impact the organic loading in the WSP through application of fish feed and other chemicals in form of disinfectant or growth medicines which will ultimately impact the mandate of the treated discharge quality from the WSP against the stipulated standard.

77. Therefore, GSPPL has decided on not allowing any fish farming activity in the Bally WSP area from the date of official handover of the Site by KMDA to the Concessionaire. This will trigger livelihood loss for approximatelyl 46 fishermen from 4 fishing cooperative groups and apprximately18 workers engaged with the fishermen groups. Compensation for permanent loss of livelihood will be as per the livelihood restoration plan (LRP). Potential impact with effective mitigation is assessed to be **small**. As per the consultation meetings held under Chairmanship of the District Magistrate, Howrah involving representation from WBSPMG, KMDA, VA Tech WABAG and NMCG on 28th July and 4th August 2020, the fishing cooperatives have no tenable legal claim on the WSP ponds or to create any legal encumbrance of any nature on the government. Nevertheless, GSPPL on it's own account will implement the Livelihood Restoration Plan (LRP) in alignment with the LRF in compliance with to meet the safeguard requirements of IFC Performance Standard 5 on Involuntary Resettlement and the ESMF of NMCG (guided by World Bank Operational Policy 4.12 on Involuntary Resettlement) as also to create a positive environment and community goodwill in the project area.

Potential Impact on Gender

78. An analysis of the workforce participation of the surveyed population indicates that majority of the women are not participating in the workforce and the consultations also revealed that majority of the women are engaged in unpaid domestic work. Female workforce among the surveyed population accounted for 17% (as per SIA survey). Reason such as limited employment opportunities, women busy in household works and movement restrictions are some of the reason for low female workforce in the area.

79. Review of the workforce participation at the existing Bally WSP and linked facilities reveal that all the workers are male workers. Therefore women are almost entirely unrepresented in the workforce. As a result, there is need to promote gender equality in all aspects of economic development. Women's roles in construction are mainly confined to supply of unskilled labour and vending of foodstuffs to the construction workers. As civil construction work will take place at Bally WSP, including at the linked facilities during the construction phase, the participation of women in the construction workforce should be ensured to reduce gender disparity and enhance gender mainstreaming. Accordingly, detailed methods of engagement for women in the project area are presented in the Gender Action Plan (GAP) developed for the Project.

Potential Social Impact due to Loss of Employment for the Existing Worker

80. At present there are thirty-two (32) contractual workers employed at the Bally facilities under Associated Cooperative Labour Contractor and Construction Society Ltd and Ganga Action Plan Contract Workers Co-operative Society Ltd. During project operational phase, the project will be operated and maintained by the new O&M entity engaged by the Concessionaire, therefore, there is a potentiality of retrenchment scenario of the existing contracted workers, which may lead to a loss of livelihood for these workers. Consultation with the existing workers during site visit revealed that some of the workers have been employed for over 25 years. Thus, the project will impact the employment and livelihood of the existing contractual workers who may get laid off during the new O&M contract regime.

81. As the mitigation measure, it has been mutually agreed and accorded between GSPPL and KMDA to ensure livelihood of the existing workers, that KMDA they will re-deploy the existing contractual workers from Arupara and Baranagar facilities to other facilities of KMDA, while GSPPL will be responsible for re-engaging 32 existing contractual workers from Bally MPS and the linked facilities.

F) Analysis of Alternatives

Site Location Alternatives

82. The proposed project involves involve construction of a new STP of 40 MLD capacity will be built on the reclaimed area after partial filling up of two ponds and renovation of linked intersection and diversion sewerage network. As part of the project bidding process under NMCG programme, the Concessionaire GSPPL is entrusted to implement and operate, the project within the pre-existing premises and piece of land, therefore no alternate sites were considered. Moreover, he proposed plant site is in accordance with Ministry of Environment, Forests and Climate Change, Government of India guidelines, i.e. there are no National Parks/Sanctuaries within 10 km radius of the proposed project site as well as there are no Historical places/places of tourist importance within 10 km radius of the proposed project location.

Technology Alternatives

83. Comparative statement of different STP technology such as Conventional Activated Sludge, Process (ASP), Extended Aeration (EA), Sequencing, Batch Reactor (SBR), Cyclic Activated Sludge (CAS), Membrane Bio Reactor (MBR) and Trickling Filter along with the corresponding environmental and social impacts are analysed. Based on analysis, it has been objectively established that Sewage treatment plant based on sequential batch reactor (SBR) as selected for the proposed project activity is a proven technology and has specific advantages compared to other conventional sewage treatment technologies.

Sewer Pipeline Route Alternatives

84. The proposed work for replacement of gravity sewer line and laying of new gravity sewer line and rising main will be carried out in the existing RoW; hence, no alignment route will be required. As a result, the scope for analyzing the alternative alignment/site for sewer line is very limited. However as reported by the site representative of the Project Concessionaire, the following alternatives will be adopted. Therefore as per the scope of the bounding Concession Agreement to GSPPL, opportunity on analyzing alternative sewer pipeline alignment route will be very limited.

85. Reportedly, during construction phase GSPPL will consider the alternatives. *Alternative A:* in case the stretches for carrying out the proposed work is found to have any sort of displacement (physical or economical), the alignment of the sewer line, will be adjusted either shifting the alignment of the existing sewer line from the flank of the roads towards the center of the road or likewise to avoid physical displacement. *Alternative B:* In case the stretches for undertaken the work were found to have any severe impact such as displacement (physical or economical), the proposed work will be revisited to avoid major impacts. Moreover, for impacts that are unavoidable, including temporary impacts, consultation will be undertaken and mitigation measures will be taken meeting the safeguard requirements of IFC.

G) Information Disclosure, Consultation and Participation

86. Series of consultations and meeting were held during the ESIA process with relevant stakeholders (government officials, local community, project affected people and existing workers) to have an insight of the baseline situation of the site and regulatory and administrative setups in relation to the proposed project activity, site and envisaged social impacts. This in turn helped in developing an understanding of the perceptions of stakeholders with regards to the project and also allowed for a means of recording their feedback. The stakeholder views expressed were incorporated in the ESIA and the planning and development of the project. Furthermore, GSSPL will establish a stakeholder engagement program for the proposed project site which includes a comprehensive suite of stakeholder consultation, disclosure activities and engagement exercises and media interactions.

H) Grievance Redressal Mechanism

87. A Grievance Redressal Mechanism (GRM) will be in place to handle and resolve the conflicts and aggrieved situations. The GRM will aim to provide a time bound and transparent mechanism for expressing and resolving social and environmental concerns linked to the project. GSSPL will establish a Grievance Redress Cell for reporting and addressing grievances of the affected communities and workers. The Grievance Redress Cell (GRC) will comprised of key members from GSPPL, District Magistrate (if required), KMDA, Local Authority, Local NGOs and key members of the local Municipal ward. The proposed GRC will involve at least two female members.

I) Environment and Social Management Plan

88. Project specific Environment and Social Management Plans (ESMP) have been developed with an aim to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts/risks and to propose enhancement measures. The plan covers;

- Mitigation of potentially adverse impacts;
- Monitoring of impacts and mitigation measures during project implementation and operation;
- Institutional capacity building and training;
- Compliance to statutory requirements; and
- Integration of the ESMP with project planning, design, construction and operation.

Livelihood Restoration Plan

89. As a part of the ESMP, a standalone Livelihood Restoration Framework (LRF) has been prepared. Based on further detailing of project plans and firming of the project footprint and subsequent land requirements, a Livelihood Restoration Plan (LRP) will be prepared by GSPPL that will delineate the exact magnitude of impact, number of affected persons (Aps) and their

compensation entitlement along with cost for implementing the LRP. Impacts related to land acquisition, involuntary resettlement and livelihood restoration of the APs - titleholders, non-titleholders, land users groups, encroachers will be covered in the LRP based on the final project footprint.

Environmental Monitoring

90. The environmental monitoring programme has been devised with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;
- To verify compliance with statutory and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project area.

Reporting Mechanism for Environmental and Social Monitoring Program

91. A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will ensure regular flows of information from the Project site to the Project headquarters and, as necessary, to regulatory authorities and funding agencies. The reporting system will provide a mechanism for ensuring that the measures proposed in the Project's ESMP are implemented.

92. Reporting will be done in form of environmental checklist, incident record register, environmental and social performance reports on periodic basis (monthly, quarterly, half-yearly, yearly etc.)

93. The quarterly reports of the management measures will form an integral part of the Quarterly Progress Reports that can be submitted to KMDA, NMCG and the lenders involved.

1. INTRODUCTION

1.1 Background

Kolkata Metropolitan Development Authority (KMDA) is the statutory planning and development agency with the specific purpose of carrying out major infrastructure development projects in Kolkata Metropolitan Area in the state of West Bengal. KMDA (through State Government of West Bengal) is the owner of the existing Bally WSP, linked sewerage infrastructure and land as well as the designated executing agency for the renovation and upgradation of the Bally WSP and construction of new 40 MLD Sewage Treatment Plant under the National Mission for Clean Ganga (NMCG) Programme[1] and the principal project titled “Development of Sewage Treatment Plants – Kolkata City Area”.

The existing WSP and proposed STP is located in Kona, under Howrah Municipal Corporation (HMC) and is one of the identified sub-projects under project titled “Development of Sewage Treatment Plants – Kolkata City Area” of Kolkata Metropolitan Development Authority (KMDA) in West Bengal. This project involves construction as well as O&M of a new STP of 40 MLD and O&M 22 MLD WSP along with renovation of linked intersection and diversion sewerage network.The proposed project Site is located at Chamrail Gram Panchayat area under Bally-Jagacha Block and the linked project components are spread across Howrah Municipal Corporation area in district of Howrah, West Bengal.

M/s Ganga STP Projects Private Ltd (GSPPL) has been selected as the successful bidder of the project. M/s Ganga STP Projects Private Ltd (the “Concessionaire”) has been incorporated by M/s VA Tech Wabag Limited as 100% equity funded entity to fulfil the requirement towards Hybrid-Annuity based Public Private Partnership (PPP) model. GSPPL is the developer of the project and will hold the ownership of the project assets till the end of concession period of fifteen (15) years. M/s GSPPL in turn will subcontract the Design, Build as well as Operation and Maintenance (O&M) scope for the project to M/s VA Tech Wabag Limited (Wabag). The Concession includes three (3) components i.e. STP and associated pipeline networks in Baranagar, Arupara and Bally. This ESIA focusses on the Bally project while separate ESIA have been undertaken for the Arupara and Baranagar projects.

1.2 Overview of the Project

The river Ganga, which flows from north to east India, has more than 500 million people living along its basin. Most of the sewage generated from the towns and cities situated along the banks flow into the river, significant part of it without receiving any treatment. Previous plans to clean the river had been carried out through the Ganga Action Plan (GAP). Lauched in 1985, the GAP focused on developing sewerage infrastructure assets, which were operated and maintained by state governments or urban local bodies (ULBs). However, the plan met with limited success and did not result in any significant improvement in the water quality of river Ganges.

In recent years, the Government of India (hereinafter referred as “GOI”) identified cleaning of the river Ganga as one of its key priorities, and approved the Namami Ganga program (Clean Ganga initiative) for cleaning, rejuvenation, and protection of the river Ganga. Over the years, the river Ganga has been subjected to pollution from various sources which include discharge of urban liquid wastes and sewage, industrial liquid wastes, large scale wallowing and bathing of cattle, throwing of carcasses and dead bodies in the river, surface run-off from agricultural fields using pesticides and insecticides and leachate from solid and industrial waste dumps. The overall scheme aims at preventing the discharge of untreated industrial and municipal wastewater into the River Ganga through several planned water treatment projects.

[1] NMGC Administrative Approval and Expenditure Sanction (No. T-15/2015-16/1245/NMCG); dated 10.10.2017

Recognising the need, National Mission for Clean Ganga (NMCG) constituted under Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India has set an objective to ensure effective abatement of pollution and conservation of the river Ganga and its tributaries by adopting a river basin approach for comprehensive planning and management. An Integrated Ganga Conservation Mission namely "Namami Gange" has been approved as 'Flagship Programme' set up in June 2015 to accomplish effective abatement of pollution, conservation and rejuvenation of the river. The approach in achieving this objective entailed the preparation of an integrated and comprehensive scheme to intercept and treat the entire quantity of waste water generated in the town and would flow through the drains into the Ganga. The program is being implemented by the National Mission for Clean Ganga (NMCG), and its state counterpart organizations i.e., State Program Management Groups (SPMGs). The 'Urban Development & Municipal Affairs Development (Urban Development Branch), under State Government is the designated SPMG, which is a registered society of the State Government constituted with the objective of serving as the dedicated institution for effective implementation of the Namami Gange programme activities at the State level. The Government of India had accorded Cabinet approval to Hybrid Annuity- Public Private Partnership (PPP) model for creation and maintenance of sewage treatment infrastructure under the Namami Gange Programme. Under this model, the development, operation and maintenance of the STPs will be undertaken by a Special Purpose Vehicle (SPV) to be created by the winning bidder at the local level. As per this model, 40% of the capital cost quoted would be paid on completion of construction while the remaining 60% of the cost will be paid over the life of the project as annuities along with operation and maintenance (O&M) cost. A key element of this model will entail making Annuity and O&M payments linked to the performance of the STP in order to ensure continued performance of the assets created. Based on better accountability, ownership and optimal performance.

The principle scheme objective is to prevent untreated wastewater of drains from joining the river by intercepting the drains that have outfalls in the Ganga, divert them through sewers to STPs for treatment and allow only treated sewage to be discharged into the Ganga.

The overall scheme envisages implementation of a number of wastewater treatment projects along the river to clean municipal wastewater before discharge. Under the flagship program of Namami Gange, NMCG in association with Kolkata Metropolitan Development Authority (KMDA), has conceived to implement the project titled "Development of Sewage Treatment Plants – Kolkata City Area", which for the Bally STP project comprises of the following components:

i. Reduction of the capacity of existing WSP from 40 MLD to 22 MLD
ii. Construct, operate and maintain a one new STP near the WSP with a proposed capacity of 40 MLD,
iii. Renovate, operate and maintain Bally linked Infrastructure which include lifting stations, main pumping station (MPS), I&D structures, Sewer pipeline network and Outfall points,
iv. Operation and maintenance of the Bally STP and WSP for 15 years after completion of its construction and renovation work.

The project is being implemented on hybrid annuity based PPP mode and for the implementation of the project, M/s VA Tech Wabag Ltd. as the selected bidder has incorporated a Special Purpose Vehicle (SPV) – the "Concessionaire" entity M/s Ganga STP Projects Private Ltd. (GSPPL) under Indian Companies Act, 2013 on 5th April 2019 for development of the project "Development of Sewage Treatment Plants – Kolkata City Area". Subsequently a Concession Agreement (tripartite) has been signed among NMCG, KMDA and M/s GSSPL. In the proposed project context, KMDA is the client to the Concessionaire and will be the owner of all assets after the end of concession period of fifteen (15) years. The NMCG will operate as the governing authority and will be governing the overall escrow mechanism and payments to Concessionaire.

Previously KMDA had commissioned one (1) ESAMP study on the STP project through external agency Genesis Fintech Pvt.Ltd for Namami Ganga Scheme during 2017-2018. Since the earlier ESAMP study did not capture the quantitative nature of impacts based primary monitoring and analysis, along with other insufficiencies and gaps. Hence as per requirement of Concession Agreement, the Concessionaire GSPPL has commissioned a fresh ESIA-EMP study for the proposed project activity by engaging ERM India Pvt. Ltd (hereinafter referred as “ERM”) during May, 2019 in order to identify and address all the impacts due to project activity.

1.3 Need of the Project

The Government of India (the GOI) identified cleaning of the river Ganga as one of its key priorities, and approved the Namami Ganga program (Clean Ganga initiative) for cleaning, rejuvenation, and protection of the river Ganga. Over the years, the river Ganga has been subjected to pollution from various sources which include discharge of urban liquid wastes and sewage, industrial liquid wastes, large scale wallowing and bathing of cattle, throwing of carcasses and dead bodies in the river, surface run-off from agricultural fields using pesticides and insecticides and leachate from solid and industrial waste dumps.The overall scheme aims at preventing the discharge of untreated industrial and municipal waste into the River Ganga through a number of water treatment projects.

Bally WSP with 40 MLD capacity was built to treat the sewage water generated in northern and eastern part of Howrah municipality area but the WSP stopped functioning in 2016 due to reduced flow of inlet sewage water from sewer network. Sewage water is currently been discharged directly into River Hooghly through respective outfalls. As per the new scope of work total of 62 MLD of wastewater will be treated. Firstly the new STP will treat 40 MLD (as per the project documents) sewage water and the rest 22 MLD of sewage water will be treated through existing WSP. During Site visit it was observed that sewage water collected from areas were discharged into the outfall lines from existing lifting stations (LS).These outfall line are meet Hooghly River at different locations along the bank of the river.The proposed STP and exiting WSP will treat the sewage water coming from northern and eastern part of Howrah municipality. The treated water from the proposed project will improve the water quality of the Hooghly River in addition to the surface waterbodies/streams in the area and result in a reduction of pollution load of the same.

The capacity of the existing WSP was built based on the previous population load. The generation of the wastewater has increased with the increase in population. The enhanced capacity of the new sewage treatment scheme is designed to accommodate the increasing population load. It is to be noted that the treatment capacity of the proposed project was pre-determined by KMDA under the NMCG scheme and accordingly it has governed under the Concessionaire Agreement with GSPPL.

1.4 Objective and Scope of the Study

The primary objective of the assignment is to ensure that the proposed STP and linked infrastructure project complies with the national and international policy frameworks and safeguards for environmental and social compliance (as per IFC Performance Standards 2012; IFC General EHS Guidelines (2007) including Industry Sector Guidelines for wastewater treatment plant; and applicable national and international laws, regulations, standards pertaining to environment, health, safety, social and labour in India) while carrying out the construction and pre-commission operations and maintenance work.

The objectives of the overall assignment is to support VA Tech Wabag Ltd. in conducting:

a) Conduct an environmental and social gap assessment of the existing infrastructures under the proposed project;

b) Update/ revalidate and prepare an environmental and social (E&S) impact assessment of the existing and new facilities proposed under the project; and

c) Formulation of E&S management plans (ESMP), entitlement framework along with stakeholder engagement plan (SEP), gender action plan, and labour management plan.

1.4.1 Scope of Work

The scope of work for this ESIA project is elaborated below:

Sl. No.	Scope Items
Phase I	
1.	Environmental and Social (E&S) Gap Assessment
2.	Preparing Environmental and Social Baseline Assessment for the project's area of influence
3.	Updating and preparation of Environmental and Social Impact Assessment (ESIA) Addendum of existing new components under the project
4.	Formulating E& S Management Plans that will include Stakeholder Engagement Plan (SEP), Gender Action Plan (GAP) and Social Impact Assessment , Livelihood Restoration Framework and Labour Management Framework
Phase II	
5.	Undertake Census Survey and prepare of Livelihood Restoration Plan (LRP)

As the part of the overall scope of work, Phase I of the assignment entails preparation of the environmental and social baseline of the project's study area and assessing impacts associated with the proposed project activities, covering the following points:

The assessment shall include the following components:

- Review of existing EIA/ESMP report for Bally STP area;
- Conducting enviornmental and social baseline assessment based on secondary information and environmental primary data collection through monitoring of environmental parameters in the study area and social primary data collection through socio-economic sample survey;
- Conducting environmental and social impact studies for Bally project in accordance with IFC PS, covering the following issues and risks
    - The location and impacts on sensitive receptors including residential houses, schools, health care facilities, aged care facilities, ecological sensitive habitats etc.;
    - Monitoring of the receiving environment, including water quantity and quality;
    - Noise, vibration, air quality and odour impacts (including airborne pathogens) during construction and operation, in comparison to national and international standards;
    - Assessment of the terrestrial and aquatic ecology of the site, surrounds and receiving environment, including presence of Modified Habitat, Natural Habitat, and/or Critical Habitat, protected areas, protected or endangered species or habitats;
    - Study proposed solid and hazardous waste management practice, including waste management during construction, volumes of sludge to be produced, processing, recycling and reuse of treated wastewater and bio solids, storage and/or disposal;
    - Assess flood risk and draw up mitigation measures focusing on design and operation, including impacts of heavy rainfall events and climate change, as well as discharges from the STPs, PS or trunk sewers in such events;
    - Preparing plan for protection of worker and community health and safety during construction and operation, including construction camps, traffic management, hazardous substances, solid waste and effluent discharge.

- Identify any impacts on physical cultural resources and heritage sites;
- Assess the social impacts of the Project, including completion of a socioeconomic survey with gender -disaggregated baseline socio-economic data, compare survey results, undertake focus groups and key informant interviews to validate predictions in the social impact section of the existing Environment and Social Management Framework reports;
- Undertake a gender analysis and conduct focus groups with women in the communities and among female employees and staff to identify issues, develop measures to address time poverty, improve living conditions and promote economic empowerment and other opportunities for gender mainstreaming; and
- Provide the process and outcomes of meaningful consultation with project affected people and concerned stakeholders, how concerns have been addressed, and how engagement will continue during construction and operation.

Note: It has been recognised that bio-aerosols (which may include microorganisms such as viruses, pathogenic bacteria, and fungi) emitted by STP components may constitute a health risk to STP workers and neighbouring community. However, as the STP is not presently operational, there is no way that the bio-aerosol load on atmosphere in the immediate vicinity of the STP can be monitored in terms of colony-forming units per unit volume of air (CFU/m3). There are also no standardised predictive approaches to estimate potential bio-aerosol emissions based on a proposed STP design. In terms of treatment through this ESIA, ERM proposes a monitoring plan through which bio-aerosol concentrations can be monitored periodically and appropriate mitigation actions can be planned, as required during operational phase of the project.

- Formulate mitigation measures and actions, where impacts and risks cannot be avoided or prevented and prepare an Environmental and Social Management Plan (ESMP) for the project. The ESMP shall also include a Stakeholder Engagement Plan (SEP), Gender Action Plan (GAP), Livelihood Restoration Framework and Labour Management Framework
- The ESMP has charted out of feasible control technologies, embedded controls and mitigation measures for implementation by the Client to minimize adverse impacts of proposed activities such as:
  - Pollution control measures proposed to meet the emission, effluent and noise standards etc.;
  - Solid/hazardous waste management practices;
  - Mitigations on Occupational health and including an occupational health surveillance programme.
  - Mitigations for management of social impacts through mitigation measure at community level;
  - Mitigation measures and management plans for implementation with defined timelines and responsibilities;
  - Organisation required for implementation of management program during construction and operation phases of the Project;
  - Monitoring and reporting mechanism both for regulatory compliance as well as internal assurance within the Client organisation.
  - Environmental quality monitoring programme during construction phase and operational phase will be provided;

- Emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.

1.5 Approach and Methodology of ESIA

The ESIA has been undertaken following a systematic process that predicts and evaluates the impacts on aspects of the physical, biological, social/socio-economic and cultural environment of the surrounding due to project activity. It also identifies measures that need to be taken to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. The ESIA methodology follows the overall impact assessment approach illustrated in ***Figure 1.1***.

Figure 1.1 Impact Assessment Process

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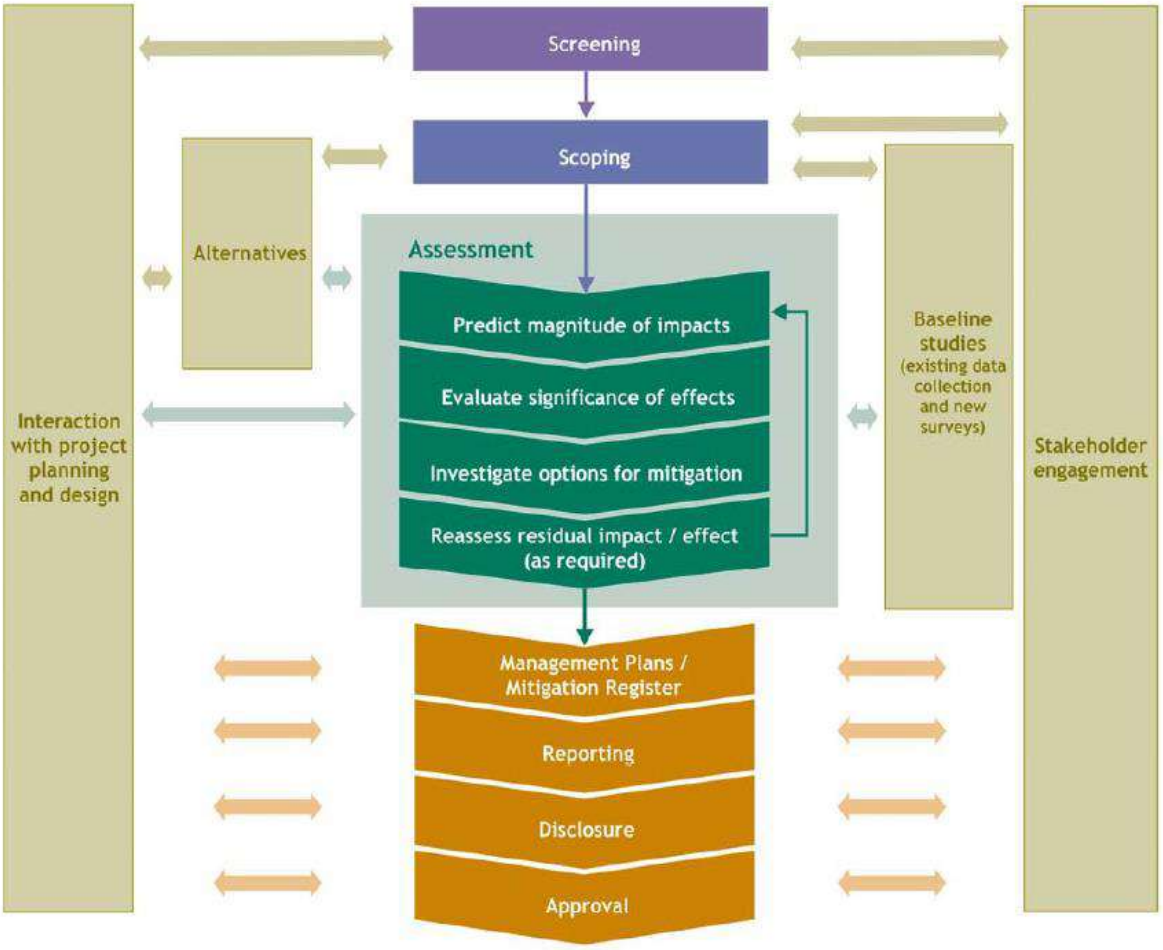


1.5.1 Screening

The screening process has been carried out based o preliminary information provided to ERM for determining applicability of relevant GoI legal regulations, IFC performance standard requirements to the project. This step was conducted desktop review of documentation and an on-site assessment of the project area as well as linked infrastructures and facilities.. The screening process involved the following:

- Reviewing of available project related documents which include Process design document, T & D (Technical and Design) work document, previous study reports etc.

- Reviewing of applicable regulatory framework for the proposed project;
- Collection and compilation of available secondary baseline data from different sources;
- Categorisation as per EIA notification 2006
- Categorisation of Project as per IFC guidelines.

1.5.1.1 Project Categorization as per EIA notification 2006

The proposed project activity involves renovation and reduction of capacity of existing Bally WSP and construction of new STP, renovation and installation of sewage treatment plant and linked sewerage infrastructure. The proposed project does not qualify for Environmental Clearance under the listed project as per EIA Notification, 2006.

1.5.1.2 Categorization as per IFC PS (2012)

IFC's has provided a provisional categorization tool for projects. The tool assigns an E&S category based on risks inherent to the particular sector, as well as on the likelihood of a development taking place and on what can be reasonably ascertained about the environmental and social characterization of the Project's likely geographical setting. As part of the review of environmental and social risks, impacts and magnitude for the proposed project, it is envisaged that the impacts on are few in number, site- specific, largely reversible, and readily addressed through mitigation measures.

Hence, the proposed project can be categorized as Category B project as per IFC PS (2012).

For Environment, the project has been categorized as B because though the project is expected to have certain environment and social impacts, they are mostly site specific and can be managed with targeted mitigation measures.

The project is also categorized as B as the Project will mainly trigger temporary livelihood loss due to construction of the STP at the WSP, the renovation activities such as replacement, laying of new pipelines and desilting work undertaken for the sewer pipelines causing temporary income loss of road side vendors, kiosks, carts and shops along certain stretches of the project sewer line

1.5.2 Scoping

The purpose of scoping exercise was to identify the likely project activities influencing the environmental components which should be covered in the ESIA study. Scoping was further used as a basis for defining the impact assessment, planning and implementation of mitigation, monitoring and reporting mechanisms for the project to meet potential Lender's requirements. The scoping exercise identified the range of environmental and socio-economic topics to be studied and the geographical area to be covered (spatial scope). No separate scoping study was conducted for this project although an Impact Identification Matrix for Bally STP and linked Facilities has been developed and elaborated in Section 5.3 for assessing the overall impact of the project on various environmental and social components

1.5.3 Baseline Data Generation

The required environmental and socio-economic baseline data were collected and compiled from primary and secondary sources. Primary environmental monitoring data surrounding the proposed STP area is collected from June, 2019 to August, 2019. Primary socio-economic data was collected during July, 2019 to September, 2019.

Apart from primary data, secondary data was also collected from different government department websites, local bodies, literature surveys etc. All data's were compiled and compared with applicable relevant standards, and the same has been represented in ***Section 4*** of this report.

1.5.4 Impact Assessment and Management

Impact identification and assessment commenced with scoping and continues through the remainder of the Impact Assessment Process. Impact Assessment Methodology has been detailed in in ***Section 5***. The section covers the identification, prediction and quantification through modelling (where appropriate) of potential impacts from the proposed project activities.

The impact assessment involved the prediction and evaluation of impacts from the proposed project in different phases, i.e. construction and operation phases of the Project and included consideration of mitigation measures towards the same.

Impact prediction covered residual impacts (impacts remaining after all possible mitigation has been incorporated) and took into account control measures that are part of the Project design. Additional measures aimed at further avoiding, minimizing and mitigating predicted impacts were suggested where necessary or appropriate.

Impact assessment has also covered potential for cumulative impacts if any due to presence of existing and planned features in the region. Impact assessment also involved risk assessment covering hazard identification, consequence analysis and risk reduction measures and recommendations.

1.5.5 Environmental and Social Management Plan

Based on the findings from the impact assessment process, an Environmental and Social Management Plan (ESMP) (in **Section 9***)* has been developed for the proposed STP project. ESMP includes suggested mitigation measure, roles and responsibilities for implementation.

1.6 Report Structure

The layout of the Report has been divided into 10 sections as briefly described in **Table 1.1**

Table 1.1: Layout of ESIA Report

Chapter No.	Chapter Title	Description
0	Executive Summary	This section includes ■ Brief summary of the entire ESIA report
1	Introduction	This section includes ■ Introduction about the project, ■ Project background, ■ Brief description, ■ Scope of the ESIA study ■ Approach and Methodology ■ ESIA team
2	Project Description	This section describes ■ The proposed project; ■ Its major components; and ■ Its geographic, ecological, social, and temporal context, including This section also examines ■ Alternatives to the proposed project site, technology, design, and operation. ■ It also states the basis for selecting the particular project design proposed and, justifies recommended emission levels and approaches to pollution prevention and abatement.
3	Administrative Framework	This section discusses It also covers the applicable reference framework being used for the ESIA study in addition to the national regulatory requirements for project financing.

Chapter No.	Chapter Title	Description
4	Environmental and Social Baseline Conditions	This section describes ■ relevant socioeconomic conditions within the study area, and ■ Looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.
5	Impact Assessment and Mitigation Measures	This section ■ predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental media, and physical cultural resources in the project's area of influence, in quantitative terms to the extent possible; ■ identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, transboundary, and cumulative impacts as appropriate.
6	Alternative Analysis	This section provides analysis of the followings: ■ Technological alternative ■ No Project Scenario
7	Stakeholder Consultations and Participation	This section describes ■ Describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders; ■ Summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups; and describes the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation.
8	Grievance Redress Mechanism	This section deals with: ■ compensation payment, ■ improper estimation of affected assets, ■ failure to fulfil commitments, ■ poor management of construction activities, ■ accidents due to inappropriate planning of vehicle movement, ■ Cultural conflicts between migrant workers and local communities etc.
9	Environmental and Social Management Plan (ESMP)	This section deals with ■ the set of mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts; ■ describes the mitigation, monitoring, implementation arrangements and performance indicators for effective implementation of the ESMP; and ■ Framework management plans for construction phase of the project. This section also describes:

Chapter No.	Chapter Title	Description
		■ the grievance redress framework, setting out the time frame and mechanisms for resolving complaints about environmental performance; and ■ Structure of the grievance redress cell to be formed for the project.
10	Conclusion and Recommendation	This section provides ■ the conclusions drawn from the impact assessment; and ■ Recommendations for environmental and social management during the project lifecycle.

1.7 Limitations

The ESIA study is based on certain scientific principles and professional judgement to certain facts with resultant subjective interpretation. Professional judgement expressed herein is based on the available information.

The assessment was conducted based on the information and documents made available by Wabag along with key informant discussions with relevant stakeholders including KMDA and local inhabitants in and around the project area. This is to be noted that the final project design is yet to be completed by the Concessionaire. While this report has endeavoured to present all identified gaps, issues and impacts against the relevant standards, the following disclaimers should be noted that the review is based upon certain facts with resultant subjective interpretations based on professional judgements. The professional judgements expressed are based on the available facts within the limits of the existing data, budget, schedule and other limitations highlighted above.

ERM is not engaged in social and environmental, health & safety consulting and reporting for the purposes of advertising, sales promotion, or endorsement of any client's interests, or other publicity purposes. The client acknowledges that the report prepared by ERM are for exclusive use of the client and agrees that ERM's reports or correspondence will not be used or reproduced in full or in part for such promotional purposes, and may not be used or relied upon in any prospectus or offering circular. The client also agrees that none of its advertising, sales promotion, or other publicity matter containing any information obtained from these assessments or reports, either in parts or entirety, will make reference to ERM's trade name.

1.8 Uses of this Report

The Client acknowledges that report provided by ERM in relation to the provision of Services is delivered to the Client solely for the Client’s benefit. ERM, its officers, employees, contractors, and agents shall owe no duties, obligations or liabilities to any persons in connection with any use of or reliance on the Project information provided by the Client. We make no warranties, express or implied, including without limitation, warranties as to merchantability or fitness for a particular purpose.

ERM is not engaged in social and environmental, health & safety consulting and reporting for the purposes of advertising, sales promotion, or endorsement of any client's interests, including raising investment capital or recommending investment decisions, or other publicity purposes. The Client acknowledges that the report prepared by ERM are for exclusive use of the Client and agrees that ERM's reports or correspondence will not be used or reproduced in full or in part for such promotional purposes, and may not be used or relied upon in any prospectus or offering circular. The client also agrees that none of its advertising, sales promotion, or other publicity matter containing any information obtained from these assessments or reports, either in parts or entirety, will make reference to ERM's trade name.

Nothing contained in this report shall be construed as a warranty or affirmation by ERM that the site and property described in the report are suitable collateral for any loan or that acquisition of such

property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

The information provided to ERM on the work done for the linked project facilities are limited. Documents shared by KMDA show that certain stretches of the work will involve laying of new diversion pipeline in order to divert the sewage water from I&D structures to the gravity sewer lines, though specific detail in this regard is yet to be finalised.

2. PROJECT DESCRIPTION

2.1 Project Background

The existing waste stabilization ponds of capacity 40 MLD at Bally and linked infrastructures i.e. underground I&D sewer, six (6) Lift Stations (LS), one (1) Main Pumping Station (MPS) were reportedly installed and commissioned during 1995 under jurisdiction of local Panchayat Authority. During project site visit conducted during June 2019, it has been learnt that the existing Bally WSP is functioning at bare minimum capacity due to non-functionality of pumps at Kona MPS. All the lifting station were reported to be partially working, however in the present condition, the raw sewage is being released to the river Hooghly through the outfall points along the river banks. It was also found that the condition of lifting stations were poor in terms of health and safety measure, absence of barricades and handrails in the location of grid or chambers.

The proposed Bally STP project include:

- The proposed scenario involves partial filling of one Anaerobic Pond (AP) and one Facultative Pond (FP) of the existing WSP.
- Construction of new 40MLD STP on the reclaimed part of the existing WSP.
- Laying of new gravity sewer line of
  - 250mm dia and 260m of length near Bally BOC ground
  - 300mm dia and 430m of length near Rashbari Ghat and mandir
  - 300mm dia and 600m of length near Jaganath Ghat
  - 300mm dia and 750m of length near Burning Ghat of Ramlochan Shaire Street
  - 200mm dia and 10m of length at Panchanantala
  - 300mm dia and 820m length at Jaya Bibi Road near Ghusuri
- Laying of new raising main of
  - 450mm dia and 50m of length near Belur Math
  - 300mm dia and 900m of length at Panchanantala
  - 300mm dia and 160m of length at Golabari
  - 600mm dia and 657m of length at Salt Gola
  - Laying of new outlet line from LS3 to Bally khal of 300mm dia and 10m length
  - Renovation and desilting of existing gravity sewer line and gravity main
  - Rehabilitation of existing lifting stations and outfall points
  - Rehabilitation of 22MLD WSP

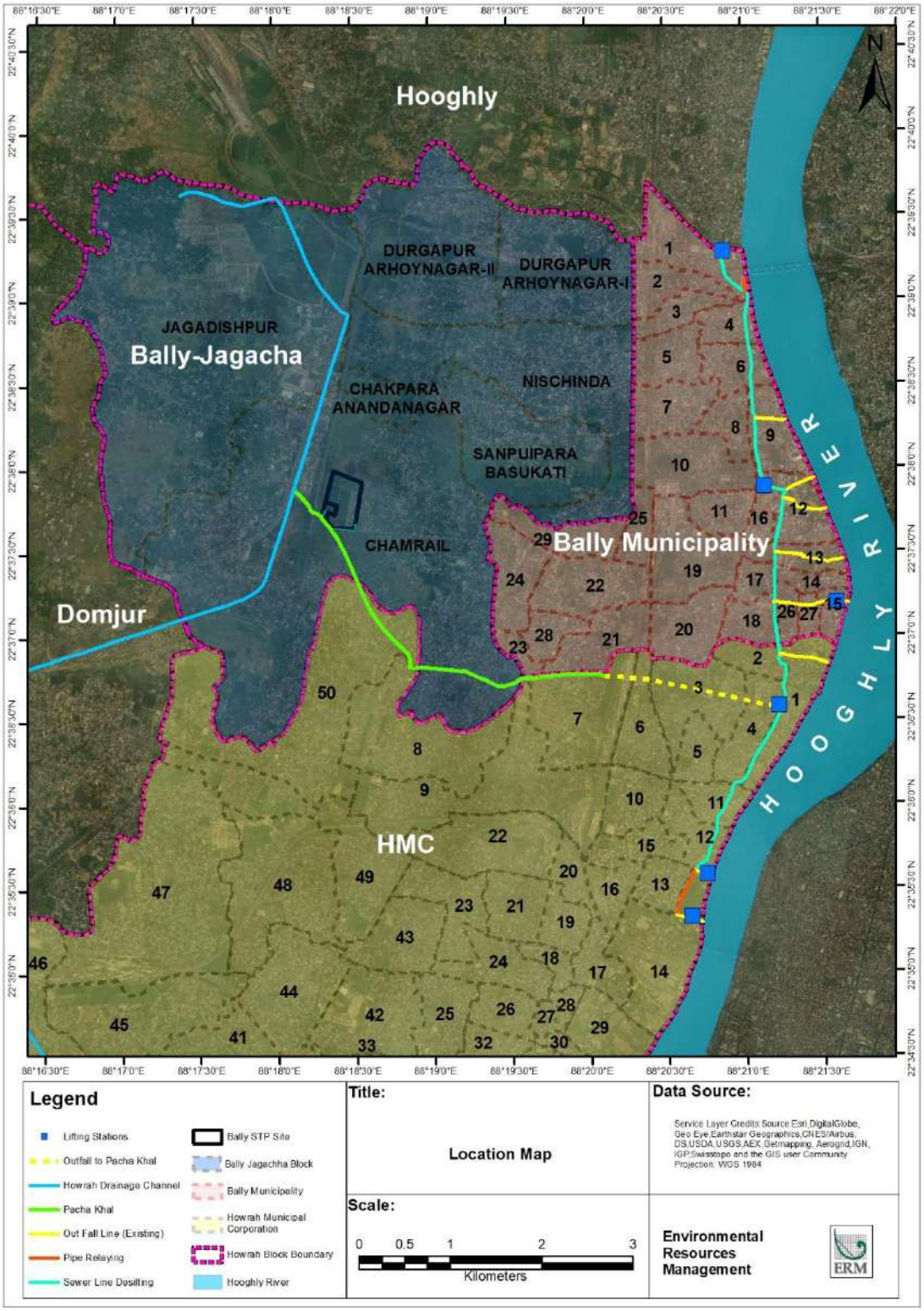
2.2 Existing and Proposed Project Facility Location

The existing Bally Waste Stabilization Pond Site is located at Chamrail Gram Panchayat area under Bally-Jagacha Block and the linked project components are spread across Howrah Municipal Corporation area in district of Howrah. Bally Municipality, which was formed in 1883, and was responsible for the civic infrastructure and administration on the northern suburbs of the city of Howrah, was merged into Howrah Municipal Corporation in 2015. So, the entire sewer line network passes through the eastern part of the Howrah municipality area.

Wastewater from surrounding areas (wards under jurisdiction of HMC) of LS-2, LS-3, LS-4, LS-5 and LS-6 are diverted into gravity sewer line from individual LS. The gravity sewer line originates at Bally Khal and flows along G.T.Road, Belur Math Road and G.K.Bhaduri Road, taking wastewater from LS-3,LS-2 and LS-4 respectively. Similarly wastewater from LS-5 and LS-6 are pumped into gravity sewer line which runs along J.N.Mukherjee road. Wastewater from these LS are collected at LS-1 which is located on Girish Ghosh Road. From LS-1 wastewater is pumped through raising main and diverted into Pacha Khal, which flows till MPS and WSP at Kona located at Bhattanagar.The location of WSP and its linked facility is given in ***Figure 2.1***.

The proposed project will utilise the existing land and infrastructure of the sewage treatment facility and linked sewerage infrastructure. The new STP will be built on the reclaimed area after partial filling up of two ponds. The gravity sewer lines, rising main and effluent discharge lines are within the ROW of the public roads under the ownership of PWD (Government of West Bengal) and Municipal roads therefore no additional ROW/ land acquisition in the project scenario will be involved.

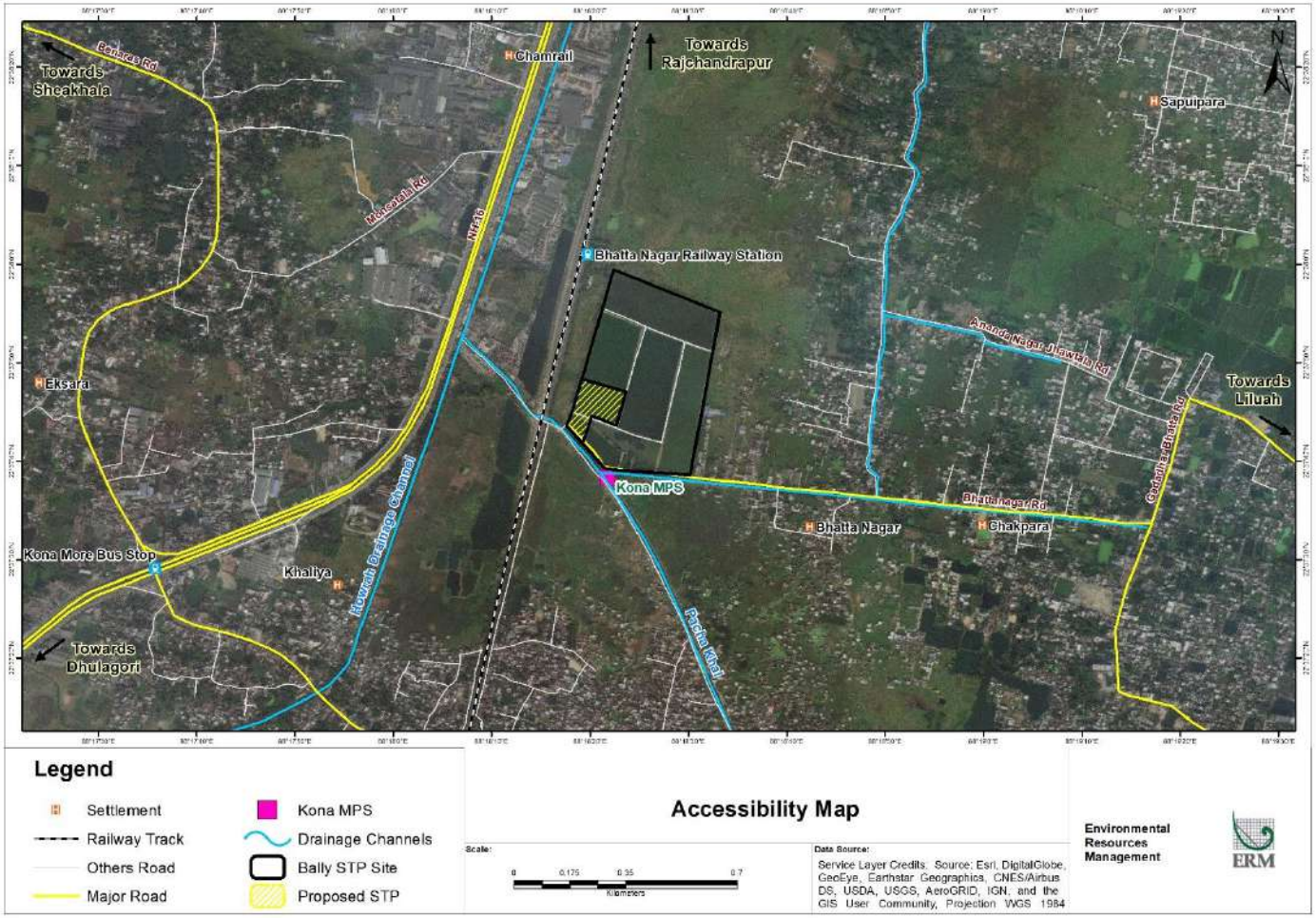
Figure 2.1 Project Location Map



2.3 Accessibility

The proposed project Site is situated on the western bank of Hooghly River in Chamrail Gram Panchayat area, the Site is positioned between two (2) important roads, i.e. Benaras road and Bombay road (NH-6). The nearest railway station is Howrah Junction located at a distance of 10 km from project site in western direction. Dankuni –Santragachi railway corridor passes adjacent to the project site in western direction.The project site will be accessible through Bhattanagar Road only as there are no other major road network connecting the Site. The width of the Bhattanagar road varies from 12 -15ft. During Site visit it was also observed that, there is a rural road connecting the site to Benaras Road, this road runs parallel to the railway line and positioned in south-west direction from the Site. This road is majorly used by the local residents for daily activities. This road cannot be accessed for the proposed project as the width of the road is very narrow and movement of heavy vehicles is not possible.The accessibility map is given in ***Figure 2.2***.

Figure 2.2 Accessibility Map of the Project Site



2.4 Environmental Setting

As mentioned in **Section 2.2**, the proposed project Site will fall under the jurisdiction of Chamrail Gram Panchayat of Bally-Jagacha Block. During Site visit it was observed that the proposed site is located within a low lying marshy area. Settlements of Bhattanagar (22°37'32.89"N and 88°18'36.47"E) Chakpara (22°37'33.38"N and 88°18'55.48"E) are located on the eastern side of the proposed Site, the nearest settlements of Bhattanagar is located at aerial distance of 0.17km from the Site.Bhattanagar railway station, part of south-eastern railway route is located at an aerial distance of 0.1 km in western direction (22°38'5.42"N and 88°18'13.85"E). As the Site is near to an industrial area, hence there are number of industry on the western boundary within 0.50 km. South (22°37'34.56"N and 88°18'18.26"E) and North direction (22°37'59.94"N and 88°18'28.34"E) the proposed site is coverd by marshy land and green cover of native origin. The environmental sensitivities present within 1 km of the STP site are given below:

a) Pacha Khal is present at an aerial distance of 0.05km on the southern side of the Site;

b) Howrah drainage channel is located at an aerial distance of 0.38km on the western side of the Site;

c) There are a number of pond present surrounding the site, the nearest pond is at an aerial distance of 0.29 km from the south-eastern boundary of the proposed Site. The ponds are used for recreational fishing and occasional bathing by the local people.

d) A number of medium to large scale industries are present on the western side of the Site i.e. Hindustan Lever Limited, V-Trans (India) Limited, Britannia Industries Limited, Dyes Impex Private Limited, Roy and Birdi Engineers etc.

e) Vivekananda Prathamik School is located at aerial distance of 0.79 km on the western side of the Site.

The environmental setting map is given in ***Figure 2.3***.

Figure 2.3 Site Setting Photographs

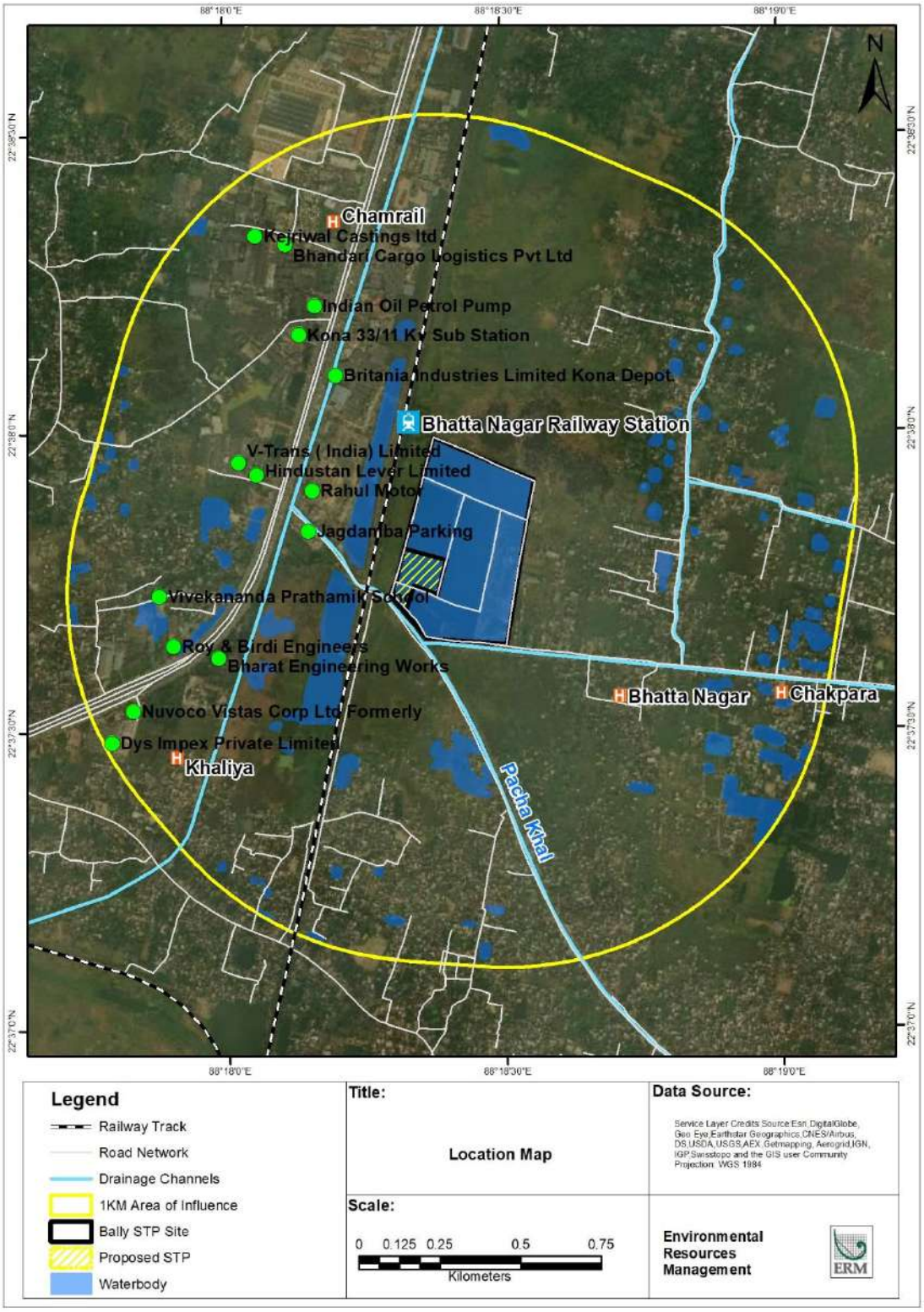
MPS to WSP Raising Main

Lock gate on Pacha Khal before MPS

Approach Road to STP

View of Discharge point on Pacha Khal

Figure 2.4 Environmental Settings Map of the STP Site



2.5 Project Component

As a part of the re-development project, sewage waste water from eastern part of HMC are collected through strategically placed LS and flows through gravity sewer network. Each LS collects sewage waste water from respective areas, and diverts sewage waste water into gravity sewer network through electrical pumps. LS-1 acts as a single collection point, as it pumps the sewage waste water flowing in gravity sewer line into Pacha Khal through raising main. Sewage waste water discharged in Pacha Khal flows under natural gradient and gravitational force. This flow is stopped before Kona MPS by I&D structure and lock gate. Sewage waste water collected at I&D structure will be pumped in at MPS and diverted to proposed STP facility and existing WSP. The treated water from the proposed STP and existing WSP will be discharged in Pacha Khal that connects to Howrah Drainage Channel. The major components of the STP project are:

a) Lifting Stations (LS)

b) Outfall Point

c) Raising Main

d) Gravity Sewer Line

e) Main Pumping Station (MPS)

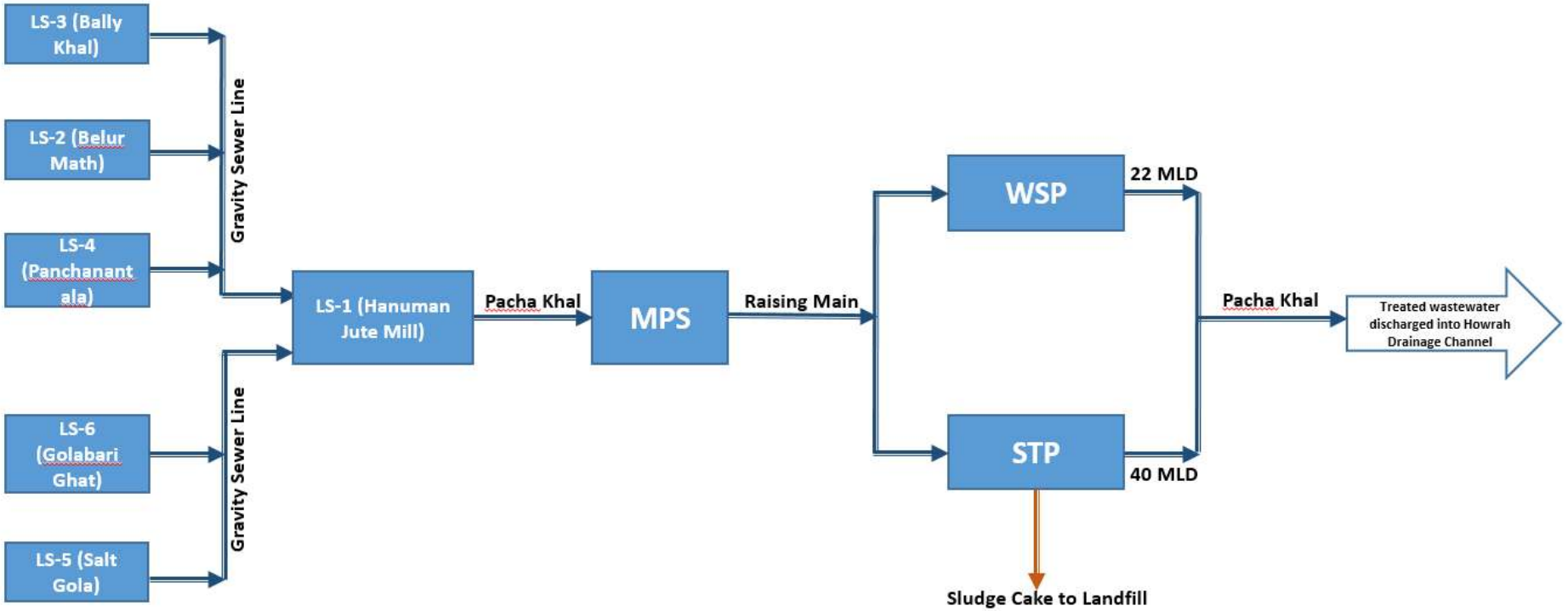
f) WSP

g) STP

h) Outlet Pipeline

The schematic diagram of the proposed project is given in Figure 2.5.

Figure 2.5 Schematic diagram of Sewage Water flow for the Proposed Project



2.5.1 Lifting Stations

There are six (6) lifting stations present for the Bally STP projects. The Six (6) lifting stations are:

a) Lifting Station-1 (LS-1)- Hanuman Jute Mill

b) Lifting Station-2 (LS-2)- Belur Math

c) Lifting Station-3 (LS-3)- Bally khal

d) Lifting Station-4 (LS-4)- Panchanantala

e) Lifting Station-5 (LS-5)- Salt Gola

f) Lifting Station-6 (LS-6)- Golabari

Lifting stations act as collection point for nearby areas and pump the wastewater into the gravity sewer line through raising mains.Wastewater collected at LS-6, LS-5, LS-4, LS-3 and LS-2 is pumped into gravity sewer which flows to LS-1. Sewage wastewater from flowing into LS-1 is diverted into Pacha Khal. During Site visit all six (6) lifting stations were found to be in maintained poorly. As per scope of work all civil structures will be renovated along with replacement or repairing of the existing pump sets and electrical installations.The flow of sewage water from lifting stations is shown in **Figure 2.69**.

2.5.2 Outfall Point

Outfall points are used to discharge the excess untreated sewage water from the lift stations to the Hooghly River during peak load conditions i.e.monsoon season. As observed during Site visit there are six (6) outfall points present, discharging the untreated sewage water to Hooghly River. As reported an outfall point will be constructed near LS-3 to divert the extra load during rainy season to the Bally Khal. The location of outfall and flow from outfalls are shown in **Figure 2.7, Figure 2.8 and Figure 2.9.**

2.5.3 Raising Main

It is a pipeline which carries water from Lifting Stations to the existing gravity sewer line. The pumps at LS increase the head by creating a pressure difference which helps in pushing the waste water into the gravity sewer line. As reported some of the raising main are damaged and new raising main will be laid for the damaged sections. Open-cut method will be used for laying of new raising main. The depth of the new raising main will be within 1 km from the surface. A description of the congested locations have been detailed in **Sections 4.4.14 and 5.5.2**.

2.5.4 Gravity Sewer Line

The raising main carries the raw sewage water to the gravity sewer line which carries the sewage water to the LS-1. The diameter of the gravity sewer line varies from 200mm to 900mm. The diameter of the gravity sewer line increases towards the LS-1. The depth of the gravity sewer line varies from 1.5 to 2.5 m below the surface. The alignment of the gravity sewer line is along the middle of the GT Road as reported by the concessionaire during site visit. A gravity sewer line from LS-1 carries the untreated sewage water to the Pacha Khal. The Location of the Gravity Sewer line is discussed in **Section 2.2** and the associated work is discussed in **Section 2.1**. A description of the congested locations have been detailed in **Sections 4.4.14 and 5.5.2.**

2.5.5 Main Pumping Station (MPS)

Kona Main Pumping Station is located adjacent to the Bally Waste Stabilization Plant situated at Bally Waste Stabilization Pond Site is located at Chamrail Gram Panchayat area under Bally-Jagacha Block, District Howrah, covering approximately 212 m^2 area. The function of Kona MPS is to pump the

sewage water from Pacha Khal to fed Bally WSP. The MPS will be renovated, new pump sets and electrical installations will be added. The MPS will draw water from I&D structure and divert the water to proposed STP and existing WSP for the treatment. The existing building structure will be renovated and the existing pump sets will be changed. Presently the Kona MPS is non functional. The screens at the grit chamber will also be changed. During operational phase, waste which will generate at the screens will be disposed bi-weekly at the KMDA designated site. The MPS facility is covered by boundary walls and permission is needed to enter the facility.

Figure 2.6 Photographs of Kona Main Pumping Station

Kona Main Pumping Station

Raising Main from Kona MPs connected to Bally WSP

Figure 2.7 Sewage water flow from Lifting Stations

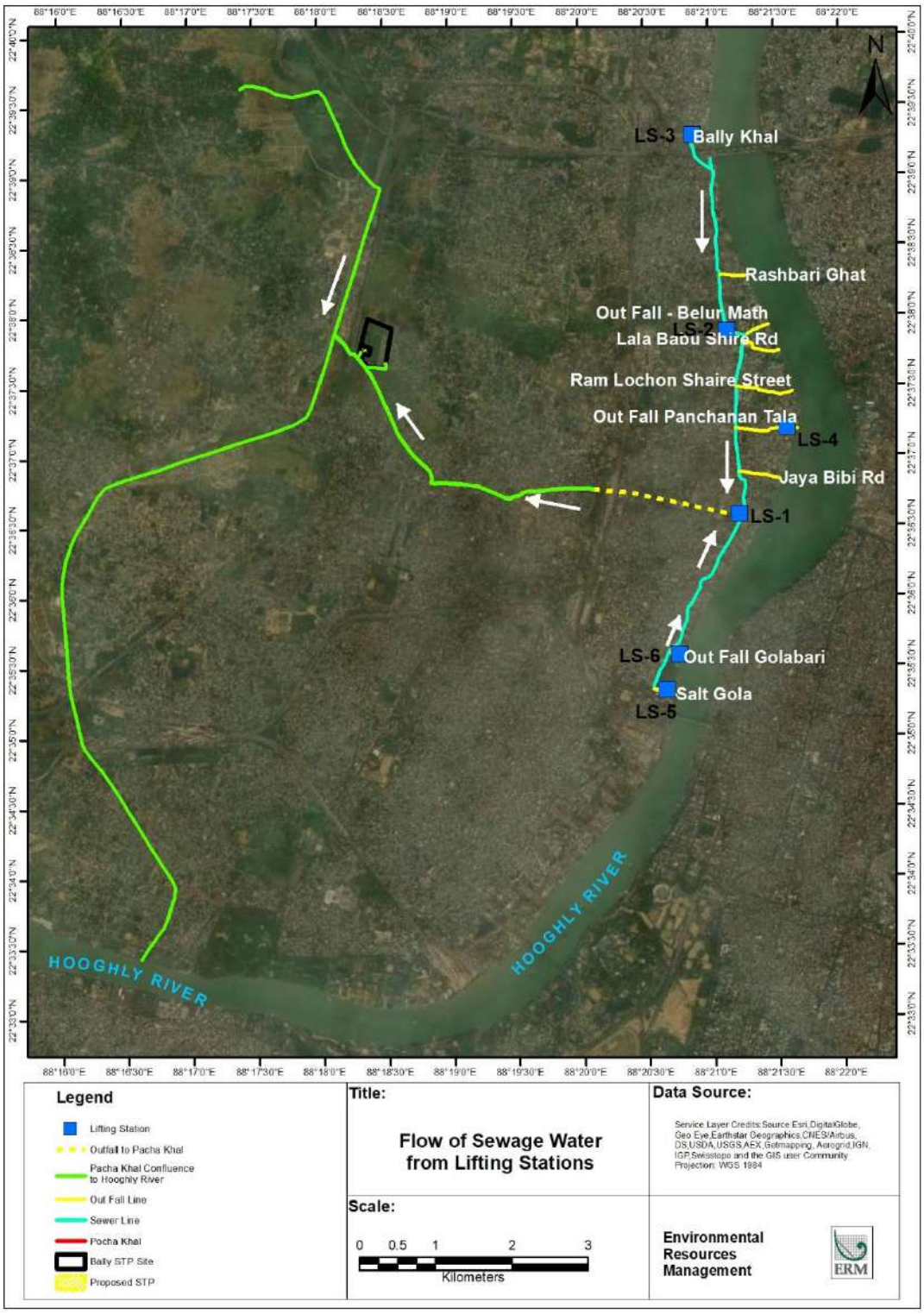


Figure 2.8 Outfall Location LS-2 and LS-3

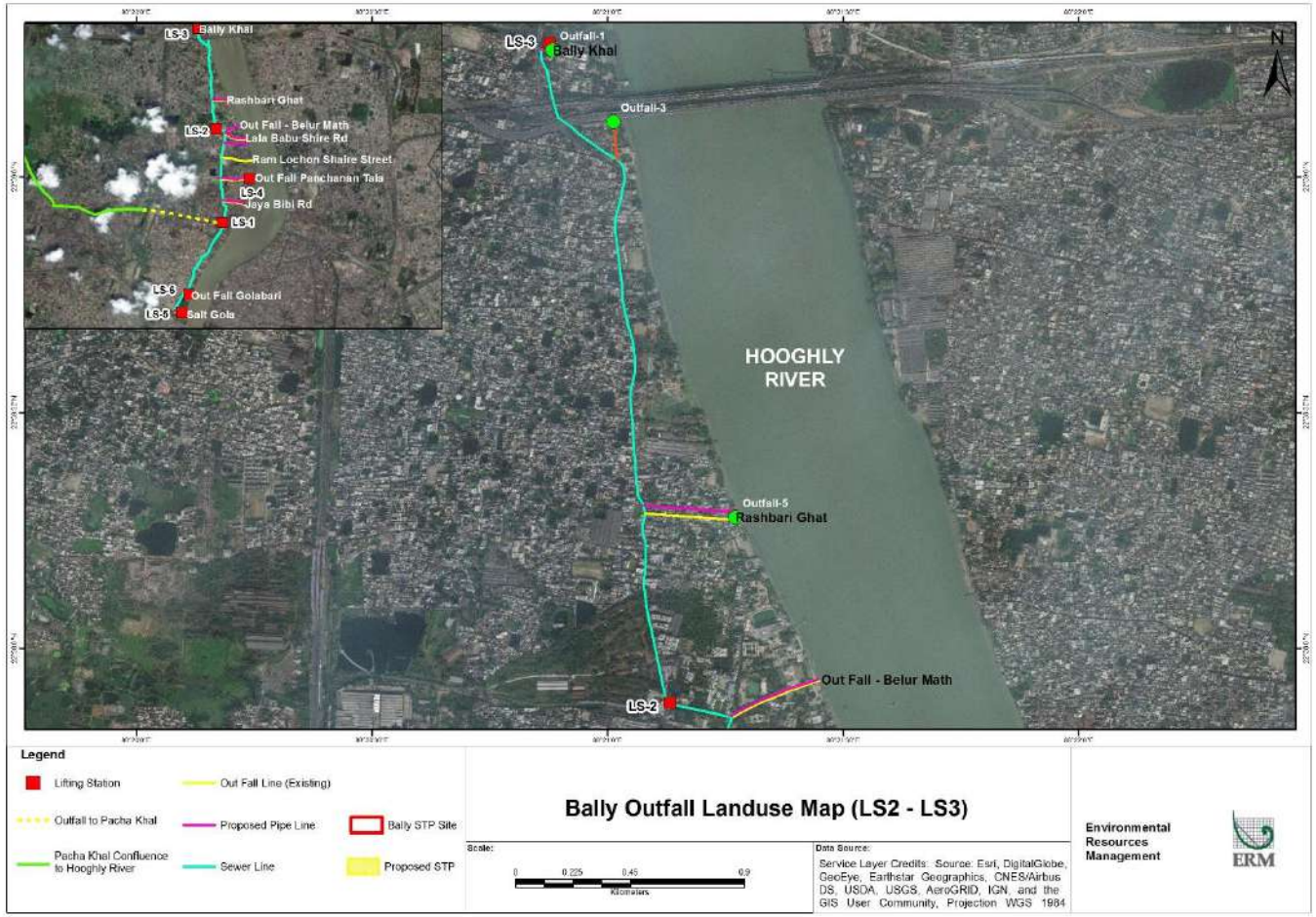


Figure 2.9 Outfall Location LS-4 and LS-1

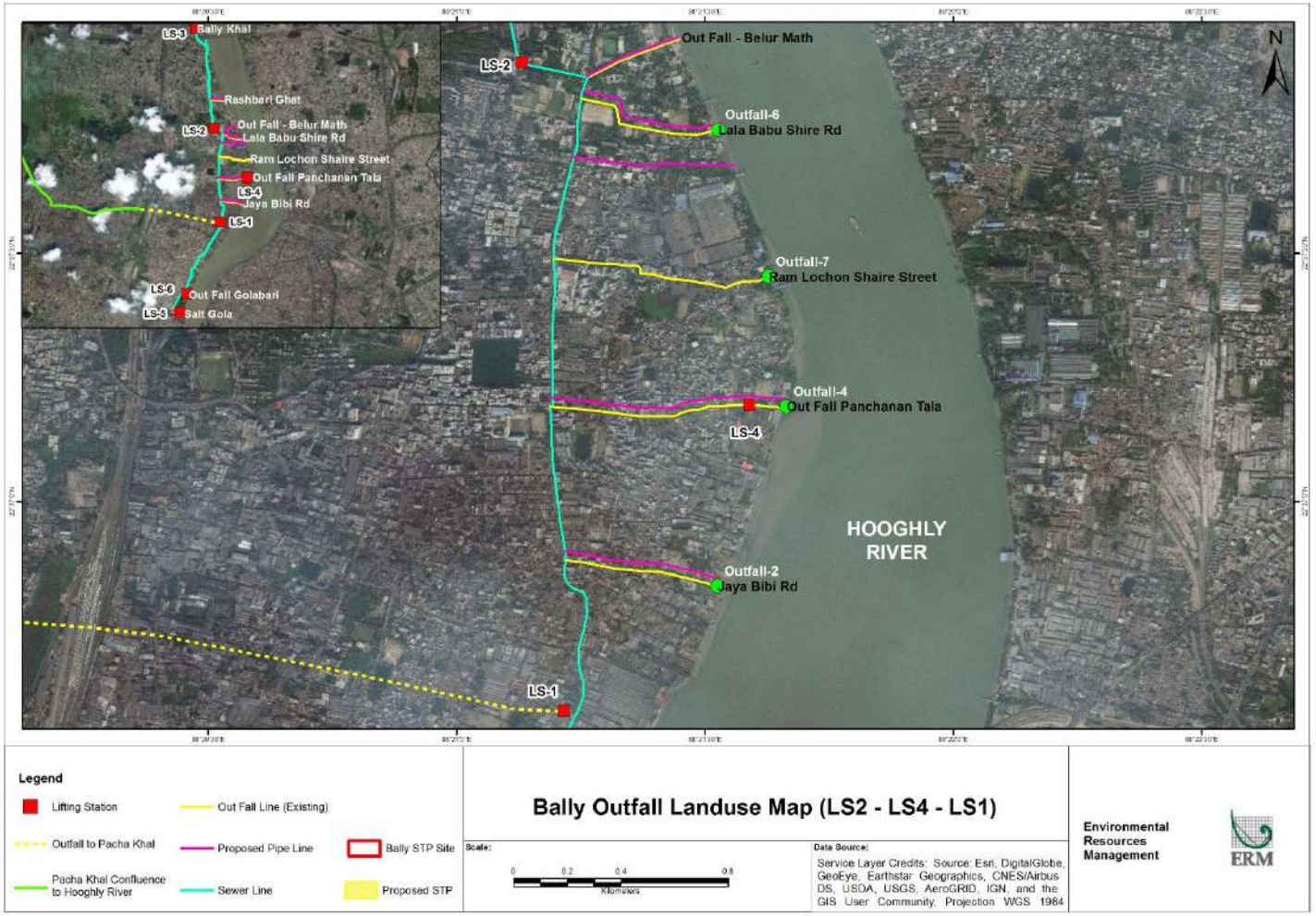
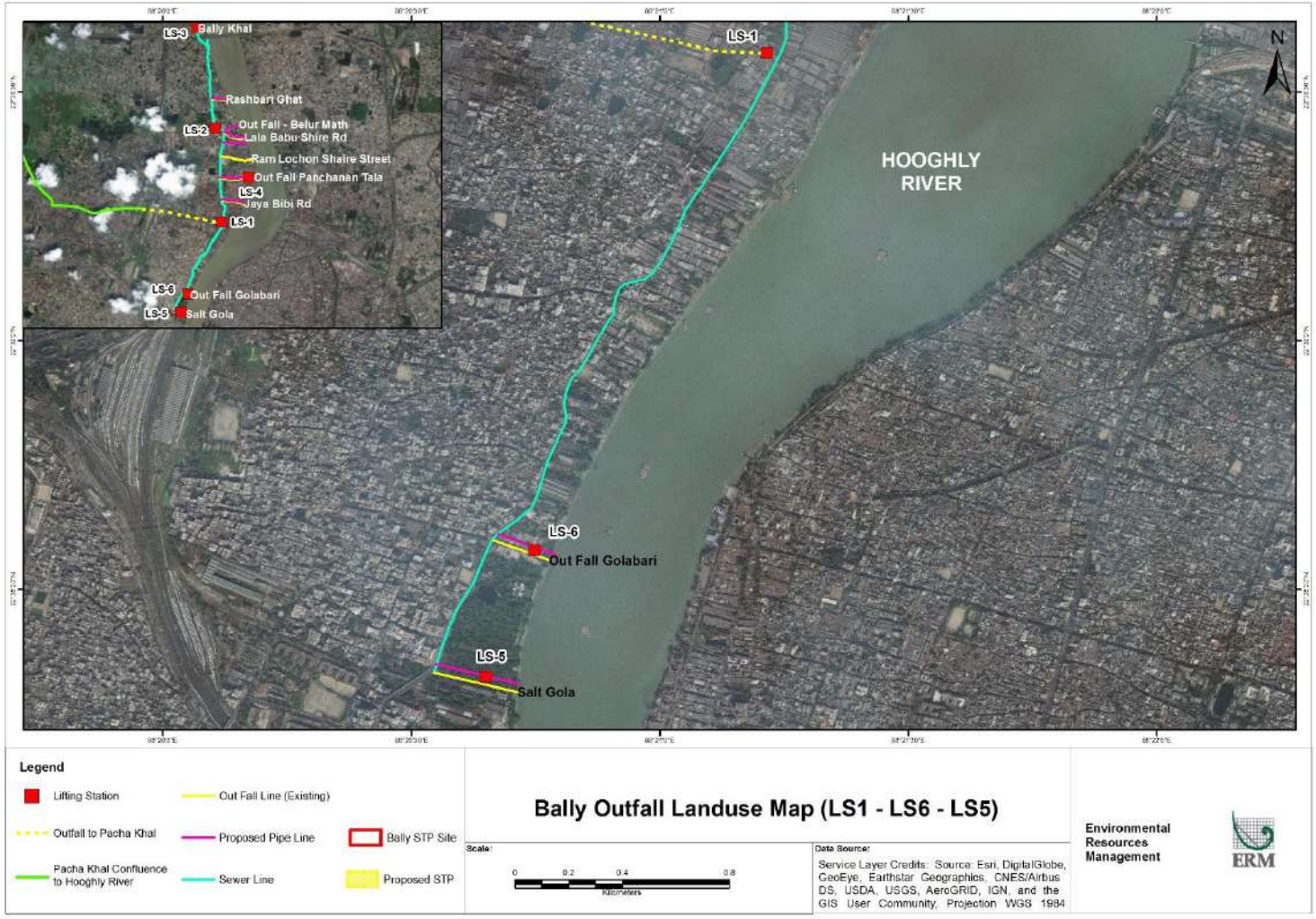


Figure 2.10 Outfall Location LS-5 and LS-6



2.5.6 Wastewater Stabilization Pond (WSP)

WSP is a low cost wastewater treatment method consist of 3 sets of pond namely, Anaerobic Pond, Facultative Pond and Maturation pond. Presently there are 6 ponds viz., 2 Anaerobic Pond, 2 Facultative Pond and 2 Maturation pond. The present capacity of the WSP is 30MLD which will be reduced to 22MLD. Part of one anaerobic pond and one facultative pond will be filled to create space for new 40 MLD STP that will be constructed.

2.5.7 Sewage Treatment Plant

The proposed 40 MLD STP will involve four (4) sequential treatment stages including preliminary treatment, primary treatment, secondary treatment and Chlorine based disinfection stages. Considering the required treated wastewater characteristics, land availability and ease of operation, Conventional Activated Sludge Process has been considered by the Concessionaire for secondary treatment process. Further, the sludge generated from the treatment plant will be anaerobically digested to produce Biogas which in turn will be used for power generation through Gas Engines. Details of the process are described below and represented in **Figure 2.13**.

In general, sizing criteria for the units will be based on the requirements of the contract and the Central Public Health and Environmental Engineering Organisation (CPHEEO) Manual for Sewage and Sewerage Treatment. For design parameters which are not mentioned in the contract specifications or CPHEEO Manual, the operating parameters will be considered from standard literature and based on WABAG's operational experience of similar plants in India and other countries.

The STP will comprise of the following sections:

- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Disinfection and Disposal
- Sludge Handling
- Biogas Handling and Power Generation
- Heat Recovery System
- Auxiliary Units

2.5.7.1 Preliminary Treatment

The preliminary treatment comprises of Screenings and grit removal operations. During this operation, solid substances like floatables, rags, grit etc. are removed from the wastewater. This is achieved in two process steps:

- Coarse and fine solids and clogging constituents are removed from the sewage by fine screen units.
- In the grit chamber heavy particles (grit) with high settling velocities are removed by sedimentation.

This preliminary treatment section comprises of the following units:

Stilling Chamber

The Stilling Chamber will be designed to arrest the turbulence of flow from the rising main and to ensure smooth gravity flow of sewage to the downstream units. The inlet chamber will receive flow from the Main Sewage Pumping Station and the chamber will be designed with adequate depth and

free board above top water level to avoid splashing. Necessary valves will be provided for flow control and the waste water drain pipe will connect to the subsequent STP stages.

Mechanical Fine Screen

Raw sewage from the Stilling Chamber flows by gravity to the downstream 2 Nos.)2W(Screen Channels. The purpose of the screens is to remove fine solids from the sewage and to protect the subsequent aggregates and components against blocking and damage. Beside the screen, the other required equipment for collection and storage of screenings trapped by the Mechanical Fine Screens are also provided. Isolation of the screen from the flow during either repairs or due to low flow conditions are made through the sluice gates, placed in the upstream and downstream of each of the screen chambers.

Mechanical Fine Screens will be provided to trap the screenings exceeding 6 mm in size from the sewage flow. Two)2(Nos.)2W(.
The expected quantity of grit generation at the proposed Arupara STP will be 5 m3/d. The screenings from the screen chamber will be washed and transported through conveyors and collected in screening containers. The grit particles from the detritor are then passed through frit washer and classifier before being collected in grit bins. The organics will be returned back to the inlet of detritor. The collected screenings and grit will be disposed in a place identified by KMDA.

Grit Distribution Chamber & Grit Basin

Grit comprises of sand, gravel, food particles or other heavy solid materials that are “heavier”)higher specific gravity(than the organic biodegradable solids in the wastewater and has the potential to cause increased wear and tear of the mechanical equipment, cause pipe blockages, can settle and reduce the effective volume of the treatment basins. The screened sewage from the mechanical fine screen will be conveyed to the Grit Distribution Chamber from where electrically operated sluice gates will be provided to facilitate isolation of flow to any one or more grit basins which are square sedimentation tanks in which grit and organic solids are removed collectively. The solids are raked by a rotating mechanism to sump at the side of the tank, from which they are moved up an incline by a reciprocating rake mechanism. The organic solids are then separated from the grit and fall back into the basin while passing up the incline.

Grit comprises of sand, gravel, food particles or other heavy solid materials that are “heavier”)higher specific gravity(than the organic biodegradable solids in the wastewater. Grit and other solids has the potential to cause increased wear and tear of the mechanical equipment, cause pipe blockages, can settle and reduce the effective volume of the treatment basins. The fine screened sewage flows into the grit basins, which are square sedimentation tanks which remove grit and organic solids collectively, working on the velocity principle. The collected solids are raked by a rotating mechanism to sump at the side of the tank, from which they are moved up an incline by a reciprocating rake mechanism. The organic solids are separated from the grit using a Detritor and fall back into the basin while passing up the incline.

Parshall Flume

A Parshall Flume arrangement will be provided for flow measurement of the raw sewage after de-gritting. The Parshall flume will also act as a velocity control device so that the sewage can pass through the remaining phases of treatment without turbulence. An ultrasonic flow meter will measure the fluctuating liquid depths to give accurate measurement of the average sewage flow. The sewage would then flow further by gravity to the Primary Treatment stage. The Bypass arrangement is only an emergency provision and is not operated during normal flow conditions. During any abnormal scenarios or when there is excess storm water or if when the inlet flow is higher than peak flow, the excess flow shall be bypassed so as to prevent any overflow events in the plant and to avoid any MLSS washout from the biological system.

2.5.7.2 Primary Treatment

This section receives the screened and de-gritted sewage. In this part of treatment plant, substantial amount of influent suspended solids and a portion of influent BOD are removed in the Primary Clarifier.

This section comprises of the following units:

Primary Clarifier Distribution Chamber

The de-gritted sewage will be conveyed to the Primary Distribution Chamber through a conveying channel. Excess Sludge from the secondary clarifiers, overflow from the digesters, centrate from dewatering centrifuges and supernatant from the centrifuge feed sump will be transferred to this Distribution Chamber for further treatment along with the main stream. A rectangular shaped distribution chamber is provided to equally divide and distribute flow received from the Parshall flume to the primary clarifiers. Uniform flow distribution to individual primary clarifiers is achieved by overflow weirs and individual isolation gates provided. Drain arrangement is provided with necessary valves for draining the unit to next stages of treatment process.

Primary Clarifier

Clarification comprises of a physical treatment process in which gravity settling of particles takes place in tanks. The purpose of the primary clarifier is to remove substantial portion of the settleable solids from the untreated wastewater thereby resulting in a decrease in solids content of sewage flowing into the subsequent biological unit. Two Nos. Inclined Plate type Primary Clarifiers with integral thickener will be constructed as square concrete structures.

In addition to the above, the other key advantages of providing primary treatment would include:

- Primary sludge will be major contributor to gas generation due to its rich VSS content;
- Reduction in inorganics load which has escaped screening and grit treatment to biological treatment;
- Reduction in organics load to the biological treatment;
- Reduction in power required for biological treatment;
- Reduction in downstream sludge treatment unit sizing due to high sludge consistency;
- Reduction in carryover of inert to biological treatment section.

In addition to above, co-settling of waste activated sludge from biological treatment will also be considered in Primary Sedimentation Units. This will be a recirculation system for feedstock from biologically treated activated sludge from treatment process. Primary settling units will also be provided with integral thickening mechanism to improve the thickening of the sludge and the resultant thickened sludge will be fed for anaerobic digestion. Considering land availability and space saving requirements, plate type lamella sedimentation tanks with integral thickener scrapper mechanism will be built.

The degritted sewage will enter the clarifiers through openings on the sides of the clarifier. The main feature of this primary clarifier is that inclined plates would be provided for increasing the settling area for sludge particles thus reducing its footprint. The Primary Clarifier will have a square configuration with bottom of circular configuration suitable for picket fence sludge scraper mechanism to scrap the settled sludge. Each of the clarifiers will be provided with adequate number of plates arranged in rows with overflow launders. The inclined plates will be spaced in such a way that the flow through the plates shall be laminar and ensuring that the projected area of settling is much higher than conventional clarifiers. The Plates will be so arranged that the incoming solids would be distributed between the plate rows evenly whereby the solids leave

the plates in the lower portion and the clarified water overflow take place over adjustable overflow launders to be located in the periphery of the clarifier.

2.5.7.3 Secondary Treatment Section

The principle of biological treatment involves converting soluble or dispersed organic wastewater constituents, which cannot be removed from the wastewater by preliminary treatment, into biomass. Thus, the pollutants are converted into a settle-able form, which in turn can be removed from the wastewater by a final sedimentation step.

The process implemented here is Conventional Activated Sludge process with carbonaceous BOD Removal. To ensure that the biological processes be carried out rapidly, the wastewater must be brought into close contact with the microorganisms and sufficient oxygen must be supplied at any time. The biological treatment stage would comprise of activated sludge tanks and secondary clarifiers. In the activated sludge tank, the microorganisms (bacteria) would be supplied with oxygen. The bacteria use the wastewater constituents as nutrients for their metabolism cleaning the wastewater at the same time. After aeration, the pollutants transform into biomass the mixed liquor is passed to the final clarifier, wherein it is separated from the cleaned wastewater. The settled biomass will be continuously recycled to the aeration tanks (return sludge) in order to maintain sufficient biomass concentration in the aeration tanks and in order to maintain an optimal sludge age.

Secondary treatment section comprises of the following units:

Aeration Distribution Chamber

Aeration Distribution Chamber will be designed to receive the primary treated sewage and also the return activated sludge and distribute sewage to the Aeration Tank. The sludge from the secondary clarifier will be conveyed to the inlet of the Aeration Tank distribution structure as Return Activated Sludge by pumping in order to maintain the MLSS level in aeration tank. The primary treated sewage from Primary clarifiers will be received by gravity through channel connecting to the Aeration Distribution Chamber. The Aeration Tank distribution chamber will be provided with sluice gates for isolation purpose.

Aeration Tank

Two Aeration Tanks will be provided as a means for efficient oxidation of BOD and the design will be based on Central Public Health and Environmental Engineering Organisation (CPHEEO) Manual for Sewage and Sewerage Treatment. The biological processes for decomposition of the organic matter would require the supply of considerable quantity of oxygen. The aeration system will be based on fixed type fine bubble Aeration Tank Diffusers. The mixed liquor will flow into a common drop chamber from the outlet weir of the aeration tank, from where it will be conveyed to the secondary clarifier through pipes. The recirculation sludge will be fed to aeration tanks with the help of Return Activated Sludge Pumps to maintain the concentration of MLSS in aeration tank within the desired range. The capacity of blowers will be adjusted so as to maintain optimal DO level at the outlet of each tank which is in the range of 1 mg/L. Separate air pipe headers will be provided for each aeration tank. The air blower header will be so designed that outlet of the total three (3) (2W + 1S) nos. blowers, one blower will be dedicated for each aeration tank with suitable interconnection valve between common standby blower and the dedicated blower. An Online DO Analyser will be provided at outlet of each Aeration Tank for monitoring the Dissolved Oxygen (DO) level.

Secondary Distribution Chamber & Clarifier

The mixed liquor from the outlet channel of aeration tanks will be distributed to secondary clarifiers through a Secondary Clarifier Drop Chamber. The distribution chamber will be of RCC construction and provided with sluice gates for isolation of the Secondary Clarifier from the flow during maintenance.

In the next step, the major task of the secondary clarifier will be to separate the activated sludge from the treated wastewater, producing an effluent with an acceptable concentration of suspended solids and BOD. In addition, the settled activated sludge will be efficiently thickened and moved to a central sludge hopper by the final clarifier scraper. The design and operation of the clarifier will account for minimisation of short-circuit in the return sludge flow.

2 Nos. Secondary Clarifiers will be constructed as circular concrete structures and of radial flow type. A central drive unit will move the bridge and the Secondary Clarifier Scrapper Mechanisms will be fixed to the drive head through a central cage. The scraper blades would aid the transport of the settled sludge to the central hopper. The design of the clarifiers will ensure that uniform sludge draw-off would occur to a well sized sludge pit leading the sludge towards the centre. The settled sludge will be withdrawn from the sludge hopper of each clarifier and transferred to return activated sludge sump by gravity. The sewage will flow through opening at the top and move radially towards the periphery. The entry ports would remain submerged below the water surface. The flow at the periphery of the clarifier will pass through a weir and will be collected in a RCC launder along the outer periphery of the clarifier. The effluent weir along with baffles provided along the outer periphery will comprise of adjustable ‘ V ‘ notch weir plates for uniform withdrawal of flows. The clarified sewage from the launder of clarifier will be taken into RCC channel leading to Chlorine contact tank. The floor of the clarifier will be in the shape of hopper sloping radially towards the centre having a slope of 1:12. The sludge settling on the floor of the clarifier will be scrapped to a central pit from where it will be withdrawn into the return activated sludge sump under hydraulic pressure.

Return Activated Sludge Sump

In order to provide for continuous sludge withdrawal from each clarifier, a Return Activated Sludge (RAS) Sump will be provided to receive the secondary activated sludge (bio sludge) from the secondary clarifiers. The sump will house 3 No.’s of return activated sludge pumps (2W+1S) with capacities designed to pump the RAS flow to aeration tank and excess sludge to primary clarifier. The RAS pumps will discharge flow to the aeration tank on a continuous basis. A tapping in the RAS header line will be provided to facilitate excess sludge bleeding, which will be made to flow back to the Primary Clarifier where it will be thickened along with primary sludge. An electromagnetic type flow transmitter will be provided in the excess sludge line for monitoring the discharge quantity.

Process Air Blower Area

The process air blowers will be located adjacent to the Aeration tanks in the Process air blower area. 3 Nos. (2W+1S) Aeration Blowers would cater to the requirements of aeration tank. The blower capacities will be designed to keep the minimum oxygen concentration in the aeration tanks at 1 mg/L. The blowers would calibrated to operate automatically based on a pre-set oxygen value monitored in the aeration tanks.

2.5.7.4 Disinfection and Disposal Section

The Secondary Treatment Section will be followed by a disinfection system based on Chlorination to reduce coliforms levels present in the treated sewage to desired levels. After disinfection, the sewage will disposed to the Udaypur Khal through a drainage channel. This treatment stage will comprise of the following units:

Chlorine Mixing & Contact Tanks

The output from secondary treatment stage will be mixed with Chlorine Solution in the Chlorine Mixing Tank and Diffusers will be provided for effective diffusion of chlorine solution with the secondary clarified sewage. The treated water would then subsequently move on to Chlorine Contact Tank via an inline vacuum ejector and would receive at Chlorine Contact Tank, through bottom mounted perforated pipe (chlorine diffuser pipe). The Chlorine Contact Tank will be designed to provide effective contact time between Chlorine gas and secondary treated Sewage for effective disinfection and would comrpise of 1 No. Chlorine Contact Tank of RCC construction along with provision for

required number of RCC baffles to allow for proper mixing of Chlorine solution with treated effluent. A Residual Chlorine analyser is provided at the outlet end of Chlorine Contact Tank to measure the free residual chlorine

Gas Chlorination System

Chlorine gas will used as a disinfectant and will be delivered to the STP facility in form of cylindrical Tonners and system would be housed in the Chlorine building. The Chlorination system would consist of a Chlorinator, which will dose Chlorine in aqueous form into the Chlorine Contact Tank. 2 Nos. of Vacuum operated type Chlorinator (1W+1S) suitable for floor mounting, each complete with a remote mounted ejector to give aqueous solution output, will be provided. The chlorinators would be designed for output control proportional to the flow measured upstream of the dosing point and for residual control. Adequate connections and tonner isolating valves will be provided to enable the drums to be connected in two banks, each to an automatic drum changeover device so that one bank of drums are on duty and the other bank of drums remains on standby. Automatic changeover of tonners from duty to standby banks will be initiated by low pressure measured by a pressure switch on the common gas header.

Control Measures

Considering the toxic property of Chlorine gas, should an accidental release occurs, several safeguards would be considered to be an integral part of the Chlorination system and will conform to Indian Standard IS 10553, Part I – General Guidelines for Chlorination Plants including handling, storage and safety of Chlorine drums. These would include:

- ***Chlorine Leak Absorption System:*** An air extraction system connected to a Leak Absorption System will be provided for the tonner room and chlorinator room to remove chlorine in contaminated air, in case of Chlorine leak in these rooms. The extraction system will consist of extractor fans 2 Nos. (1W+1S) withdrawing air from these areas separately by a system of low level ducts through a chlorine absorber and discharging chlorine free air to the atmosphere. The ductwork will be arranged to extract from the rooms and provided at floor level connected to the absorber. The scrubber exhaust rate will be designed to maintain negative pressure in the tonner room and Chlorinator building during a leak. In the chlorine scrubber tower, the chlorine gas will be neutralized with absorbent (Caustic) solution. The pH of the spent absorbent (caustic) will be checked at the outlet of the scrubber. If the pH is found to be high, then absorbent will be neutralised with water in a neutralisation pit. This activity would be triggered only in case of an accidental release of Chlorine which has a probability of less than 1 event in less than 100 years. If such an instance occurs, the neutralised water from the pit would be recycled back to the Clarifier and will be treated through the STP system, before being discharged along with treated sewage water.
- ***Absorbent Tank:*** The absorbent to be used for Chlorine would be Caustic (NaOH) solution. The concentration of caustic used in the absorber will be selected such that it can limit the temperature rise during the absorption process to 10^{o}C. One (1) no, Caustic solution cum recirculation tank adequate to neutralize the content of One (1) Chlorine drum will be provided for this purpose. The tank will also be provided with dilution water supply.
- ***Caustic Solution Recirculation Pump:*** Two (2) Nos. Horizontal Centrifugal Type Caustic Solution Pumps (1W+1S) will be provided to transfer the NaOH solution required for neutralizing the contents of one chlorine drum (1000 kg), from the storage tank to the scrubber. These pumps will also be used for loading the Absorbent Holding / Recirculation tank with fresh caustic solution.
- ***Chlorine Leak Blower***: Extraction fans will be mounted on the downstream side of the absorber to induce an upward draft of contaminated air through the absorber. Two Centrifugal Blowers

(1W+1S) each of capacity adequate to provide the required number of air changes per hour will be provided.

- Vacuum regulating/pressure relief valves will be provided on each line to Chlorinator.
- Chlorine Booster pumps will be provided with isolating valves, non-return valves and pressure gauges

2.5.7.5 Sludge Handling Section

- ***Digester Feed Sump***

The function of the Digester Feed Sump will be to balance the intermittent sludge discharges from the primary clarifiers and therein provide a well-mixed uniform sludge feed to the digesters as well as act as a sump for the digester feed pumps that will feed the anaerobic sludge digester. The tanks will be sized to balance the intermittent flow with sludge being withdrawn at a steady rate and concentration to the digesters.

A low speed mixing agitator will be provided in the digester feed Sump to keep the solids in suspension and to avoid any settling. Three (3) Nos. (2W+1S) Digester Feed Pumps of Horizontal Centrifugal Non-clog type Pumps will be provided for transferring the sludge to the Anaerobic Sludge Digester. An Ultrasonic type level transmitter will be provided in the Thickened Sludge sump to monitor the level in the sump and to protect the pumps from any dry run. In addition, a magnetic type flow transmitter with a totalizer will be provided to measure the flow of Thickened Sludge to each Digester, at each of the header lines that would be feeding into the Sludge Digester.

Anaerobic Sludge Digester

Anaerobic Sludge stabilization will be undertaken as a part of the treatment process in order to reduce organic content of sludge through anaerobic digestion and recovering energy from sludge in form of Biogas. During anaerobic stabilization process, organic substances in the sludge will be decomposed to a considerable level in order to get digested sludge that is in a biologically stable condition i.e. maximum decomposition of organics, reduction in generation of odours, and having proper dewatering characteristics.

The Anaerobic Sludge Digesters would have a fixed cover with facility for heating and mixing. Mixing will be achieved by recirculation of sludge using Sludge mixing pumps. The thickened sludge will be fed into the digester and undergo anaerobic decomposition in absence of air (oxygen) at mesophilic conditions of about 35 °C and with a retention time of a minimum 10 days being maintained. Decomposition would take place in several transitional phases. As a result of this process, Biogas will be produced with a composition of about 65 % (by volume) of Methane.

Two (2) Nos. of Anaerobic Sludge Digesters would be developed for thickened sludge digestion using mesophilic single stage and single phase process. The digesters would be of RCC construction and would be designed as cylindrical tanks. The base will be constructed with a slope to the centre in order to evacuate the sludge. The sludge withdrawal pipeline will start from the bottom portion of vertical face of the digester and join the main header line feeding the sludge dewatering unit. One number sluice valve with ‘Y’ shape tee connection having blank flanges will also be provided in the sludge withdrawal pipe line for each digester for back pressure application / rodding for opening of chokages etc. Main sludge withdrawal pipeline will terminate into the Digested sludge sump. In order to have homogenous conditions inside the digesters and to avoid scum accumulation on the sludge surface, high efficiency sludge mixing will be provided. Effective mixing will be performed by using three (3) Nos. (2W+1S) Digester Mixing Pumps Sludge mixing pumps. The Gas line from each Digester will be provided with a thermal mass flow meter, to measure the amount of biogas generated from each Digester. In order to maintain the temperature of the digesters at a constant level of about 35 °C the content of each digester will be circulated by external circulation pumps via a sludge heat

exchanger. Four (4) Nos. (2W+2S) Sludge Recirculation Pumps of Horizontal Centrifugal type will be provided for sludge recirculation. In addition, two (2) Nos. (2 W) pipe-in-pipe Type Sludge Heat Exchangers will be provided for Sludge Heating. Temperature gauge will be provided at the inlet of each heat exchanger in the Sludge Feed Line.

The Digesters will be gas tight. Gas line on the top of digester will be connected to a common header pipeline leading to the gas holder. The pipe lines will be provided with moisture/drip traps at suitable places. To prevent building up of excessive gas pressure inside the digester, provision be made for hydrostatic pressure relief and gas ventilating arrangements. The arrangement will also consist of a water seal and connecting pipe line. A pressure safety valve with an inbuilt flame arrestor will be provided on the dome of each digester. The pressure safety valve will protect against overpressure and also prevent the occurrence of a vacuum condition, by letting in atmospheric air when required. An in-built-flame arrestor will prevent the ingress of any external source of heat into the digester.

The expected quantity of digested sluge and treated sludge generation at the proposed Arupara STP will be 380 m^3/d (6% DS) and 100 m^3/d (20% DS) respectively. Prior to digestion, the sludge will have a consistency of about 6% dry solids. Digestion process is designed to destruct 50% volatile suspended solids. After digestion, the consistency will be slightly less than 6%.

Digested Sludge Sump

Digested Sludge from Sludge Digesters will be transferred to the Digested Sludge Sump by gravity. A low speed agitator will be provided in the Digested Sludge sump and will prevent the settling of solids in this sump. The digested sludge will be transferred into Sludge dewatering unit by Centrifuge Feed Pumps.

Centrifuge

Solid bowl type Centrifuges will be used to dewater digested sludge of sewage treatment plant. The Centrifuge units will be installed in a Centrifuge Platform which will be designed to permit dewatered sludge being directly loaded onto disposal containers (1 No. for each centrifuge), placed just beneath the platform. The top of the platform will comprise of a RCC slab and all associated machineries will be supported over suitable foundation. A RCC staircase with hand-railing will be constructed to have access to platform from foundation level.

The solid bowl centrifuge operation concept will be based upon sedimentation assisted by centrifugal force. The cylindrical bowl, with a conical end, rotates at rpm’s depending on the application. Inside the solid bowl will be a conveyor having a spiral drive spinning in the same direction as the bowl, but at lower speeds. The digested sludge will enter the bowl near the centre of the cylinder and undergo sedimentation due to the centrifugal force. The liquid will drain out of the bowl through openings at the cylindrical end. The conveyor will then push the solid material to the conical end of the bowl where the dewatering process continues. The separated solids will be pushed out of the conical end of the bowl and discharged into the collection channel. The settling speed will be determined by particle size, particle shape and difference in density between solids and liquids in addition to viscosity of the material. The geometry of the bowl, relation with length and diameter would be adapted to suit the application.

2 Nos. (1W+1S) Sludge Dewatering Machine (Centrifuges) will be provided to dewater the digested sludge from the anaerobic sludge digesters and to be installed in the Sludge Dewatering Building. The Sludge Dewatering Building will be provided with an electrically operated overhead crane (Y-16) for installation and service requirements. Polyelectrolyte dosing will be provided independently for each Centrifuge. Provision will be made to dose polyelectrolyte along with dilution water arrangement in order to adjust the desired dosage.

Polymer Dosing System

Polymer will be used for conditioning of the sludge and will be prepared in a polymer dosing tank. The tank will have a slow speed polymer dosing tank agitator to enable mixing of the polymer solution in

the tank. The polymer will be dosed by means of 2 No's (1W+1S) of diaphragm type dosing pumps. Rotameter type flow meters will be provided at the dilution water line to be used for online dilution of the solution.

As per KMDA's requirement, the dewatered sludge will be disposed off to a site identified by KMDA, which will be suitable for disposal of dewatered sludge without any further treatment. Composting or any further treatment is not envisaged as part of the governing Concession Agreement for GSPPL.

Biogas Handling Section

Biogas generated from anaerobic sludge digester with approx. 65% methane concentration, would be used as an alternative source of energy. The following sections describe the facilities planned to handle the generated Biogas from the Plant and recover energy from the Biogas.

Gas Holder

Biogas production during anaerobic stabilization will be a continuous process. However, there would be some variations in the inlet load, based on which there will be fluctuations in the production of the Biogas. To overcome these differences and to provide continuous supply of biogas to the gas engines, one number (1 No.'s) of 2150 m^3 storage capacity for the biogas produced from the plant will be considered.

The gas holder primarily would be of double membrane type and have an internal and an external membrane made of polyester. The internal membrane would hold the biogas and the external membrane provide protection to the internal membrane and is always in inflated condition. The internal pressure in between the internal and external membrane will be maintained by support air blowers. The gas holder will be equipped with a hydraulic safety device in order to protect against overpressure. The biogas generated by the anaerobic digestion process will be used in a co-generation plant in order to produce heat and electrical energy. In cases of emergency, when the CHP unit fails, the excess biogas will be flared off through a flaring system.

An ultrasonic type level transmitter will be provided in the Gas Holder which will monitor the level of filling in the gas Holder. If the biogas level in the holder touches the high level, the valve controlling the pilot burner in the biogas flare will be opened and the gas flow will be diverted for flaring of the excess gas. During normal conditions, the biogas will be scrubbed in the biogas scrubber and sent to the biogas engine. A Thermal mass type flow meter will be provided in the scrubbed biogas header line from biogas scrubber leading to Biogas Engines. Drip trap will be provided in biogas lines in appropriate locations to remove the moisture from the saturated biogas. The moisture will be drained out through a baffling arrangement in the drip trap.

Biogas Scrubber

Hydrogen Sulphide (H_2S) which is present as an impurity in the biogas has to be removed because of its corrosive characteristic. The presence of H_2S causes corrosion, especially in pressure regulators, gas flow meters, valves and steel parts of equipment. Also, SO_2, which is the combustion product of H_2S, when combined with water vapour can lead to corrosion in gas engines. Lubricating periods become shorter and maintenance needs increase as a result of corrosion and wearing in gas engines.

Two (2) Nos. (1W+1S) Biogas blowers of twin lobe type will be provided for transferring the Biogas at the required pressure to the Biogas scrubber followed by Biogas Engine Units. Each discharge line will be provided with a Pressure gauge and Pressure Safety valve. Variable speed drives will be provided for Gas Blowers, to control the required gas flow to the Gas Engine. The biological type Biogas scrubber plant will be designed for an average daily digested gas volume production and for a reduction of H_2S content to meet the requirement of Biogas Engine. Caustic Soda solution will be used for biogas scrubbing so as to reduce the H_2S present in the biogas. The spent caustic will be regenerated in a Biological Aerobic Reactor and recycled back to the scrubbing process.

Biogas Flare

Gas burner with drip trap, pressure regulator and pilot burner will be provided with capacity adequate to burn the biogas produced from the treatment plant, under emergency conditions. Two (2) Nos. (1W+1S) Gas flares designed for 120% of gas generated from the plant, will be provided for this purpose. The burner will be mounted conveniently on a steel flare stack structure at a minimum height 10 m above fixed ground level (FGL)[2]. Aspirator type Gas flare with auto ignition through pilot burner is provided. Biogas will be used as a pilot fuel. and the pilot flame generated with the help of spark ignition system will propagate through the flare unit to ignite the main biogas stream. Flare control system involving control panel, ignition transformer, low pressure switch etc. Will be provisioned for as a part of the flaring arrangement. Adequate retention time, depending on temperature of the flare, would be arranged to ensure efficient combustion of Biogas stream.

To prevent the movement of flame in the pipeline and other associated areas, flame arrestors (one each on pilot burner and the main burner) will be provided for the Gas Flare system. Moisture content present in the Biogas may impact the efficiency and performance of the Gas flaring system. One (1) No. Moisture separator will be provided at the Biogas feed line to the Gas Flare. Water collected due to separation of moisture will be sent back to the clarifier.

The biogas flare will be a vendor package and the actual specification will be confirmed after vendor finalisation. Tentative details for the biogas flare system will include the following:

- Type: Self Aspirating type
- Retention Time: Not Applicable
- Flare height from ground level: 12m
- Design capacity: 120% of design biogas production/day
- Combustion temperature: Details would be provided at later stage after equipment finalization
- Emission standards: Details would be provided at later stage after equipment finalization

Biogas Engine

The biogas generated by the anaerobic digestion process will be used in a co-generation plant in order to produce heat and electrical energy. Electrical energy requirement of the STP will be supplied from the electrical energy produced via the CHP unit. This will help in countering global warming and climate change impacts from the STP's operation besides it reducing withdrawal of power from grid.

One (1) No's of Biogas Engine (rated capacity 635 kWe) will provided for generation of electricity from Biogas. The type of engine proposed is a Single Fuel type biogas engine. A Co-generation system will be provided inside the Gas Engine Building. Heat Recovery units, Cooling system and Ventilation system for Biogas Engine will be housed in the Biogas Engine Building. Biogas engine to be supplied will be complete with required Exhaust ducting, HT radiator, Wet Ventilation System, Fresh and used lube oil system, Cooling water circuit for HT and LT system and Cooling water filling system.To provide makeup water for the cooling system, a fresh water storage tank along with Water Softener will be provided. The soft water from Softener (activated carbon filter) will be transferred by the Utility Water Pump as Make-up water for Cooling Water Circuit of Gas engine and the Waste Heat recovery system. Biogas engine and the associated utilities to be installed with the biogas engine will be a vendor package and the corresponding technical specification will be confirmed at a later stage after vendor finalisation.

[2] Neither the general WB EHS Guideline or Sector Specific Guidelines (Water & Sanitation) provide any specification for minimum height from the ground level for the gas burner system of a flare burning CH_4/Biogas. There are however specific guidelines on retention time in the gas burner which is related to the temperature necessary to achieve highly efficient combustion of Methane gas ranging from 0.6-1.0 seconds at 850 degrees Celsius to 0.3 seconds at 1000 degrees Celsius for enclosed flares.

The proposed bio gas engine will be a lean burn engine and produces emissions with NOx < 500 mg/m^3.

2.5.7.6 Heat Recovery Section

A seasonal temperature variation in the incoming raw sewage is expected during winter and summer season. However, the maximum temperature range of the incoming raw sewage is expected to be around 30 ^{o}C considering geographical location of the project. As per the treatment scheme for the STP, sludge feed for the Anaerobic Sludge Digester will be made from the primary clarifier of the STP where the temperature of the sewage water/sludge will be in the same range of 30 ^{o}C. In the context of ensuring optimum performance of the Anaerobic Sludge Digester, the temperature will need to be maintained in the range of 35^{o}C to facilitate the biological decomposition of the sludge. Therefore, to maintain the optimum temperature condition, incoming sludge to digester will be required to be heated to 35 ^{o}C throughout the year.

The heat requirement for the heating purpose will be extracted from the waste heat of Bio-gas engine flue gas. Soft water will be used as the heat carrying media in plate type heat exchangers and water softener unit will be installed as an auxiliary unit of the Bio-gas engine. The softener of an approx. capacity 5 m^3/h shall be installed. Softener system is a vendor based package that consists of a single FRP vessel packed with ion exchange resins that aids in reduction of hardness present in water. There will be no PSF/ACF in the softener package. Design specification of water the softener will available after the finalization of order for the Bio-Gas engine at a later date.

Hot Water Tank and Hot Water Pumps

A Hot Water Tank will be provisioned to collect the Hot Water Return from Sludge Heat Exchanger and then recirculate back the same to Sludge Heat Exchanger as Hot Water Supply through the Heat Recovery units, at required pressure. Hot Water Recirculation Pumps will be provided to develop the require pressure for passing the Hot Water through these heat recovery units and Sludge Heat Exchanger. The Hot Water Tank will also act as a buffer for compensating any occasional water losses.

One (1) No. Hot Water Tank will be provided, above the Gas Engine utility room, as Buffer tank to collect the return water from Sludge Heat Exchanger and supply back to Sludge Heat Exchanger. The tank will have requisite insulation to prevent any heat loss to the atmosphere. The tank will have nozzles for receiving hot water supply, hot water recirculation line, make up water line, suction for hot water pump, drain, vent and overflow. The tank will also have a ladder and an access platform to access the top of the tank for maintenance purposes and to reach the nozzles provided on the top of the tank. Two (2) Nos. (1W+1S) Horizontal Centrifugal Type Hot Water Recirculation Pumps will be provided for circulating the water from the Hot Water Tank through the Jacket Water Waste Heat recovery unit, Exhaust Gas Waste Heat Recovery Unit, Sludge Heat Exchanger and back to Hot Water Tank. A facility for recirculating the Hot Water back to the Hot Water Tank will also provided.

Jacket Water Waste Heat Recovery Unit

The Gas Engine would have an inbuilt HT circuit, will exchange heat with a Radiator, where the heat will be lost to the atmosphere. To recover the heat from this circuit, a HT Heat Recovery unit will be provided. The hot fluid from the Gas engine will exchange heat with the water circulated from the Hot water circulation pumps through a Plate type Heat Exchanger. All necessary pipelines, valves for isolation and required instruments for monitoring will be provided for this circuit. Whenever there is no requirement for heating of sludge, this circuit shall be bypassed and the normal circuit to Radiator will be made online.

Exhaust Gas Waste Heat Recovery Unit

The Exhaust Gas Waste Heat Recovery Unit will recover heat from exhaust gas of the Gas Engine. The exhaust gas from gas engine will be discharged at a temperature above 400 ^{o}C. This will be emitted into the atmosphere through a stack arrangement, with stack height conforming to statutory

requirements. The waste heat from this exhaust gas will be used as additional heat source required for heating the sludge in the Sludge Heat Exchanger. The gas engine will have an independent Waste Recovery Unit.

One (1) No. Exhaust Gas Heat Recovery Unit (H-02) will be provided for exchanging heat with the exhaust gas from Gas Engine. The exhaust gas from the gas engine will exchange heat with the water circulated from the Hot water pumps through this Heat Exchanger. The heat recovery units will allow for recovery of heat, which will be sufficient to meet the sludge heating requirement in the Anaerobic Digester. The estimated total heat recovery from the units for the Baranagar STP is estimated to be 520 kW. However, value as stated is tentative and will be subject to equipment specification.

All necessary pipelines, valves for isolation will be provided for this circuit. An electrically operated modulating Three Way Diverter Dampener will be provided in the Exhaust Gas line from the Gas Engine to the stack arrangement. Whenever there will be no requirement for heating of sludge, this diverter valve would ensure that this circuit is bypassed and the normal circuit to flare stack will be made online. Exhaust Gas after exchanging heat with the cold fluid, will be released to the atmosphere through the same stack arrangement.

Process Monitoring

Online analysers are provided at the following location for effective monitoring of the plant.

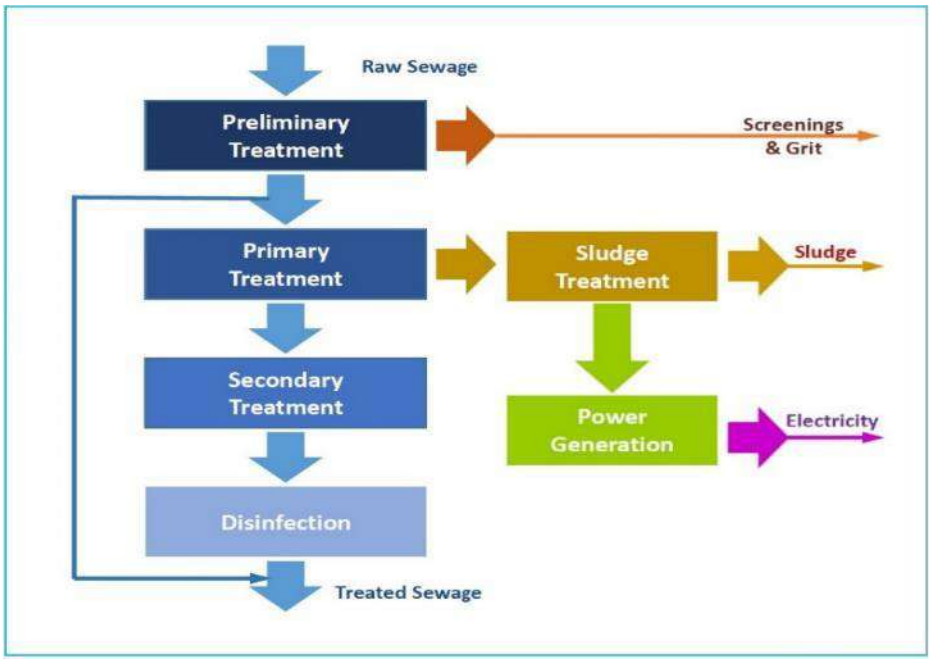
- Ultrasonic Flow Meter at the Parshall Flume and Chlorine Contact Tank Outlet
- TSS Analyzer at Grit Distribution Chamber and Chlorine Contact Tank Outlet
- COD Analyzer at Grit Distribution Chamber and Chlorine Contact Tank Outlet
- BOD Analyzer at Grit Distribution Chamber and Chlorine Contact Tank Outlet
- Conductivity Analyzer at Grit Distribution Chamber and Chlorine Contact Tank Outlet
- pH Analyzer at Grit Distribution Chamber and Chlorine Contact Tank Outlet
- Residual Chlorine Analyzer at Chlorine Contact Tank Outlet
- DO Analyzer at each Aeration Tank

Figure 2.11 Existing Bally WSP

Figure 2.12 Proposed Area of Bally STP on the Existing WSP

Figure 2.13 Proposed Site Layout of Bally STP on the Existing WSP

Figure 2.14 Proposed Treatment Scheme



Source: Adopted from Wabag DPR (Process Design Basis Sewage Treatment Plant)

2.5.7.7 Adequacy Assessment of STP Project

The proposed STP will be designed to treat 40 MLD of sewage. The raw sewage parameters based on which treatment considerations have been planned is provided in the **Table 2.1:** Influent Sewage Characteristics

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Table 2.1: Influent Sewage Characteristics

Parameter	Value
pH	6.5-8.0
TSS, mg/L	600
VSS, mg/L	360
BOD, mg/L	80-250
COD, mg/L	450-600
Faecal coliform, MPN/100ml	10^7-10^8

Source: Wabag, Process Description Document (10P153 – B0012 – 201)

The treated effluent characteristics and digested sludge characteristics, as per design criteria provided in **Table 2.2** and **Table 2.3** respectively.

Table 2.2: Treated Effluent Characteristics

Parameter	Treated Value as per Concessionaire Agreement[3]	Environment (Protection) Amendment Rules, 2017[4]
pH	6.5-9.0	6.5-9.0
TSS, mg/L	< 50	< 50
VSS, mg/L	-	-
BOD, mg/L[5]	< 20	30
COD, mg/L	< 100	< 100
Faecal coliform, MPN/100ml	< 1000	< 1000

Source: Wabag, Process Description Document (10P153 – B0012 – 201)

Table 2.3: Treated Sludge Cake Characteristics

Parameter	Value
Outlet concentration of dewatered sludge, %	>20
Faecal Coliform Limit, MPN/ g TS	<20,00,000

Source: Wabag, Process Description Document (10P153 – B0012 – 201)

As per the condition of governing Concessionaire Agreement, the project designing specification shall follow guidelines provided under "Manual on Sewerage and Sewage Treatment Systems – 2013" [6] as issued by Central Public Health & Environmental Engineering Organisation (CPHEEO), Ministry of Housing and Urban Affairs, Government of India.

The project design consideration aims to attain water quality compliance with the national effluent discharge standards[7] for STPs. Further the sludge generated from the STP will be anaerobically digested to produce Biogas which in turn will be used for generation of power from the gas engines. Biogas generated from anaerobic sludge digester with approx. 65% methane, could be used as an alternative source of energy. After energy recovery from waste sludge, the remaining waste material will be disposed to the KMDA designated site near the STP facility.

[3] Project output performance will be governed by the stipulated Indian regulatory standard as specified under Concessionaire Agreement

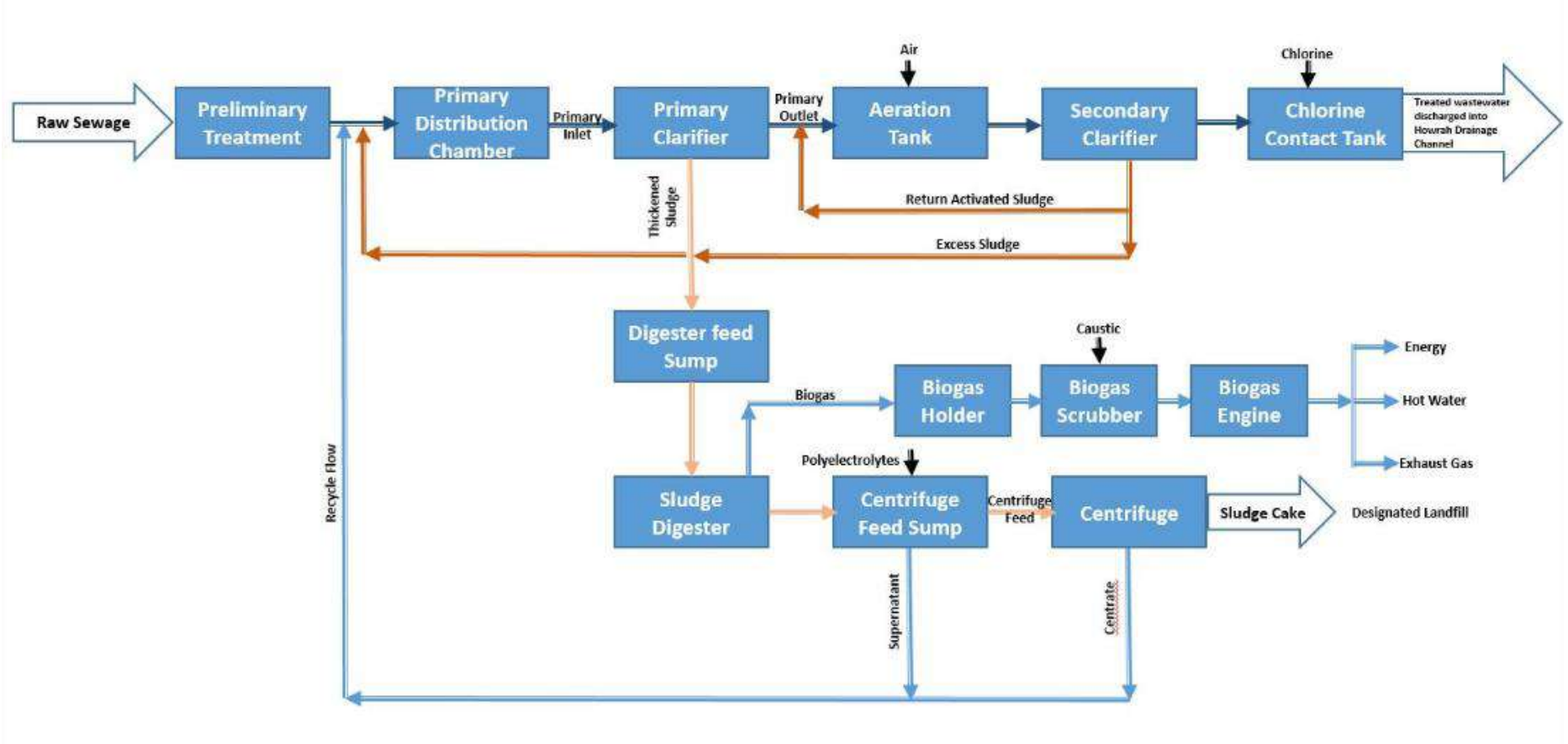
[4] Traceability: http://www.indiaenvironmentportal.org.in/files/file/Sewage%20Treatment%20Plants_2.pdf (last accessed on 24/03/2020)

[5] The refered Indian standard has not specified testing period for this BOD limit. In general, mostly other Indian standards for BOD limit are prescribed in terms of 5 days at 20ºC.

[6] http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php

[7] http://www.indiaenvironmentportal.org.in/files/file/Sewage%20Treatment%20Plants_2.pdf

Figure 2.15 Process Block Diagram of Proposed Bally STP



2.5.8 Outlet Pipeline

The treated water from the WSP is discharged into a Nala which is connected to the Pacha Khal and Howrah drainage channel. The same outlet will be used to discharge the treated sewage water from WSP. A new outlet point will be constructed to drain the treated sewage water from STP into the Pacha Khal and then into Howrah drainage channel.

2.6 Details of Plant Machinery

Details of all plant machinery and equipment have been attached in **Appendix B** in the Wabag Process Design Specifications document.

2.7 Resource Requirement

The resource required for the project are given below:

2.7.1 Land

Reportedly the land for the proposed STP is under the jurisdiction of the Kolkata Municipal Development Authority (KMDA). Along with STP land specification, the trunk sewer lines, effluent discharge lines are within the ROW of the public roads under the ownership of PWD (Government of West Bengal) and Municipal roads. The existing land of WSP is 20.13 ha. The area required for the construction of proposed STP is 1.85 ha and the construction will be doen by reclaiming land portion from one facultative pond as part of the existing WSP.

The renovation work at the MPS and LS will be done within the MPS and LS facility respectively, so no extra land will be required for proposed activity at MPS and LS. Temporarily 60 to 75 m^2 (30m of length and 2 to 2.5 m width) of land will be required for laying of new pipeline or raising main. There may be minor changes in the area requirement may change with the depth at which the new pipelines or raising main will be laid.

The land for the proposed STP and linked facilities belong to the KMDA and the same has been confirmed through a declaration provided to the WABAG. The Declaration further points out that there are no land ownership issue, disputes, grievances or court case raised against the land area of the STP and its linked facilities. Moreover, during execution of the project, if any requirement for land acquisition arises, this will be carried out as per the direction of the Government of West Bengal. The Declaration from KMDA is attached in the **Appendix C** for reference.

It is also to be noted that if any land required for construction back up area/ lay-down area for the construction equipments would be limited within the STP site boundary only.

2.7.2 Workforce

The existing workforce deployed at the Bally WSP and six Lift Stations and Main Pumping Station are engaged by KMDA through single contractor agency M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd. for operation and maintenance of sewage pumping station under Ganga Action Plan (GAP).

Based on the information shared by KMDA, there are total thirty-two (32) contracted workers are presently deployed and belongs to semi-skilled and un-skilled category workers. The present workforce of total 32 workers falls under age group ranging from 24 to maximum 59 years and there are total nine (9) worker are falling in the age bracket of 55 – 59 years. The service duration of the total existing workforce are ranging from minimum 3 years to maximum 26 years and with average 20 years.

Information related to the workforce planned to be deployed for the proposed project scenario was not made available by the Concessionaire at this ESIA stage. However reportedly, Concessionaire is in

discussion with KMDA to develop a reasonable re-engagement plan for the existing contracted workers in the project.

Reportedly, the man power requirement for the construction phase is approximately 100-150 workers, will be mobilized for the construction and civil work. These include unskilled, semi-skilled and skilled workers. Reportedly, 80% of the labour is expected to be sourced from outside the district and only 20% will be sourced locally.

The O&M and EPC contractor for the project i.e. M/s. VA Tech WABAG has a formalised Occupational Health, Safety and Environmental Policy endorsed by the Managing Director and Group CEO Mr. Rajiv Mittal. A copy of the Occupational Health, Safety and Environmental Policy is attached as an **Appendix A.**

2.7.3 Water

Water will be required for both construction and operational phase. The water requirement and utilization of water in both the phases is given below:

Construction Phase:

The water requirement during the construction phase will be about 50 KLD and would mainly be used for dust suppression and meeting drinking water requirements at the labour camp. The source of water during construction phase will be arranged by KMDA through the existing municipal water supply pipeline in the locality.The water requirement for this phase has not been estimated by concessionaire.

Operational Phase:

The source of water during operational phase will be arranged by KMDA through the existing municipal water supply pipeline in the locality.Water for routine operations will be required for Caustic Soda preparation, Scrubber operation and in Chlorination tank. The water will be also required for drinking purpose for the workers during the operational phase. The main source water is pipe water supply and the amount of required during this phase will be 0.5 KLD. Another 0.1 KLD of water will be required to maintain the present greenbelt within the facility.

2.7.4 Power

During construction phase of the project portable DG sets will be used as a common practice in India. During operational phase, existing grid will be used as the primary electricity source. Whereas, a back-up Diesel Generator (DG) set of 800 KVA will also be installed as standby for emergency purpose during the operational phase of the project. The capacity of biogas plant is to generate 800 kW of power. The power from bio-gas generation plant will also proposed to be utilized within the STP facility. The approximate expected total power consumption for the STP operation at design conditions will be 8,000 kWh/day. . The onsite biogas engine generates electricity from biogas produced in the STP. The electricity generated from biogas is used to meet the power demand of the STP to the extent possible.

When there is any shortfall in the generated power, grid power will be utilized to meet the shortfall. Standby DG set is only a provision and will be used in the case of power cut. It is expected that at design conditions, the STP will be self sufficient and the power demand can be met by the power generated by Onsite Biogas Engine alone.

2.7.5 Chemical Requirements

The required chemicals for the treatment of sewage water at the STP are Chlorine, Caustic Solution and Poly-electrolytes. Accounting for any hazardous property, the chemicals will be stored in a dedicated area, conforming to standard safeguards for storing and handling. More specific details of

onsite chemical storage area specification will be updated on completion of detailed design engineering for the proposed project.

2.7.5.1 Chlorine Gas

Chlorine gas shall be stored in form of chlorine tonner at dedicated chlorine storage room. The Chlorine as would be procured in the form of tonners and will be stored in the Chlorine Tonner room. A Chlorine leak neutralisation system will be provided to handle in case of any leakage of chlorine. All safety equipment as per regulatory requirements will be provided in the chlorination room (IS 10553 – Part I). The Chlorination room and Tonner room will be provided with adequate ventilation. At a time, 12 Chlorine tonner each of 900 kg capacity will be present at the site. Details of the Chlorination process in **Section 2.5.7.4** under **Disinfection and Disposal Section.**

2.7.5.2 Poly-electrolytes

Liquid Poly-electrolytes shall be used in the centrifuge system. Monthly requirement will be ~10 kg. Apart from these 6 months stock will be present at a chemical storage space within the STP complex.

2.7.5.3 Caustic Solution:

Caustic solution shall be used for neutralizing Chlorine gas at bio-gas scrubbers. The requirement of caustic solution is 10 KLD and this will be stored in a tank at the site. A HDPE lined pit of 300 litre capacity will be constructed at the site for safe disposal of caustic solution in case of leakage. More specific details of onsite chemical storage area specification can be updated on completion detailed design engineering for the project site.

2.8 Project Activity

2.8.1 Construction Phase

The construction activity will involve partial filling of two ponds (one Anaerobic pond and facultative pond),construction of new 40 MLD STP, rehabilitation of existing WSP, renovation of MPS facility, renovation and repairing of lifting stations, laying of gravity sewer line and raising main and desilting and rehabilitation of outfall points. The construction work will include excavation, pilling, backfilling etc. Construction work will also include desilting work of the existing gravity sewer line. At MPS and lifting stations, replacement and installation of pumps will also be carried out during construction phase.

2.8.2 Operation and Maintenance Phase

During Operation and Maintenance the sewage water from northern and western part of Howrah municipality will treated at the new STP as per the Central Pollution Control Board (CPCB) prescribed standard. Biogas and sludge will be generated from the treatment of sewage water. Biogas will be utilised in the bio-gas plant for power generation whereas the dry sludge cakes can be utilised for composting after dewatering of the sludge, though this aspect has not been considered in scope of work for O&M contractor as per Concession Agreement. The treated water will comply with effluent discharge standards set by CPCB and shall be discharged into the Howrah Drainage Channel.

2.9 Pollution Source and Control Measures

a) ***Air Emissions:*** Construction activities will generate emission of fugitive dust caused by on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to will lead to emission of fugitive dust. DG sets will be used during construction period which will generate exhaust gas. Biogas will be generated during the operation phase which may partially require to be flared under certain circumstances resulting in flare combustion products. In addition, STP's of the proposed configuration are expected to

emit Bio-aerosols (which may include microorganisms such as viruses, pathogenic bacteria, and fungi) during operations phase and may pose a health risk to STP workers and neighbouring communities.

Embedded Control Measures:

i. Sprinkler systems will be used to supress the fugitive dust emission during construction phase.

ii. The DG sets will be installed with emission standards in compliance with the CPCB guideline

iii. The concessionaire will ensure to maintain the stack height as per the CPCB guideline of H= h+0.2√capacity of DG sets in KVA where H is the total height of the stack in meters and h is the height of the building in meters where the DG set will be installed.

iv. Biogas-scrubber (s) will be used to remove the hydrogen sulphide (H_2S) traces present in the biogas generated during anaerobic digestion process

v. Appropriate flaring system will be installed to ensure efficient combustion of Bio-gas through flaring burners located 6 m above ground level.

vi. The quantification of health risks from bio-aerosols is difficult to predict and can be better characterised through monitoring (in terms of colony-forming units per unit volume of air (CFU/m3)) when the STP commences operations.

b) ***Noise Generation:*** During construction activities, noise and vibration will be caused by the operation of pile drivers, earthmoving and excavation equipment, concrete mixers, cranes and the transportation vehicle. During operations phase, noise will be generated from high noise equipment and machineries like hydraulic pumps, mixing pit pump, digester loading pump, HGV movement, material tipping, air blower and compressor.

Embedded Control Measures

i. Necessary noise control equipment such as mufflers will be provided to DG sets with Insertion loss of minimum 25 dB (A) to ensure ambient noise level.

ii. No construction activity will be done during night time to maintain ambient noise quality.

iii. Provision for noise enclosures or barriers for high noise machineries, equipment.

iv. Provision for green belt along boundary walls.

c) ***Wastewater Discharge:*** During Construction Phase, the only source of potential liquid discharge is the wastewater that is presently stored within the existing WSP. As the WSP is non-functional over two years, the stored waste water has more or less similar characteristics of rainwater, with possibility of some sediment organic material. It is unlikely that the stored waste water would have high pollution potential and it is unlikely that the stored water will be discharged to adjacent areas,or canal. During the operations phase, the STP will be treating sewage water and discharge into the Pacha Khal so that it doesn't cause significant adverse impact to the environment or surrounding community – in fact by discharging treated waste water, the STP is expected to result in a minor improvement of the existing water quality of the receiving surface water stream, the Pacha Khal. The treated sewage water from the proposed 60 MLD STP operation will be discharged into adjacent canal maintaining the stipulated regulatory limits set for STP operation under Environment (Protection) Amendment Rules, 2017 by Ministry of Environment, Forests and Climate Change, Government of India and stipulated qualitative discharge characteristics as under the Concession Agreement.

d) ***Waste Generated :*** Waste will be generated during construction phase activities i.e. packaging materials, cement bags, ready mix concrete discards, excavated materials, empty barrels

etc.These waste can be hazardous and non-hazardous in nature and are categorized as Construction and Demolition (C&D) wastes governed by Construction and Demolition Waste Rules, 2016 for the proposed project site and linked faculties.

During operation phase, periodic maintenance of the sewer line will generate de-silted sludge. De-watered sludge will be generated due to treatment of sewage water. Solid wastes from grit chambers and screens will be generatd at the pumping stations and STP. Used oil and grease and cotton waste (contaminated with oil) generated from maintenance activities at the LS, PS and STP equipment are the sources of hazardous wastes during operation phase.

All non hazardous solid wastes generated will be stored temporarily at respective location and then disposed to designated landfill sites assigned by KMDA as per Concession Agreement.

Approximately 5m3/day quantity of grit will be generated during operation of the proposed Arupara STP. The estimated quantity of used oil generation due to maintenance of the mechanical equipment at the STP will be available at a later stage after equipment finalization.

Embedded Control Measures

i. As reported the C&D waste generated during the construction activities will be stored separately at a designated area within the STP complex.

ii. The concessionaire will reuse a portion of the waste for backfilling activities, to the extent required.

iii. The concessionaire will dispose the other solid wastes at a designated landfill site of KMDA near the STP in conformance to the Construction and Demolition (C&D) Waste Management Rules, 2016.

iv. The Residual Grit, the Screenings and silt will be disposed at the relevant Waste Disposal Site to be identified by the KMDA within a radius of 10 km from the relevant Site, in accordance with the Technical Specifications.

v. The sludge generated from the sewage water treatment will be used for the bio-gas generation and composting (end-use).

e) ***Hazardous Waste:*** Construction activities may result in the potential for generation of petroleum based wastes, such as used oil including lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. Quantity of the used oil generation due to periodic maintenance of the equipment during the STP operational phase will be estimated at a later stage after equipment finalization.

Control Measures:

i. Making arrangement for proper segregation, storage and disposal of such wastes;

ii. Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids,

iii. Using impervious surfaces for refuelling areas and other fluid transfer areas

iv. Providing portable spill containment and clean-up equipment on site and training in the equipment deployment

v. Training workers on the correct transfer and handling of fuels and chemicals and the response to spills

2.10 Project Schedule

The project schedule is given in **Table 2.3**.

Table 2.4: Project Schedule for Bally STP Project

Activities/Month	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Basic Engineering																														
Detailed Engineering																														
Order Placement																														
Manufacturing & Supply																														
Mobilization at Site																														
Information Disclosure																														
Stakeholder Engagement & Grievance Redressal																														
Civil Work (Construction)																														
Erection Work																														
Final Documentation																														
Commissioning and Trail Run																														

2.11 Project Cost

The total cost for STP in Kamarhati and Barangay municipality is Rs. 164.93 crores which includes total capital cost of 90.07 crores and 74.86 crores for 15 years O&M under Hybrid Annuity based on PPP mode.

3. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This section highlights only the relevant environmental and social policies and regulations, IFC guidelines, which are applicable for this project.

- Applicable national and state-specific EHS and Social regulations in India;
- IFC Performance Standards on Social and Environmental Sustainability, 2012 along with IFC General EHS Guidelines (2007) and Industry Sector Guidelines: Water and Sanitation, (10 December 2007);
- National Mission for Clean Ganga Environmental and Social Management Framework for Navami Gange Program
- Gender Equity Theme (GEN)
  - Gender equality and women's empowerment (GEWE) as explicit project outcome (on top of outputs) e.g., Gender-focused education project, microfinance
- Effective Gender Mainstreaming (EGM)
  - GEWE substantially integrated in outputs during but not explicit outcome (e.g., gender-responsive infrastructure designs)
- Some Gender Elements (SGE)
  - A few proactive gender designs (but not as strong as EGM)
  - Gender-related mitigation/safeguards alone not sufficient for SGE
- No Gender Elements (NGE)
  - No proactive gender designs
  - Gender-related mitigation/safeguards still requirement

3.1 Environment, Health and Safety-related Regulations, Guidelines and Rules in India

The applicable regulations in the context of the project are presented in below table:

Table 3.1: Applicability of Environment, Social, Health and Safety (ESHS) Regulatory Regime

National Legislations	Applicability
■ Prior **environmental clearance** from the concerned regulatory authority for 39 types of projects as stipulated under Schedule of **EIA Notification, 2006** under Rule 5 of the **Environment (Protection) Rules, 1986** and covers aspects like screening, scoping and evaluation of the upcoming project. The main purpose is to assess impact of the planned project on the environment and people and to try to abate/minimise the same.	Not Applicable The proposed project activity involving renovation and installation of sewage treatment plant and linked sewerage infrastructure which does not fall under ambit of EIA Notification, 2006 as amended and therefore does not require Environmental Clearance.
■ As per requirement of the **Water** (**Prevention & Control of Pollution**) **Act, 1974** (the Water Act); **Air** (**Prevention & Control of Pollution**) **Act,**	Applicable

<table>
<tr><th>National Legislations</th><th>Applicability</th></tr>
<tr><td>1981 (the Air Act) it is mandatory to obtain Consent to Establish (CTE/NOC) from respective State Pollution Control Board before commencement of the construction activities on the site and to obtain a Consent to Operate (CTO) from the State Pollution Control Board before initiation of the any commercial operations at the facility.</td><td>The proposed project activity would involve diversion and reduction in capacity of existing 30MLD WSP to 22 MLD followed by construction as well as operation and maintenance (O&M) of a newly constructed 40 MLD STP along with 22 MLD WSP. During the construction phase wastewater generated from activities i.e. mixing of concrete, washing of equipment, waste water from dust suppression etc.will be discharged, and during O&M phase treated sewage water will be discharged into existing drainage channel i.e.Howrah Drainage Channel through pacha khal. As per the regulatory requirements, obtaining CTE/NOC from West Bengal Pollution Control Board (WBPCB) will be mandatory before initiation of any site work and the CTO from WBPCB will be mandatory prior initiation of operations.</td></tr>
<tr><td>■ As per Environment (Protection) Act, 1986, (Section 6) and Environment (Protection) Rules, 1986. Project Proponent is required to ensure all pollutant emissions and effluents discharge during different phases of the project must comply with notified environmental standards;
■ Effluent discharge standards for Sewage Treatment Plants stipulated under Environment (Protection) Amendment Rules, 2017.</td><td>Applicable

The proposed project has two phases, construction and O&M of 40 MLD STP along with renovation of existing linked sewerage infrastructure i.e. LS, MPS and Sewer network and operation of STP. The project is envisaged to generate dusts, fumes, gaseous emissions, bio-aerosols, bio-solids, solid and hazardous wastes, noise emissions during both construction and operation of the project. Thus, as per regulatory requirement, these potential pollution sources shall require to be maintained within emissions and discharge norms set out by the regulatory authority.
Effluent discharge standards for the sewage treatment plants as stipulated under Environment (Protection) Amendment Rules, 2017:
<table>
<tr><th>Parameter</th><th>Concentration not to exceed</th></tr>
<tr><td>pH</td><td>6.5 – 9.0</td></tr>
<tr><td>Biochemical Oxygen Demand (BOD) (mg/l)</td><td>20</td></tr>
<tr><td>Chemical Oxygen Demand (COD) (mg/l)</td><td>No limit</td></tr>
<tr><td>Total Suspended Solids (TSS) (mg/l)</td><td><50</td></tr>
<tr><td>Total Nitrogen (mg/l)</td><td>No limit</td></tr>
</table></td></tr>
</table>

National Legislations	Applicability
	Ammonical Nitrogen (mg/l) — No limit Total Phosphorous (mg/l) — No limit Faecal Coliform (FC) (MPN/100ml) — <1000
■ As per **Environment** (**Protection**) **Act, 1986**, (Section 5) and **West Bengal Ground Water Resources** (**Management, Control & Regulation**) **Act,** 2005 and Amendment Act 2015. No Objection Certificate for groundwater abstraction through mechanical devices for industrial purpose from District Level Ground Water Resources Development Authority (State Water Investigation Directorate).	Not Applicable. As reported water requirement for both construction and operation phase will be sourced from Municipal supply water
■ As per **Solid Waste Management Rules 2016,** waste generator need to segregate and store waste as three separate streams i.e. bio-degradable, non-bio-degradable and domestic hazardous waste and dispose them through approved vendors of West Bengal State Pollution Control Board.	Applicable The proposed project is envisaged to generate different categories of non-hazardous wastes such as packaging waste, metal scrap, solid wastes mainly plastics, cardboards, miscellaneous grits screened at MPS and LS both during construction and operational phase. As per regulatory requirement these wastes have to be segregated and stored as per three specified streams and disposed through vendors approved by West Bengal Pollution Control Board.
■ As per **Construction and Demolition Waste Management Rules, 2016** (Section 4), The waste generator shall prima-facie be responsible for collection, segregation and disposal C&D wastes separately as directed or notified by the concerned local authority and the waste generator who generate more than 20 tons or more in one day or 300 tons per project in a month is required to submit waste management plan and get appropriate approvals from the local authority before commencement of construction or demolition or remodelling work.	Applicable The proposed project activity is envisaged to generate construction i.e. Asphaltic concrete paving, Concrete, Concrete reinforcing steel, Brick, Concrete masonry units, etc., during construction of the STP and renovation of the linked sewerage infrastructure. Thus the provision of this regulation will be applicable for the project.
■ As per **Gas Cylinder Rules,2004** Chlorine tonners are classified as Compressed gas any permanent gas, liquefiable gas or gas dissolved in liquid under pressure or gas mixture which in a closed gas cylinder exercises a pressure either exceeding 2.5 kgf/cm2 abs (1.5 kgf/cm2 gauge) at +150 C or a pressure exceeding 3kgf/cm2 abs (2	Applicable The proposed project involves chlorination for disinfection of treated water and the operational phase of the project will involve storage of chlorine tonners within the STP facility.

National Legislations	Applicability
kgf/cm2 gauge) at ≠500 C or both; Explanation – Hydrogen Fluoride falls within the scope of compressed gas although its vapour pressure at 500 C is 1.7 to 1.8 atmospheric gauge;	
■ As per **E-Waste Management Rules , 2016** and Amendment 2018, used for channelization of e-waste from 'end-of-life' products from generator to authorised dismantler or recycler having Authorisation.	Applicable The proposed project will generate electronic wastes i.e. discarded circuit boards, PLC units, during renovation of linked LS and MPS, where all electrical and electronic equipment will be replaced as per Scope of Work for the Concessionaire. Thus, this rule gets triggered and these waste need to be stored separately and disposed through West Bengal Pollution Control Board authorized dismantler or recycler.
■ As per the requirements of the **Hazardous and Other Wastes** (**Management and Transboundary Movement**) **Rules, 2016** (HWR, 2016), any facility which generates, storages, handles, and disposes any type of hazardous wastes listed in Schedule-I of the said Rules, is required to obtain a hazardous waste authorization (HWA) from the State Pollution Control Board.	Applicable The proposed project is envisaged to involve generation and handling of hazardous wastes (used oil, empty chemical containers, used oil containers, fluorescent light tubes, etc.) during renovation of linked facilities and during construction phase as well as in the operation phase of STP. Thus the provision of this regulation will be applicable for the project activity. The Concessionaire has to maintain the hazardous waste storage, handling and disposal requirements as per the regulatory requirements and to obtain HWA from West Bengal Pollution Control Board prior commencement of the project operation.
■ As per **Manufacture, Storage and Import of Hazardous Chemicals Rules 1989, amended 1994 and 2000** (the Rules provide indicative criteria for hazardous chemicals and require occupiers to identify major accident hazards and prepare on-site and offsite emergency plans).	Applicable The proposed project would involve chlorination for disinfection of treated water and the operational phase of the project will involve storage of chlorine tonners at the STP facility. Chlorine is categorized as hazardous chemical under Schedule 1 Part II and Schedule 2 of Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (MSIHC Rules, 1989). Therefore the relevant provision of the MSIHC Rules will be applicable for the proposed project activity and with special emphasis on the specific criteria (isolated storage, approval and notification of Site, safety reports, on-site emergency plan) if the storage quantity of chlorine is equal to or more than the threshold

National Legislations	Applicability
	quantity for Chlorine as specified in the Column 3 (10 tonnes) and Column 4 (25 tonnes) of Schedule 2 of the MSIHC Rules, 1989.
■ As per **Public Liability Insurance Act, 1991 and rules thereunder,** any facility involved in handling, storage and transportation of hazardous chemical listed under EPA, 1986 shall issue an insurance policy which is applicable if any incident happens during handling of hazardous chemicals.	Applicable The operation and maintenance of the proposed project facility is envisaged to involve generation and handling of hazardous and non-hazardous wastes (used oil, empty chemical containers, empty chlorine tonners, high sulphur content sludge from Biogas scrubber etc.) as well as hazardous chemical as storage of chlorine tonners for chlorine based disinfection process for treated water. As per MSIHC Rules, 1989 chlorine is classified as hazardous chemicals. Thus this act and its rules are applicable as hazardous chemical handling and storage is involved.
■ As per **Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010** *(*the Rule lays down general safety requirements pertaining to construction, installation, protection, operation and maintenance of electric supply and apparatus).	Applicable The proposed project activity would involve installation and operation of medium to high voltage electrical installations (transformers, pumps, DG sets, panels etc.) at the existing LS and MPS as well as in the proposed 40 MLD STP facility. Therefore the relevant regulatory provisions as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 will be applicable for the project activity.
■ The **Factories Act, 1948** and the **West Bengal Factories Rules,1958** thereunder, (the Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours and rendering information-regarding accidents or dangerous occurrences to designated authorities.	Applicable The proposed project's major activity would entail pumping of sewage and within premise of the facility ten or more workers will be working, on any day and in any part of which a manufacturing process (pumping of sewage) is being carried on with the aid of power. Thus the provision of the Factories Act, 1948 and West Bengal Factories Rules, 1958 will be applicable for the proposed project activity.
■ As per **West Bengal Fire Service Act of 1950** and the **West Bengal Fire Services (Fire License) Rules, 2004** (Outlines legally bindings requirements to ensure that the buildings are built and maintained with adequate safeguards to prevent the occurrence of Fire or to contain Fire occurring in a high risk building as defined under	Applicable, only if the project building to be greater than 14.5 meters in height and buildings as notified in Notification No. 279/DS/FS/0/C-1/FIA-3196 Dated 8th July, 2003 or involves storage of hazardous substances (chlorine tonners) as specified under rule 3 and Schedule I of West Bengal Fire Services (Fire License) Rules, 2004.

National Legislations	Applicability
section 2(hb) of the West Bengal Fire Services Act, 1950.)	
■ As per **West Bengal Trees** (**Protection and Conservation in Non-Forest Areas**) **Act, 2006**, permission from the Divisional Forest Officer (Utilization Division), Forest Directorate, Government of West Bengal will be required to cut trees for construction. The applicant will also be responsible for plantation of trees (5 times the number of trees to be cut) within the premises.	Not applicable The proposed project activity along the sewage network has no full grown trees, but the proposed STP location has significant green cover and full grown trees, as per KMDA and concessionaire these trees will not be uprooted for the new STP. thus, this regulation is not applicable for this project location for now.If tree felling scenario comes up in later stage then this regulation is applicable and the concessionaire along with KMDA have to take up mandatory regulatory provisions under this national regulation.

Note:

In view of attaining control on the current pollution status of Indian rivers and depletion of aquatic resources, the National Green Tribunal (NGT), Government of India vide their Order dated 30 April 2019 (Original Application No. 1069/2018 (M.A. No. 1792/2018, M.A. No. 1793/2018, I.A. No. 150/2019 & I.A. No. 151/2019)) has emphasised that there is a need of revised effluent discharge standards for STPs. Therefore, based on the recommendation report from the Expert Committee (comprising the nominees from IIT Kanpur, IIT Roorkee, NEERI and CPCB) on the matter, NGT has endorsed the proposed revised discharge standards for STPs, which will apply not only for new STPs but also for existing/ under construction STPs without any delay[8].

Accordingly, NGT has directed Ministry of Environment, Forests & Climate Change (Government of India), which may issue an appropriate Notification in the matter within one month from the date of the concerned NGT Order dated 30 April 2019. The further Notification on any revised effluent discharge standards for STPs is awaited from Ministry of Environment, Forests & Climate Change as on February 2020.

In case the revised effluent discharge standards for STPs as per NGT order come into effect through official gazetted notification from the Ministry of Environment, Forests & Climate Change (Government of India), the Concessionaire needs to take up the matter with KMDA for augmenting the project treatment design and scheme to comply with the new regulatory discharge limit.

3.2 Social related Legislation in India

The major regulation that are applicable for the project life cycle is provided below:

Table 3.2: Applicability of Social Regulatory Regime

National Legislations	Applicability
■ The Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation and Resettlement Act, 2013 (provides for a transparent	Not Applicable The proposed project does not involve any land acquisition, as the proposed activity will be

[8] http://www.indiaenvironmentportal.org.in/files/file/revised-standards-STPs-NGT-Order.pdf

National Legislations	Applicability
process and just and fair compensation to the affected families whose land is acquired or proposed to be acquired or are affected by such acquisition and provides for rehabilitation and resettlement of the affected families.)	implemented within the boundary of existing facility. However economic displacement and temporary resettlement due to renovation activity within the existing ROW will be governed through IFC PS 5. Moreover, it may be noted that in 2014, the Government of West Bengal (GoWB) issued a memorandum allowing all state government departments to go in for direct (negotiated) purchase of land for public purpose, mainly involving commissioning of infrastructure projects. [9]
■ The West Bengal Estates Acquisition Act, 1953 and the West Bengal Land Reforms Act of 1955 and amendments ■ (Outlines land-related laws of the State regulating land holding (ceiling) for various purposes including change in character and ownership and use of the land and the right of the sharecroppers.)	Not Applicable No specific provisions in the Acts that will have a direct bearing on envisaged temporary involuntary resettlement under the Project.
■ Contract Labour (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);	Applicable The proposed project activity will engage contractual workers during the construction phase as well as during the operations and maintenance (O &M) phase of the project. Thus under this act registration for license is necessary before employing workers for any project related activity.
■ Payment of Wages Act, 1936 and the West Bengal Payment of Wages Rules, 1958 thereunder (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers[10]).	Applicable As per section 1(4) and 2(ii) (g) of the Payment of Wages Act, 1936, the Act applies to persons employed in establishments in which any work relating to the construction, development or maintenance of buildings, roads, bridges or canals, or relating to operation connected with navigation, irrigation, development or maintenance of buildings, roads, bridges or mission and distribution of electricity or any other form of power is being carried on. This Act is applicable because the project activities will include construction and operation of the STP. Moreover, during the operation phase, a major activity is pumping of sewage which is considered a

[9] Memorandum No. 3145-LP/1A-03/14 dated 24 November, 2014. It provides for constitution of a Purchase Committee, process of determination of value of land, buildings, and structures. It provides an incentive on the price of land finally determined if land registration is accomplished within defined time frames. GoWB has also exempted the stamp duty for such purchase of land.

[10] As of 2nd August, 2019, the Code on Wages, 2019 has been enacted which subsumes the Payment of Wages Act, 1936, the Minimum Wages Act, 1948, the Payment of Bonus Act, 1965 and the Equal Remuneration Act, 1976. However, this is subject to the adoption of the Act by the Government of West Bengal.

National Legislations	Applicability
	manufacturing process and will be carried out with the aid of power.
■ **Minimum Wages Act, 1948 and Minimum Wages Rules, 1950** thereunder (The Minimum Wages Act, 1948 Act applies to persons employed in a factory where scheduled employment is carried out. Schedule employment includes manufacturing processes, the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act). (Refer Footnote 10)	Applicable The proposed project's major activity is pumping of sewage and within premise of the facility ten or more workers will be working, on any day and in any part of which is being carried on with the aid of power. This qualifies as a manufacturing process (under Factories Act). The proposed project activity will engage contractual workers during the construction phase as well as during the operations and maintenance (O&M) phase of the project. Thus the regulatory provision under *Minimum Wages Act, 1948* will be applicable for the proposed project related activity.
■ **Employees'State Insurance Act, 1948** *(*The ESI scheme governed by the Act is a self-financed comprehensive social security scheme devised to protect the employees covered under the scheme against financial distress arising out of events of sickness, disablement or death due to employment injuries. The ESI scheme is applicable to all factories and other establishments as defined in the Act with 10 or more persons employed in such establishment and the beneficiaries'monthly wage does not exceed Rs 21,000 are covered under the scheme.*)*	Applicable The proposed project's major activity is pumping of sewage and within premise of the facility ten or more workers will be working, on any day and in any part of which is being carried on with the aid of power. This qualifies as a manufacturing process (under Factories Act). The proposed project activity will engage contractual workers during the construction phase as well as during the operations and maintenance (O&M) phase of the project. Thus the regulatory provision under *Employees'State Insurance Act, 1948* will be applicable for the proposed project related activity.
■ **Employees Provident and Miscellaneous Provisions Act, 1952** and amendments thereafter (As per section 2 *(*a*)* of the Employees Provident and Miscellaneous Provisions Act, 1952, the Act applies to every establishment which is a factory engaged in any industry specified in Schedule 1 and in which twenty or more persons are employed.)	Applicable The proposed project's major activity is pumping of sewage and within premise of the facility ten or more workers will be working, on any day and in any part of which is being carried on with the aid of power. This qualifies as a manufacturing process (under Factories Act). The proposed project activity will engage contractual workers during the construction phase as well as during the operations and maintenance (O&M) phase of the project. Thus the regulatory provision under *Employees Provident and Miscellaneous Provisions Act, 1952* will be applicable for the proposed project related activity.
■ **Workmen's Compensation Act, 1923** (the Act provides for compensation in case of injury by accident arising out of and during the course of employment).	Applicable As per Section 2 (n) of the Workmen's Compensation Act 1923 applies to workman employed in work related to a manufacturing process as defined in section 2 (k) of the *Factories Act, 1948* which includes pumping of sewage, as well as where electrical power is generated.

National Legislations	Applicability
	The Act is thus applicable as the Concessionaire will employ workmen in facilities where pumping of sewage will take place and where electrical power will be generated.
■ **Building and Other Construction Workers** (**Regulation of Employment and Conditions of Service**) **Act, 1996** and the **Cess Act of 1996** (all the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act; the employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for Workers near the workplace, etc.).	Applicable The provision of this Act is applicable for the proposed project activity, as the Concessionaire supposedly will be engaging more than ten construction workers during the construction phase of the project.
■ **Inter-State Migrant Workmen's** (**Regulation of Employment and Conditions of Service**) **Act, 1979** (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home to the establishment and back, etc.).	Applicable, only if five or more inter- State migrant workmen to be hired from outside the state of West Bengal.
■ **The Child Labour** (**Prohibition and Regulation**) **Act, 1986** (This Act prohibits engagement of children in certain employments and regulates the conditions of work of children in other certain employments)	This act specifies that no child below the age of fourteen years shall be employed to work in any factory or employed in any hazardous work. The act It aims to regulate the hours and the working conditions of child workers and to prohibit child workers from being employed in hazardous industries.
■ The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013	This Act seeks to protect women from sexual harassment at their place of work.
■ National Policy on Corporate Social Responsibility 2013 ■ This act-CSR has been recently notified in section 135 of the Companies Act 2013 by the Ministry of Corporate Affairs, Government of India.	Under sub-section 1 of the section 135, the Act mandates companies with a net worth of INR. 500 crore or more, or a turnover of 1000 crore or more or a Net Profit of INR 5 Crore or more shall be covered within the ambit of CSR provisions

3.2.1 National Mission for Clean Ganga Environmental and Social Management Framework for Navami Gange Program

The ESMF, an umbrella document for management of environmental and social issues of the river pollution mitigation projects has been developed under the National Ganga River Project (NGRBP). The ESMF has broadly categorised the projects based on the location, size and nature of the project activities that will have a varying impacts on environment. To facilitate effective screening, the portfolio of projects to be implemented under NGRBP, have been grouped into the following two

categories, based on the severity of its potential impacts, regulatory requirements of Government of India (GoI) as well as State Governments apart from the safeguard requirements of the World Bank:

- Category I – Sub-Projects requiring Environmental and Social Assessment and development of RAP (Category A as per OP 4.01 of The World Bank)
- Category II – Sub-Projects requiring implementation of safeguard management plans (Category B, as per OP 4.01 of The World Bank)

As per the ESMF categorisation, the proposed project in Baranagar falls under category II. Thus the project required an analysis of environmental and social issues and management measures shall be implemented to mitigate the temporary impacts, mostly anticipated during the construction phase of the project.

The framework also recognises the rights of both the titleholder and non-tittle holders eligible for compensation.

3.3 Lenders' Environmental and Social Safeguard Standards

IFC Performance Standards (2012)

As per IFC's Sustainability Framework, 2012, all investments and advisory clients whose projects go through IFC's initial credit review process after January 1, 2012 is required to comply with IFC's Environmental and Social Performance Standards for managing their environmental and social risks. IFC's Performance Standards offer a framework for understanding and managing environmental and social risks for high profile, complex, international or potentially high impact project. The IFC Performance Standards help IFC and its clients manage and improve their environmental and social performance through an outcomes-based approach and also provide a solid base from which clients may increase the sustainability of their business operations. IFC's Performance Standards sets out the policy objectives, scope, risk management and principles for eight key Environmental and Social Sustainability areas:

a) Risk Management,
b) Labour,
c) Resource Efficiency,
d) Community,
e) Land Resettlement,
f) Biodiversity,
g) Indigenous People, and
h) Cultural Heritage.

IFC General EHS Guidelines (2007) and Industry Sector Guidelines: Water and Sanitation, (10 December 2007)

The IFC Environmental, Health and Safety Guidelines for Water and Sanitation is a technical reference document with general and industry- specific examples of Good International Industry Practice (GIIP). This document contains relevant information pertaining to the operation and maintenance of (i) potable water treatment and distribution systems, and (ii) collection of sewage in centralized systems, such as piped sewer collection networks or decentralised systems, and treatment of collected sewage at centralised facilities.

3.4 Reference Framework and their Applicability

Based on the review of Project facility and the corresponding operational details, the following IFC Performance Standards (2012) is found to be applicable to the Project in the current scenario:

Table 3.3: IFC Performance Standards

IFC PS	Description	Applicability to the Project
PS 1	**Assessment and Management of Environmental and Social Risks and Impacts** [*This PS aims to assesses the existing social and environmental management systems and to identify the gaps with respect to their functioning, existence and implementation of an environmental and social management plan* (*ESMP*)*, a defined EHS Policy, organization chart with defined roles and responsibilities, risk identification and management procedures as well as processes like stakeholder engagement and grievance management*]	Applicable Considering the proposed project activity being implementation and operation of public utility development project (sewage treatment plant and linked sewerage infrastructure) it is essential to have a defined mechanism towards assessment and management of linked environmental and social risks and impacts. Thus ensuring compliance with PS 1 will be applicable for the Project.
PS 2	**Labour and Working Conditions** [*This PS is guided by a number of international conventions and instruments on labour and workers*' *rights*. *It recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of fundamental rights of workers*. *The PS covers following themes*: *human resource policy and management, workers*' *organization, non-discrimination and equal opportunity, retrenchment, protecting the workforce and occupational health and safety*. *The requirement set out in this PS have been in part guided by a number of international conventions and instruments*.]	Applicable Considering the proposed project activity involving renovation, capacity addition, operation and maintenance of the municipal sewerage treatment plant and the linked sewerage infrastructure, the Concessionaire and the EPC and OM contractor deputed thereunder will be deploying own and subcontracted workforce at the project site during construction and operation of the project. Wherein the labour and working conditions needs to be ensured by the Concessionaire. Thus ensuring compliance with PS 2 will be applicable for the Project.
PS 3	**Resource Efficiency and Pollution Prevention** *[This PS-3 focuses on increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also*	Applicable The proposed project activity involves overall environmental improvement context through renovation and capacity addition of the municipal sewerage treatment plant and the linked sewerage infrastructure to reduce release of untreated sewage to river Ganga to ensure effective abatement of pollution and conservation of the river Ganga and its tributaries.

IFC PS	Description	Applicability to the Project
	a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention2 and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world.]	Therefore no permanent and adverse environmental impact is envisaged due to implementation of the project activity. However, being the developmental project temporary environmental pollution is envisaged during construction and operation of the sewage treatment plant and the linked auxiliary system. Thus ensuring compliance with PS 3 will be applicable for the Project.
PS 4	**Community Health, Safety and Security** [*This PS-4 requires due diligence to anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances. It also requires to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected Communities. Key areas of compliance screened under PS-4 includes: infrastructure/equipment safety, hazardous material safety, natural resource issues, exposure to disease, emergency preparedness and response, and security personnel requirements*.]	Applicable The proposed STP is located at Bally municipality area. The linked sewage infrastructures are spread across densely populated municipal area of North Eastern HMC. Both construction and operational phase of the project may involve surrounding community health, safety and security context related to fugitive emissions, faecal coliform contamination, pathogen exposure, odour nuisance, accidental chlorine gas leakage from chlorine tonner storage and risks posed by its security arrangements. Thus ensuring compliance with PS 4 will be applicable for the project activity.
PS 5	**Land Acquisition and Involuntary Resettlement** [*PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use*. *The key themes covered under this are*: *compensation and benefits for displaced persons, consultation and grievance mechanism, resettlement planning and implementation, physical displacement, economic displacement*. *The PS-5 also prescribes private sector responsibility to supplement government actions and bridge the gap between governments assigned entitlements and procedures and the requirements of PS-5*.]	Applicable The proposed project scenario does not involve land acquisition. However, the Site reconnaissance activity during the current due diligence process revealed that though no physical displacement will take place during project implementation, there is potential for economic displacement in the form of temporary income loss for roadside vendors and kiosks, during the replacement of the sewer pipelines. The construction of the new STP facility will potentially trigger Income loss for fishermen undertaken fishing inside the WSP ponds. Therefore, ensuring compliance with PS 5 will be applicable for the Project.

IFC PS	Description	Applicability to the Project
PS 6	**Biodiversity Conservation and Sustainable Management of Living Natural Resources** [*The requirements of this Performance Standard are applied to Project* **(***i***)** *located in modified, natural, and critical habitats;* **(***ii***)** *that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or* **(***iii***)** *that include the production of living natural resources* **(***e.g., Agriculture, animal husbandry, fisheries, forestry***).** *PS-6 screens relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution. The key themes covered under PS-6 are: natural habitat, critical habitat, legally protected areas, international introduction of alien species, and living natural resources* **(***natural and plantation forest, aquatic resources etc.***)** *are sustainably managed.*]	Not Applicable It is understood based on the site reconnaissance that the existing project STP facility and associate sewerage infrastructure are located in the semi-urban and urban area and does not interfere with any ecologically sensitive and protected areas. The project location does not also involve presence any full grown trees to be impacted during development of new 40 MLD STP. Therefore the proposed project scenario is not envisaged to have any adverse impact on the local biodiversity. Hence, ensuring compliance with PS 6 is not applicable for the project.
PS 7	**Indigenous Peoples** [*This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., Whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein? PS-7 endeavour to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. Key themes covered under PS-7 are: avoidance of adverse impacts, consultation and informed participation, impacts on traditional or customary lands under use, relocation of IPs from traditional or customary lands, and cultural resources.*]	Not Applicable This Performance Standard is not applicable because the project area does not fall under Schedule V and VI areas as defined by the Indian Constitution. Moreover, as per census data the Scheduled Caste and Scheduled Tribe population in HMC only constitutes for 0.3% of the overall population and are a part of the mainstream population. Based on the information provided, the project does not trigger any impact on traditional land, ancestral domain or critical cultural heritage of any communities that are identified as Indigenous Peoples. Thus ensuring compliance with PS 7 will not be applicable for the Project.
PS 8	**Cultural Heritage**	Not Applicable

IFC PS	Description	Applicability to the Project
	[*For the purposes of PS-8, cultural heritage refers to* (*i*) *tangible forms of cultural heritage;* (*ii*) *unique natural features or tangible objects that embody cultural values; and* (*iii*) *certain instances of intangible forms of culture that are proposed to be used for commercial purposes*. *The requirements of PS-8 apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed*.]	Review of Google Earth Map and based on the site reconnaissance of the Plant locations did not point towards the presence of any significant cultural heritage site within the vicinity of Project facility as well as the ROW of the linked sewerage infrastructure. Thus ensuring compliance with PS 8 will not be applicable for the Project.

3.4.1 World Bank Group EHS Guidelines and Industry Sector Guidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative. Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility. Capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. Applicability of EHS General Guidelines has been discussed in **Table 3.5** below.

Table 3.4: IFC EHS General Guidelines

Guideline Aspect	Description	Applicability
Air Emissions	This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards.	Applicable and has been detailed out in Section 4.2.6, 5.4.2 and Table 9.1
Energy Conservation	This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps, and fans; compressed air systems and heating, ventilation and air conditioning systems (HVAC); and lighting systems	Applicable and has been detailed out in Section 2.5.5.6
Wastewater and Ambient Water Quality	This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment. This guideline is meant to be complemented by the industry-specific effluent guidelines presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or storm water should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.	Applicable. Ambient water quality has detailed out in Section 4.2.9, 4.2.11, 5.4.5, 5.4.6 and Table 2.3.
Hazardous Materials Management	These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazmats can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; Radioactive material; and corrosive substances.	Applicable and has been detailed out in Section 2.8.5 and Section 2.5.5.4
Waste Management	These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors	Applicable and has been detailed out in Section 2.10 (c, d & e)
Noise	Addresses impacts of noise beyond the property boundary of the facilities	Applicable and has been detailed out in Section 4.2.7 and Section 5.4.3.
Contaminated Land	Management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances. Releases of these materials may be the result	Not-Applicable It is not applicable since the

Guideline Aspect	Description	Applicability
	of historic or current site activities, including, but not limited to, accidents during their handling and storage, or due to their poor management or disposal	wastewater treatment process does not generate any material/ waste that can be categorized as hazardous per the relevant regulatory requirement.
Occupational Health and Safety	Provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction activities.	Applicable and has been detailed out in Section 5.4.13

The EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of collection of sewage in centralized systems (such as piped sewer collection networks) or decentralized systems (such as septic tanks subsequently serviced by pump trucks) and treatment of collected sewage at centralized facilities. The Sanitation sectoral guideline outlines measures to minimize potential community health risks can be implemented both in the collection and treatment of wastewater and sludge. Applicability of EHS Guidelines for Water and Sanitation has been discussed in **Table 3.6** below.

Table 3.5: IFC EHS Guidelines for Water and Sanitation

Sanitation	Description	Applicability to the Project
Liquid Effluents	Treated wastewater effluents are typically discharged to surface water or re-used for irrigation or other purposes. In many cases, direct or indirect human contact with treated wastewater is likely. Therefore, adequate wastewater treatment to remove contaminants and, especially, microorganisms and pathogens, is important not only to prevent adverse environmental impacts, but to protect public health as well.	Applicable
Air Emissions and Odours	Odours from wastewater treatment facilities can be a nuisance to the neighbouring community. Bio aerosols can also carry disease-causing microorganisms. Furthermore, releases of hazardous gases, such as chlorine, could adversely affect nearby residents. The following measures are recommended to prevent, minimize, and control community exposure to dust and odours from waste management facilities: - Provide adequate buffer area, such as trees, or fences, between processing areas and potential receptors; - Avoid siting facilities near densely populated neighbourhoods and installations with potentially sensitive receptors, such as hospitals and schools. Site facilities downwind from potential receptors, if possible.	Applicable
Physical Hazards	Visitors and trespassers at wastewater treatment facilities may be subject to many of the hazards for site workers. Recommended	Applicable

Sanitation	Description	Applicability to the Project
	measures to prevent, minimize, and control physical hazards to the community include: ■ Restrict access to waste management facilities by implementing security procedures, such as: - Perimeter fencing of adequate height and suitable material, with lockable site access gate - Security cameras at key access points, and security alarms fitted to buildings and storage areas; and - Use of a site visitor register ■ Light the site where necessary. As this may cause light nuisance to neighbours, the lighting installations should be selected to minimize ambient light pollution.	
Land Application	Use of treated wastewater in agriculture can pose public health risks. Hazards associated with crops irrigated with treated wastewater include excreta-related pathogens and toxic chemicals that may be present in the wastewater. The following methods are recommended to protect consumers: ■ Treat wastewater and sludge used for land application in a manner consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater and applicable national requirements; ■ Stop irrigation with treated wastewater two weeks prior to harvesting; ■ Limit irrigation with treated wastewater to crops that are cooked before eating; ■ Restrict public access to hydraulic structures carrying wastewater and to fields irrigated with treated wastewater.	Not Applicable The treated wastewater from the proposed project STP will be discharged to existing sewerage canal and without any envisaged land application.
Effluent Guidelines	The choice of sanitation technology and design of wastewater treatment begin with a determination of the required level and type of treatment. Project- specific effluent guidelines for sanitation projects should be established based on a clear definition of health objectives and a comprehensive evaluation of alternatives, considering appropriate treatment technologies; quality and quantity of raw wastewater and its variability; available land area for the treatment facility; resources for capital expenditures, training, operation, maintenance, and repair; and availability of skilled operators, maintenance personnel, treatment chemicals, and replacement parts. The selected approach should achieve effluent water quality consistent with applicable national requirements or internationally accepted standards and with effluent water quality goals based on the assimilative capacity and the most sensitive end use of the receiving water.	Applicable
Treated Wastewater Re-use and Sludge Management	Treated wastewater and sludge quality for land application should be consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater and applicable national requirements. Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources should be assessed when land is used as	Applicable

Sanitation	Description	Applicability to the Project
	part of any wastewater treatment system. Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly	
Environmental Monitoring	Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental Monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project.	Applicable
Occupational Health and Safety Monitoring	The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by credentialed professionals experienced in water and sanitation as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided In the General EHS Guidelines.	Applicable

4. ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

4.1 Introduction

This section describes the environmental and social baseline condition prevailing in the study area. The study area include all the components of the projects as discussed in **Section 2.5**. Data on prevailing baseline conditions of Physical environment, biological environment and socio-economic environment were collected for the study.

4.1.1 Area of Influence

The Area of Influence (AOI) of the Project comprises of the Project Site and the surrounding area, where influence of the Project activities are anticipated. The AOI with respect to the environmental and social resources was considered based on the following reach[11] of impacts:

- Air Quality: Gaseous pollutants (e.g. NOx and SO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$)– typically up to 1 km from projects site during construction and operational phase.
- Noise: Noise impact area (defined as the area over which an increase in environmental noise levels due to the project can be detected) –typically 500 m from project site.
- Water: Groundwater will be contaminated through leaching of pollutants from the project site depending on the geology (soil cover) of the area. Groundwater impact will be within 1 km of the project footprint (as the velocity is very slow almost imperceptible).
- Flora and Fauna (Terrestrial and Aquatic): The project area is a part of urban environmental setting. There is no natural forests in the entire study area. If any significant impact is identified near the project site, the area of influence will not exceed 1 km.
- Socio-economic: The direct footprint of the project and its linked facilities, including sewage line and lifting stations. This is based on the understanding that most of the interactions from the project will be limited to project site and 50 m of sewage pipeline replacement work.

Based on the above the AOI for environmental and social studies is limited to 1 km from the Project site and 50 m, for the sewage pipeline. New laying of pipelines or repairing of existing pipelines will be a localized activity on roads and lanes. The proposed pipeline work expected to cover 25 m per day. So the work is temporary for a particular place.

4.1.2 Study Area

Study area has been considered based on the area of influence, which includes all the components of the project. Study area includes a one (1) km buffer zone around the STP facility and one hundred meter area around the proposed sewer network line (50m on both side of the sewer network line). The study also include Lifting stations facility and Outfall points. The study area was selected based on the AOI of the project.

4.1.3 Study Period

The baseline study was conducted between June-August, 2019 for collecting information on physical environment, biological environment and socio-economic environment. Mitra SK Pvt. Ltd., a NABL certified laboratory was engaged for collecting primary monitoring data of physical environment (Ambient Air, Noise, Surface Water and Ground Water) for the study.

[11] Distance based on ERM's experience with similar projects

Note:

The ESIA scope accounts to limited primary baseline data collection and accounting for the timeline of the study, over a single season. There are no representative data for different environmental dimensions available in public domain for pre-monsoon and post-monsoon for the project location, except for air quality. Ambient Air quality data within 10 km from the proposed project location as referred from the public domain has been included in the report (Refer Section 4.2.7) for better correlation.

4.1.4 Approach and Methodology

The approach and methodology adopted for collection of baseline data on Physical, Biological and Socio-economic environment are discussed below:

a) The methodology followed for baseline data collection on Physical Environment are given below:
   - Review of existing ESMP report of the STP facility. The relevant data are incorporated in this report.
   - Selection of primary data collection location as per scope of work discussed in **Section 1.5**.
   - Primary monitoring of key environmental parameters like air, noise, soil, sediment, surface water, ground water and traffic. Primary baseline monitoring data collection was conducted by Mitra S. K. Pvt. Ltd.
   - Information about geology, hydrology, prevailing natural hazards like floods, earthquakes etc. have been collected from literature reviews and authenticated information made available by government departments.

b) The methodology followed for baseline data collection on Biological Environment are given below:
   - Review of secondary data
   - Primary survey data collection by ERM team

c) The methodology followed for baseline data collection on Socio-economic Environment are given below:
   - Review and collection of Secondary data including the Census data 2011
   - Primary data collection through consultation

4.2 Physical Environment

4.2.1 Topography

The study area is a part of lower gangetic deltaic plain. The entire district has flat topography with average elevation from MSL (mean sea level) varies from 9 to 11m near the river ganga and varies from 5 to 9 m near the WSP. The overall slope of the district is towards the South.

4.2.2 Geology

The study area is a part of lower Gangetic Deltaic plain of Bengal basin. Presently, the configuration of Bengal basin can be inferred by the presence of Gangetic-Brahmaputra delta system in the north and the Bengal Deep Sea Fan on the south[12]. The study area is characterized by thick quaternary

[12] Alam M., Alam M.M., Curray J.R., Chowdhury M.L.R. (2003) An overview of the sedimentary geology of the Bengal Basin in relation to the regional tectonic framework and basin-fill history. Sedimentary Geology, 155; 179-208.

alluvium deposit, laid down by Bhagirathi-Hooghly River system. The alluvial sediments in the form of flood plain deposits consist of the sands of various grades, silt and clay with occasional gravel beds. Immediately below the land surface a thick layer of sticky clay ranging in thickness between 30-70 m. exploratory drilling carried out by CGWB in parts of the district revealed the presence of clay layer around a depth of 300mbgl which continues beyond 548 mbgl[13].

The STP area is located at an aerial distance of 5.33 km from the Hooghly River. The Bally WSP area is situated in the eastern part of the district. The study area and eastern part of Howrah Municipality is characterized by loose sediment deposits of middle to late Holocene age. The area has alternate layers of fine sand, silt and clay. The clay layer present in the area characterized by dark grey colour and plastic nature. Grain size of the sand varies from fine to course and in some places the gravel is also found mixed with the sand. The thickness of the top-clay layer is very thin as depicted from the Hydrogeological map of the area given in Sec. The thickness of the top-clay layer increases from east to west of the district. The thickness of the top-clay layer varies from 0.5 to 3m near the Hooghly River. The thickness of the top-clay varies from 2 to 4 m near the STP area (as per discussion with the local people).

4.2.3 Land use

The study area is located in the urban settings. The broad Landuse classes identified in the study area are water bodies, drainage channels, settlements, vacant land and green cover. The Landuse map of STP and its surrounding 1 km area is given in The **Figure 4.1**.and **Table 4.1***.* The land use map of sewer line network and its surrounding 100m area is given in The **Figure 4.2** ***to 4*.4** and **Table 4.2***.* The sewer pipeline network passes through the main load with settlements on both side of the road.

[13] CGWB district report of Howrah.

Figure 4.1 Land Use Map of Bally WSP and its surrounding 1 km area

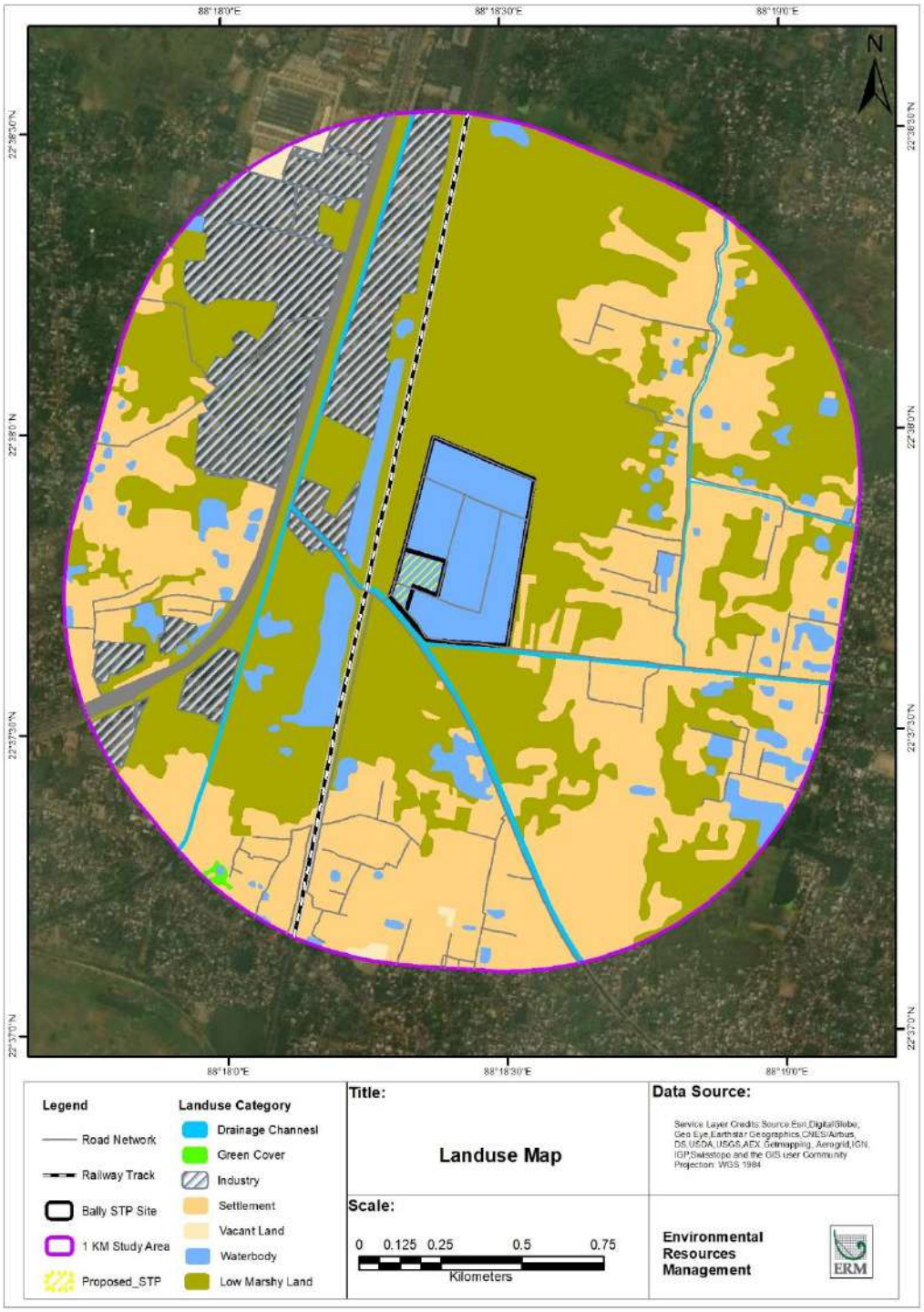


Table 4.1: Total Area Covered by Various Land Use Classes around the STP Area

Land use Category	Area sq.M	Area sq.Km	Percentage
Drainage Channels	78455.63	0.08	1.53
Green Cover	3280.17	0.00	0.06
Industry	571517.17	0.57	11.17
Railway Track	51660.75	0.05	1.01
Road Network	171114.63	0.17	3.34
Settlement	1683525.54	1.68	32.91
Vacant Land	21231.80	0.02	0.42
Waterbody	435477.91	0.44	8.51
Low Marshy Land	2099706.06	2.10	41.04
Total	**5115969.64**	**5.12**	**100.0**

Figure 4.2 Land Use Map of Existing Sewer Network LS-3 to LS-2

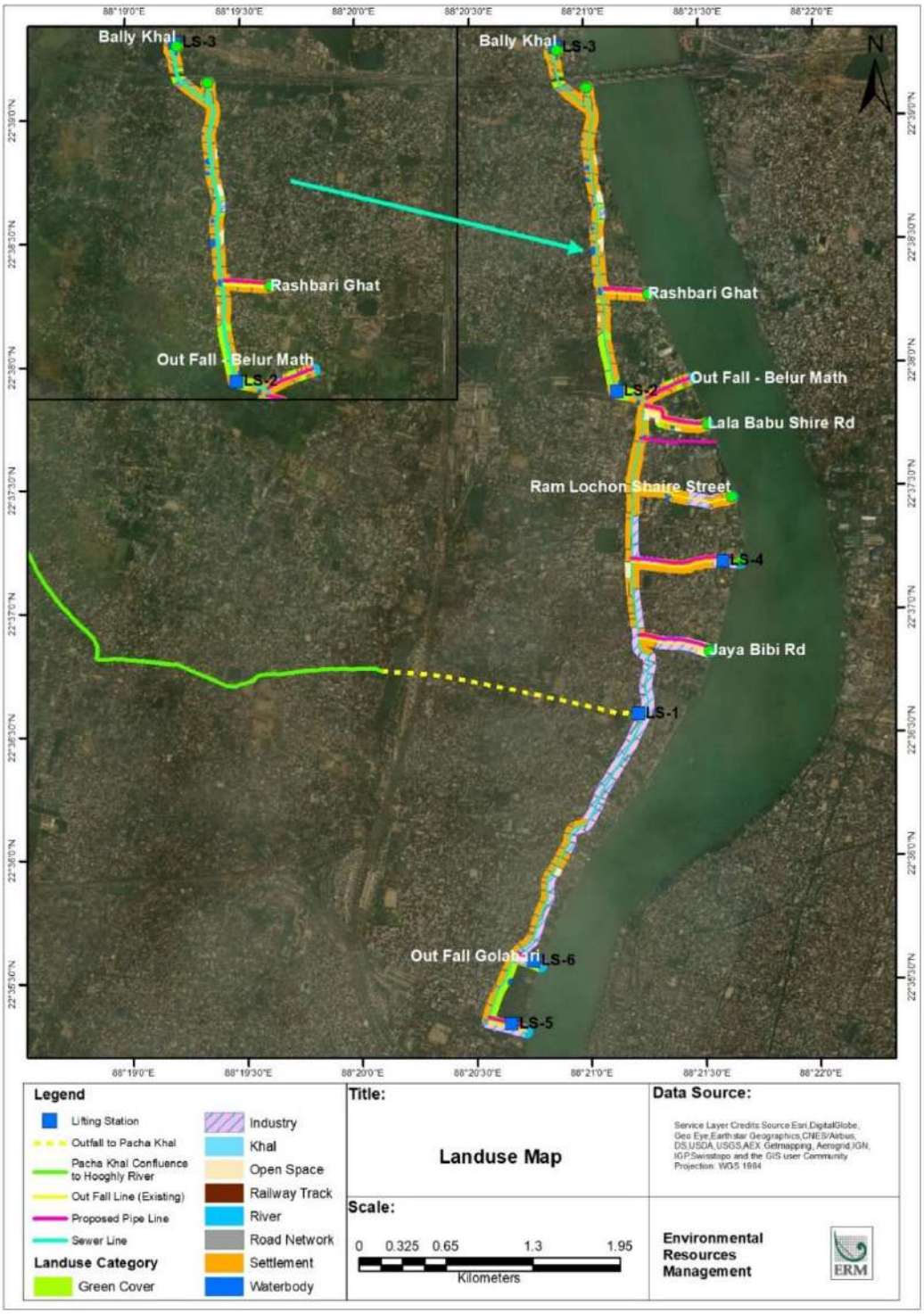


Figure 4.3 Land Use Map of Existing Sewer Network LS-2 to LS-1

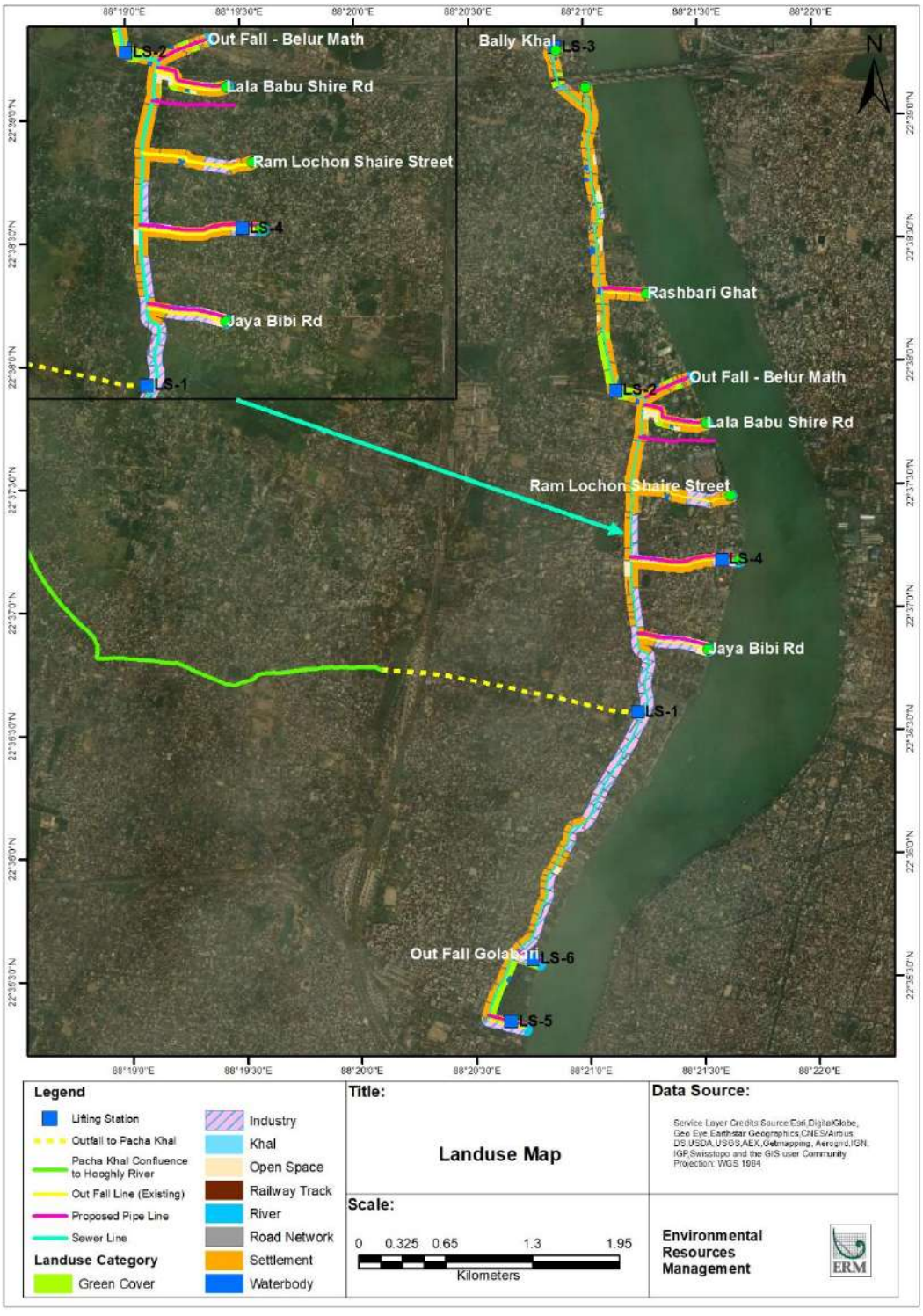


Figure 4.4 Land Use Map of Existing Sewer Network LS-5 to LS-6

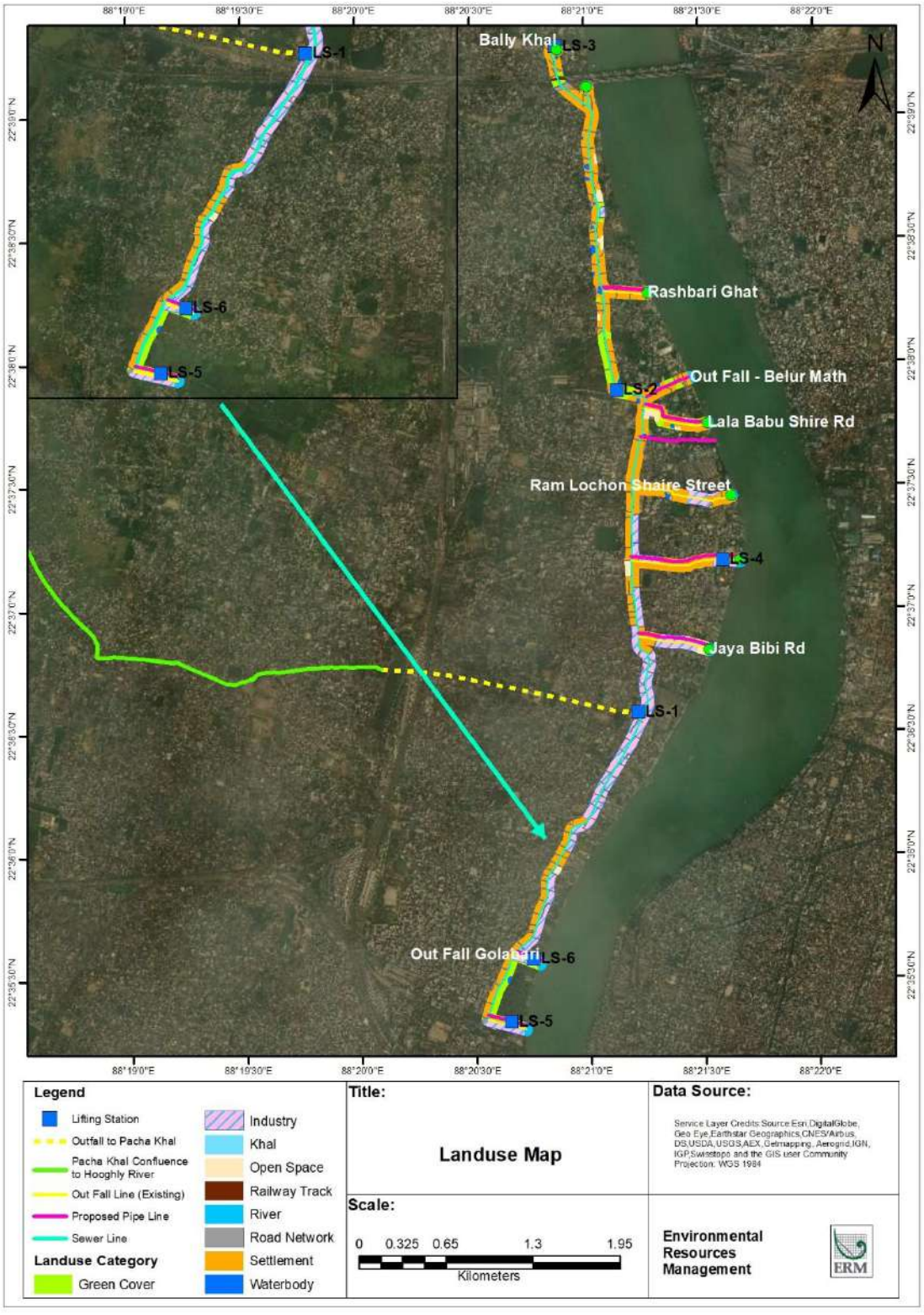


Table 4.2: Area-wise Land Use Classification adjoining Sewer Line Network

Landuse Category	Area Sq.M	Area Sq.KM	Percentage
Green Cover	83081.81	0.08	6.91
Industry	284558.61	0.28	23.65
Khal	1073.29	0.00	0.09
Open Space	42968.55	0.04	3.57
Railway Track	2270.17	0.00	0.19
River	29868.63	0.03	2.48
Road Network	157807.63	0.16	13.12
Settlement	584457.17	0.58	48.58
Waterbody	17055.20	0.02	1.42
Total	**1203141.06**	**1.20**	**100.00**

4.2.4 Soil Quality

The district of Howrah falls within the new alluvium sub-region of the lower Gangetic Plain and considered being most fertile for crop production. The prominent soil in the Howrah district falls under the new alluvial and old alluvial agro-climatic zone of West Bengal. The pH in soils ranged from 3.0 to 8.30 with a mean value of 5.75 and organic carbon content in soils ranged from 0.18 to 1.21% with a mean value of 0.55%[14]. Soils of the area are taxonomically classified into three orders i.e. Alfisol, Inceptisols and Entisols[15].

4.2.4.1 Primary Soil Monitoring

Soil quality was monitored at two (2) different locations within the study area near Kona WSP. The soil samples were collected from the top-soil within 15 cm depth. The soil samples are collected and analysed to estimate the extent of soil pollution due to previous operation of STP. One sample as collected besides the proposed facility and another sample was collected near the MPS to estimate the baseline condition and the difference in the quality of the soil sample. The details of the soil monitoring locations are provided in **Table 4.3** and the soil locations have been shown in **Figure 4.4**.

Table 4.3: Surface Soil Monitoring Locations in Study Area

S. No.	Monitoring Location	Station Number	Land Use	Latitude	Longitude	Rationale for Selection
1.	Near MPS	S-1	Marshy land	22°37'37.78"N	88°18'22.66"E	To predict soil contamination outside the WSP facility
2.	Near Proposed STP	S-2	Marshy land	22°37'46.33"N	88°18'17.78"E	To predict soil contamination near the WSP facility

[14] Rahul Kumar, Gora Chand Hazra, ruma Das, Shyam Prasad Majumdar and Amal Chandra Das (2019). Nutrient Index of Available S in Soils of Howrah and South Dinajpur Districts of West Bengal, India. International Journal of Current Microbiology and Applied Sciences, Volume 8.

[15] https://slusi.dacnet.nic.in/srm/srmabstracts/SRM_113_Howrah.pdf

Table 4.4: Results of Surface Soil Monitoring

Parameters	Location	Kona WSP	Beside Kona WSP
	Sample Id	S-1	S-2
Texture	-	clay	clay loam
Particle Size Distribution	%	sand:30%,silt:18%,clay:52%	sand:34%,silt:28%,clay:38%
Specific gravity	-	2.26	2.53
Permeability	Cm/hr	0.09	0.82
Water Holding capacity	%	44	38
Porosity	%	44.3	50.7
Bulk Density	gm/cc	1.26	1.25
Moisture	%	32	30
Infiltration Capacity	Mm/hrs	2.6	6.4
pH value	-	7.24 (1:2.5) at 25 deg C	7.66 (1:2.5) at 25 deg C
Boron (as B)	mg/kg	36	29
Calcium (as Ca)	mg/kg	1000	5650
Chloride (as Cl)	mg/kg	1640	440
Sulphate (as SO4)	mg/kg	490	39
Alkalinity (as CaCO3)	mg/kg	160	360
Arsenic(as As)	mg/kg	5	5.5
Available Nitrogen (as N)	mg/kg	218	285
Sodium (as Na)	mg/kg	1815	875
Electrical conductivity	us/cm	4730(1:2) at 25 deg C	1275 (1:2) at 25 deg C
Available Potassium (as K)	mg/kg	235	140
Sodium Adsorption Ration (as SAR)	-	3.5	2.8
Available Phosphorus (as P)	mg/kg	3.8	11
Cation Exchange Capacity	meq/100 gm	30	41
Hexavalent Chromium (as Cr+6)	mg/kg	<2.0	<2.0
Acidity	mg/kg	nil	nil
Carbonate as CO3	mg/kg	nil	nil
Copper (as Cu)	mg/kg	44	39
Iron (as Fe)	mg/kg	6.9	7.5
Magnesium (as Mg)	mg/kg	330	630
Manganese (as Mn)	mg/kg	291	319
Cadmium (as Cd)	mg/kg	<2.0	<2
Lead (as Pb)	mg/kg	18	50

Parameters	Location	Kona WSP	Beside Kona WSP
	Sample Id	S-1	S-2
Mercury (as Hg)	mg/kg	<0.1	<0.1
Nickel (as Ni)	mg/kg	34	25
Zinc (as Zn)	mg/kg	79	180
Total Chromium (as Cr)	mg/kg	43	90

Source: Primary monitoring conducted through WBPCB recognised laboratory during this ESIA study

Figure 4.5 Soil Sampling Location Map

4.2.4.2 Soil monitoring results interpretation

The results of the primary soil monitoring are discussed below:

Texture

Texture is an expression to indicate the coarseness or fineness of the soil as determined by the relative proportion of the various sized primary particles in the soil mass. The textures of the collected soil samples were found to be clay and clay loam for sample S-1 and S-2 respectively.

Particle Size Distribution

The particle distribution in the soil samples collected from the 2 locations show a considerable amount of silt variation. Sand and silt content in S-2 is greater than the sand and silt content found in S-1. The high sand content in the soil increase the permeability of the soil and indicate light soil.

Porosity

The porosity of the soils are 44.3% and 50.7% respectively for S-1 and S-2.

Permeability

The permeability of the soils are 0.09 and 0.82 cm/hr respectively for S-1 and S-2. Soil permeability is the property of the soil to transmit water and air. Ponds built in high permeable soil will lose water through seepage. The permeability value of the soils indicates clay soil texture for S-1 and clay loam soil texture for S-2[16].

pH

pH values in soils were 7.24 and 7.66 respectively for S-1 and S-2. pH values S-2 soil sample indicated slightly alkaline soil.

Electrical Conductivity

The EC values for the soils monitored at the study area were 4370 and 1275 µs/cm for S-1 and S-2 respectively. For a productive soil, the electrical conductance (EC) should be < 1000µs/cm.

Macronutrients

Nutrient status of the soil samples can be determined from the concentration of N, P, K and organic carbon in soil samples. Standard rating chart for soil nutrients is provided in **Table 4.4**. Nitrogen contents in the soil samples were 218 and 285 mg/kg (97.19 and127.06 kg/ha), phosphorus content in the soil samples were 3.8 and 11 mg/kg (1.69 and 4.90 kg/ha) and potassium contents ranges between 235 and 140 mg/kg (104.77 and 62.42 kg/ha) for SS1 and SS2 respectively. With comparison to the rating chart nitrogen status was less to good, phosphorus status was very less and potassium status was very less to less. The variation of available nitrogen concentration in soil is due to the fact that the soils were sampled from different locations.

Metals

a) **Cooper:** Copper concentration of the soil samples are 44 and 39 mg/kg respectively for S-1 and S-2. The concentration of copper in the soil samples are much below the soil remediation intervention values of 190 mg/kg specified in Dutch Soil Remediation Circular (Refer ***Appendix A***).

b) **Lead:** Lead concentration of the soil samples are 18 and 50 mg/kg respectively for S-1 and S-2. The concentration of lead in the soil samples are much below the soil remediation intervention values of 530 mg/kg specified in Dutch Soil Remediation Circular.

[16] http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6706e/x6706e09.htm

c) **Zinc:** Zinc concentration of the soil samples are 79 and 180 mg/kg respectively for S-1 and S-2. The concentration of zinc in the soil samples are much below the soil remediation intervention values of 720 mg/kg specified in Dutch Soil Remediation Circular.

d) **Iron:** Iron concentration of the soil samples are 6.9 and 7.5 mg/kg respectively for S-1 and S-2.

e) **Magnesium:** Magnesium concentration of the soil samples are 330 and 630 mg/kg respectively for S-1 and S-2.

f) **Manganese:** Manganese concentration of the soil samples are 291 and 319 mg/kg respectively for S-1 and S-2.

g) **Cadmium** (<2.0 mg/kg) and **Mercury** (<0.1mg/kg) concentrations were found to be below detectable.

The variation of heavy metal concentration in soil is due to the fact that the soils were sampled from different locations.

Sodium Absorption Ratio (SAR)

Sodium absorption ratio for the soil samples were 3.5 and 2.8 respective for SS1 and SS2.

Conclusion

The soil samples were found to be clay and clay loam in nature with slight alkalinity. The permeability value of the soils indicates the soil texture. Heavy metals such as Copper, Lead and Zinc are present in the soil but concentration are much below the soil remediation intervention values specified in Dutch Soil Remediation Circular.

4.2.5 Climate and Meteorology

Howrah district is located next to Kolkata. Due to location of the two (2) districts, the districts have same climate and weather condition throughout the year. The climate of Howrah district is tropical, like the rest of the Gangetic West Bengal. It is characterised by hot summer, high humidity nearly all around the year and well distributed monsoon season. The winter season starts from December and continues till end of February, followed by the summer from March to May. Rainfall occurs primarily during the south-west monsoon months i.e. June to September and constitutes of more than 70% of the total annual rainfall. Some rainfall, mostly as thunder showers, is received in the latter half of the summer season and in October. Sometimes a bit of shower takes places in summer accompanied by dusty violent winds, which are called 'Kal Baisakhi' by the local people

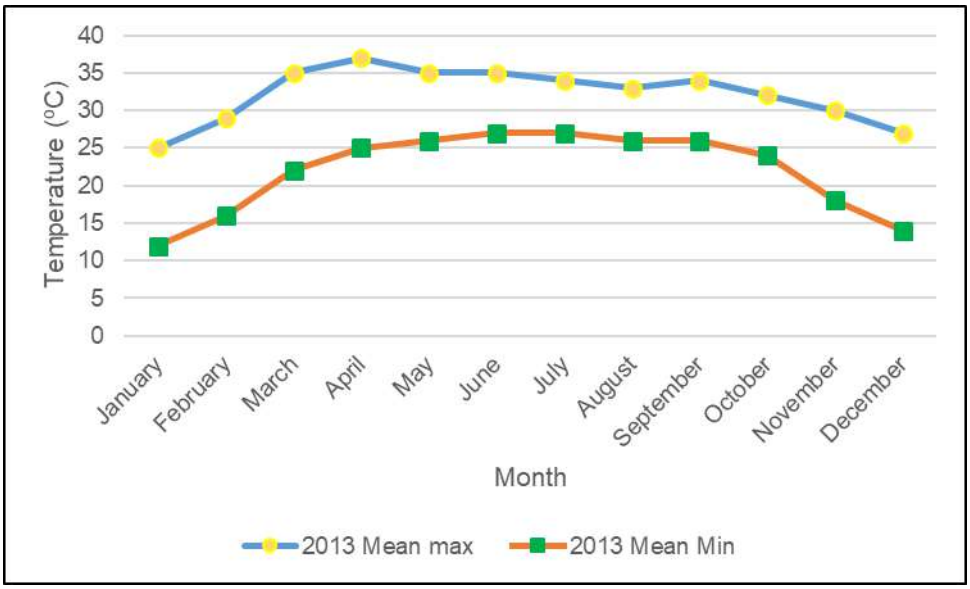
Following are the well-defined seasons of the region:

- Summer: March-May
- Monsoon: June- September
- Post-Monsoon: October -November
- Winter: December - February

Temperature

January is observed as the coldest month with mean minimum temperature of 11 ºC. Mean temperature for most period of the year besides winter season remains around 24.1 to 30.4 ºC with May being the hottest at 38 ºC (mean maximum temperature). The monthly mean minimum and maximum temperatures are shown in **Figure 4.*6***

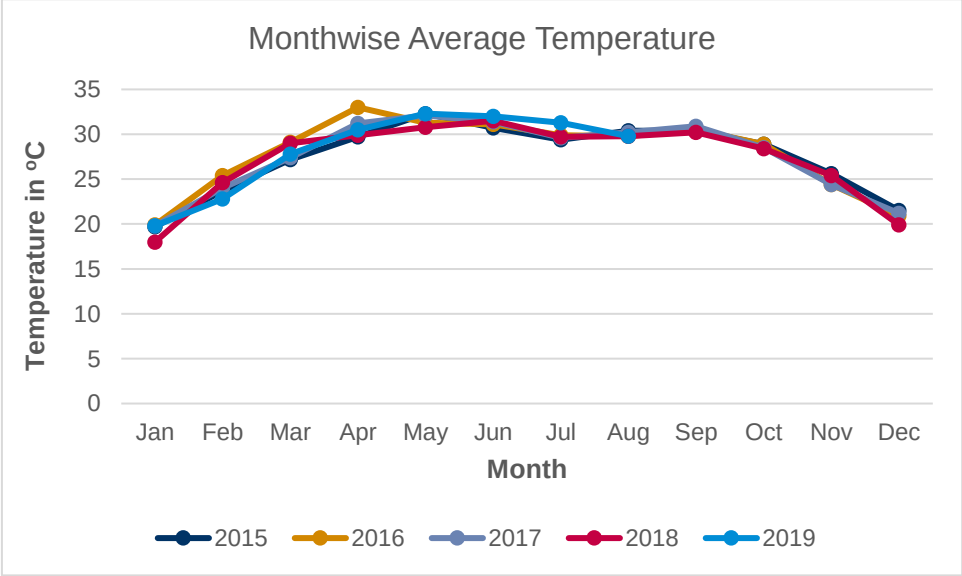
Figure 4.6 Monthly Mean Minimum and Maximum Temperature Variations



Source: *District Statistical Handbook of North 24 Parganas, 2013*

Monthly average temperature data from 2015 to 2019 was collected from Weather -Online[17].The month wise average temperature data is given in **Figure 4.7**. Highest average temperature occur in the month May.

Figure 4.7 Monthly Average Temperature data from 2015 to 2019



Relative Humidity

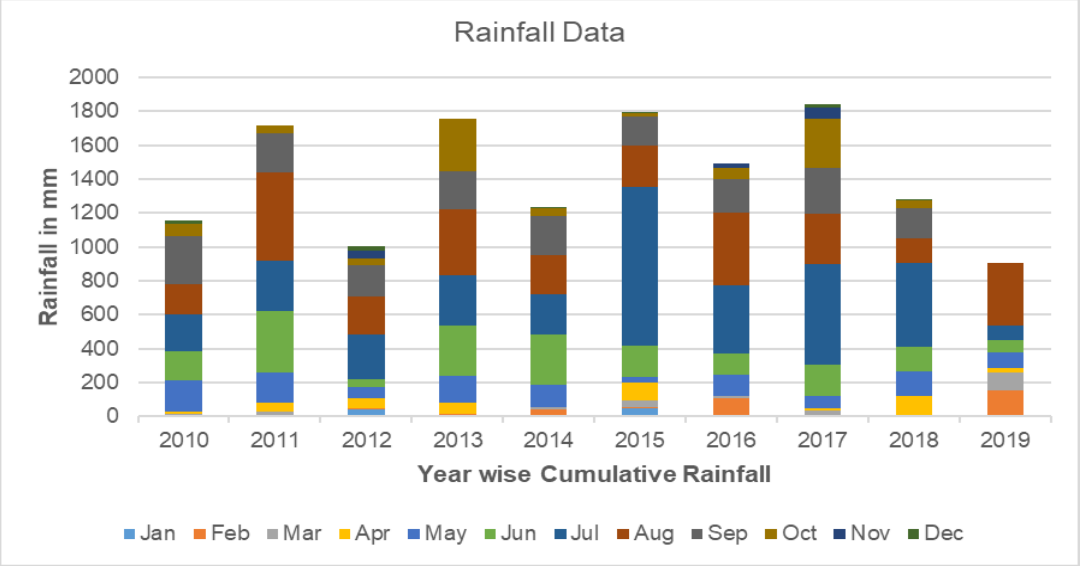
The relative humidity of Howrah district is reported to be high (71% to 85%) throughout the year.

[17]https://www.weatheronline.in/weather/maps/city?FMM=1&FYY=2019&LMM=8&LYY=2019&WMO=42809&CONT=inin&REGION=0024&LAND=II&ART=PRE&R=0&NOREGION=0&LEVEL=162&LANG=in&MOD=tab

Rainfall

The period between June to September is the monsoon season with the average annual rainfall of the district being about 1579 mm[18]. Monthly cumulative rainfall data from 2010 to 2019 was collected from Weather-Online to estimate the rainfall pattern of the area. The year wise cumulative rainfall data is given in **Figure 4.8** . It was found from the analysis of the decadal data that highest rainfall occur in the month of July. The annual average rainfall was 1473.84 mm. The highest rainfall occurred in 2017.

Figure 4.8 Cumulative year-wise Rainfall Data



Wind Speed and Direction:

The average hourly wind speed in the study area shows significant seasonal variation over the course of the year. The windier part of the year lasts for 5.3 months, from March 25 to September 2, with average wind speeds of more than 7.4 miles per hour. Whereas, the calmer time of year lasts for 6.7 months, from September 2 to March 25.[19]

The wind is most often from the west for the time period of 1.2 months, from February 13 to March 20. The wind changes and blows from the south for 6.6 months, from March 20 to October 9. During rest of the year, for 4.1 months between October 9 to February 13 the wind blows from the north.[11]

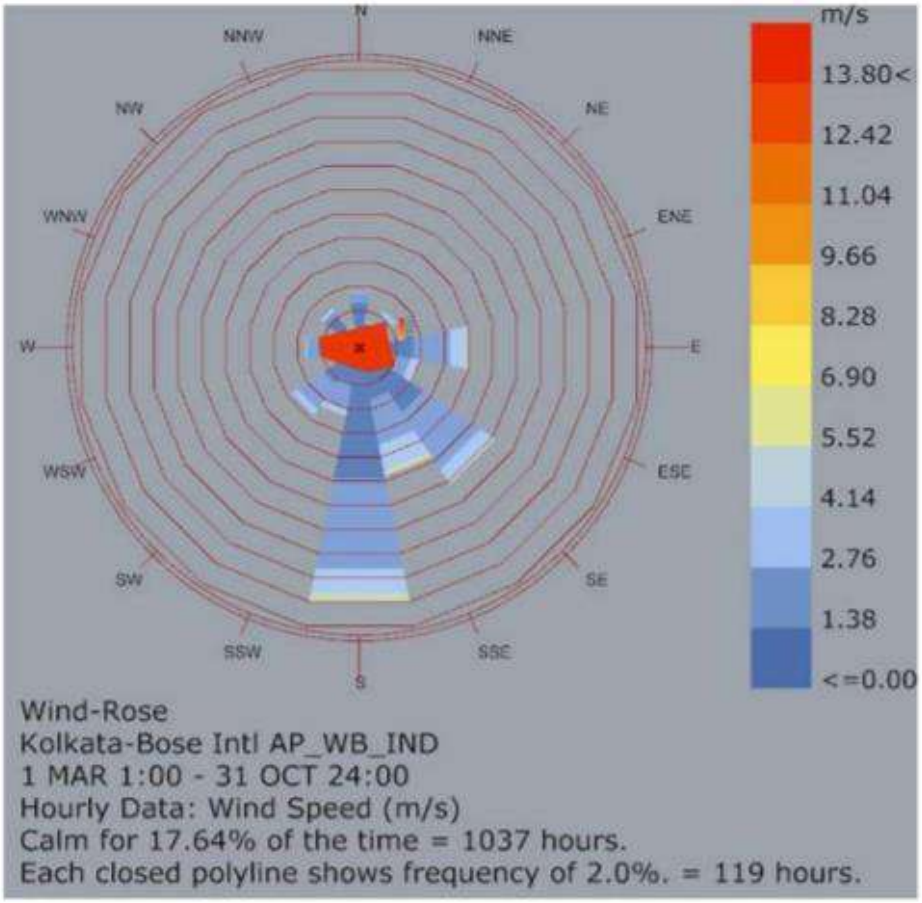
Wind Rose

The wind rose diagram of Kolkata which is located close to the Study area is given below.

[18] Disaster Management Plan- Howrah -2018

[19] https://weatherspark.com/y/111532/Average-Weather-in-Kolkata-India-Year-Round

Figure 4.9 Wind Rose diagram for the period March to October



Source: Sounok Sarkar and Biswajit Thakur, Search for the Most Climate Responsive Shape for Stacked Buildings in Warm-Humid Climate, 2017, pp. 89-94, Journal of Civil Engineering and Environmental Technology

4.2.6 Ambient Air Quality

The study area is situated in the municipality area. The major emission sources within the study area are Vehicular emission from the road and industries present at the site. The major sources of air emissions due to the proposed project activity includes fugitive dust generation from demolition and construction activity, vehicular emission due to vehicle movement and emissions from DG sets during construction phase, and biogas flaring during operational phase.

Daily air quality data of 2019 from monitoring stations located at Howrah district was available in WBPCB (West Bengal Pollution Control Board) website which is collected and analysed to estimate the baseline condition of the district. The data are available for PM_{10}, $PM_{2.5}$, NO_2 and SO_2 pollutants. The data was collected for 8 months from January, 2019 and August, 2019. The monthly average, min and max values of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 is given in **Table 4.5**.

Table 4.5: Air Quality Monitoring Data for Howrah district

Month	PM2.5 (µg/m3)			PM10 (µg/m3)			NO2 (µg/m3)			SO2 (µg/m3)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Jan	121.21	75.88	194.33	212.26	136.60	304.96	46.41	30.36	71.88	23.69	16.76	37.59
Feb	84.01	25.82	120.46	170.53	50.14	228.85	41.67	25.69	60.65	18.72	9.47	30.97
Mar	48.40	23.43	88.09	112.25	55.47	184.70	30.97	21.74	38.95	15.30	9.37	24.84
Apr	29.86	15.23	55.66	80.75	33.60	143.89	28.65	16.21	38.01	10.39	4.85	18.39
May	35.17	13.08	135.83	78.68	43.61	188.78	28.57	19.44	49.66	7.87	4.20	10.58
June	29.38	15.45	53.71	67.45	41.95	116.92	29.67	20.77	40.85	7.00	4.24	9.99
July	31.71	13.83	50.13	70.97	35.58	107.34	30.61	21.79	39.53	7.99	3.91	13.22
Aug	28.75	15.05	54.50	70.42	37.22	118.13	28.44	21.90	38.64	7.97	6.10	14.07
	51.06			**107.91**			**33.12**			**12.37**		

It was found that the average concentration of PM_{10} for Howrah district exceeds NAAQS value of 100 µg/m_3. The highest concentration of PM_{10} value was recorded during January. The PM_{10} Concentration during the month of February and March was also above the NAAQS value. The average concentration of $PM_{2.5}$ is below the NAAQS value of 60 µg/m_3. The Highest concentration of $PM_{2.5}$ was recorded during the month of January. The concentration of $PM_{2.5}$ during February was also above the NAAQS value of 60 µg/m_3. The average concentration NO_2 and SO_2 was below the NAAQS value.

4.2.6.1 Primary Air Quality Monitoring

Ambient air quality was monitored at three locations across the study from 11th June to 17th June, 2019. The parameters studied were Particulate Matter (PM_{10} and $PM_{2.5}$), Oxides of Nitrogen (NOx), Sulphur dioxide (SO_2), Carbon Monoxide (CO), Ammonia (NH_3), Hydrocarbon and H_2S. Air quality monitoring locations were selected in residential areas. The monitoring locations were Upwind, downwind and crosswind direction with respect to the STP facility to understand the baseline air environment in the study area. The monitoring location details are given in **Table 4.*6***. The air monitoring locations have been provided in **Figure 4.10*.***

Table 4.6: Ambient Air Quality Monitoring Locations

Sl. No.	Monitoring Location Number	Geo-coordinates		The Distance From the STP	Rationale for Selection
1	AAQ1	22° 37' 38.16" N	88° 18' 22.98" E	0 km	Downwind with respect to proposed STP location
2	AAQ2	22°38'8.60"N	88°18'37.33"E	0.18 km	Upwind with respect to proposed STP location
3	AAQ3	22°37'46.65"N	88°18'39.41"E	0.29 km	Crosswind with respect to proposed STP location

The result of the parameters monitored has been discussed in context of compliance to National Ambient Air Quality Standards (NAAQS) of residential, commercial and industrial area. The station wise summary results are given in **Table 4.7***.*

Figure 4.10 Ambient Air Quality Monitoring Location Map

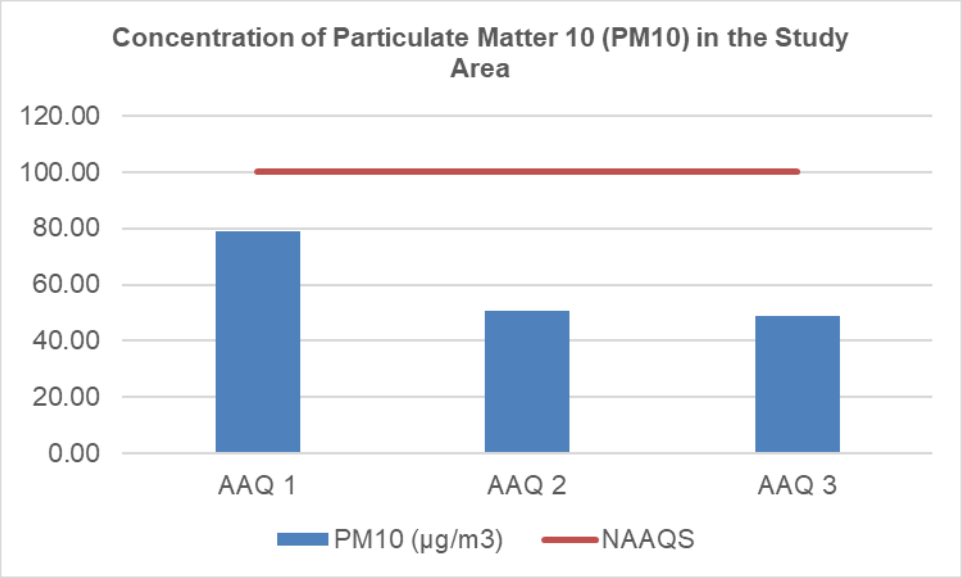
Table 4.7: Summary of Ambient Air Quality Monitoring

	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	NH_3 (mg/m³)	Hydrocarbon (as Methane) ppm	H_2S (µg/m³)
AAQ1								
Average	78.95	46.08	7.10	31.28	0.59	20.90	1.71	<10.0
Max	98.80	55.70	7.80	37.70	0.68	25.60	2.31	<10.0
Min	60.90	36.30	6.50	26.30	0.46	17.50	1.24	<10.0
98th Percentile	97.9	55.3	7.8	37.3	0.7	25.3	2.3	-
AAQ2								
Average	50.83	40.08	6.58	27.68	0.44	18.30	1.81	<10.0
Max	64.00	60.90	7.20	31.60	0.53	22.70	2.32	<10.0
Min	36.30	28.80	6.20	23.50	0.34	14.60	1.28	<10.0
98th Percentile	63.48	59.40	7.16	31.41	0.53	22.45	2.29	-
AAQ3								
Average	48.63	27.58	6.28	30.50	0.48	19.78	1.63	<10.0
Max	54.90	33.50	6.70	36.20	0.56	23.80	2.06	<10.0
Min	43.50	22.60	6.00	25.30	0.36	15.30	1.26	<10.0
98th Percentile	54.74	33.12	6.68	36.08	0.56	23.72	2.05	-

Particulate Matter (PM_{10})

The average concentration of PM_{10} in the Study Area ranged between 48.63 and 78.95 µg/m³. The average concentration of PM_{10} values in all the monitoring stations were found to be in compliance to the NAAQS value of 100 µg/m³. PM_{10} concentration at AAQ3 was in compliance with the WHO air quality guideline value of 50 µg/m³ whereas, PM_{10} concentration in other 2 sites were exceeding the WHO air quality guideline value. Variation of PM_{10} values at the monitoring stations are presented in the **Figure 4.11**.

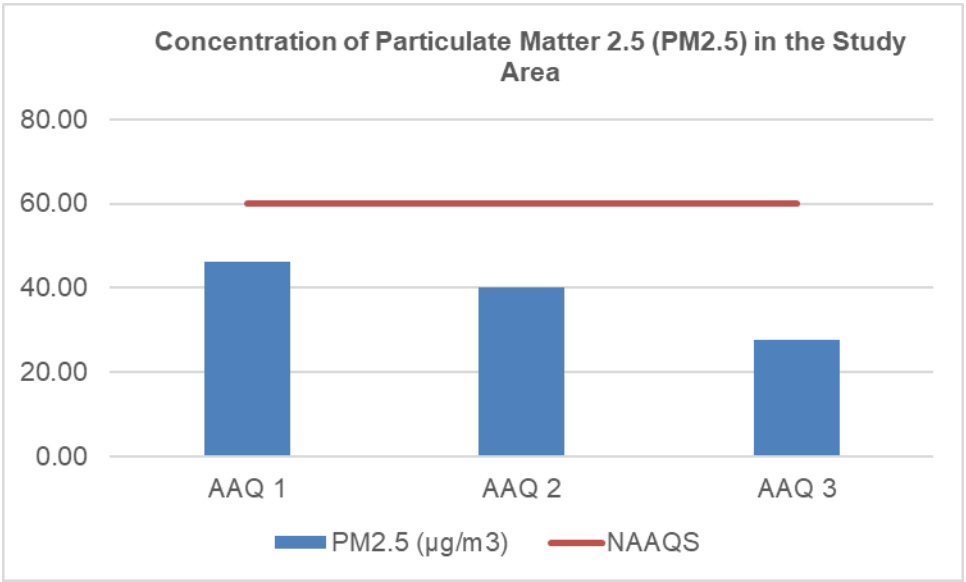
Figure 4.11 Concentration of Particulate Matter (PM_{10}) in the Study Area



Particulate Matter ($PM_{2.5}$)

The average concentration of Particulate Matter ($PM_{2.5}$) in the study area ranged between 27.58 and 46.08 µg/m^3. The average concentration in all the monitoring stations were in compliance with NAAQS standard of 60 µg/m^3 but the average concentrations were exceeding the WHO Air quality guideline values of 25 µg/m^3. Variation of $PM_{2.5}$ values at the monitoring stations are presented in the **Figure 4.12**.

Figure 4.12 Concentration of Particulate Matter ($PM_{2.5}$) in the Study Area

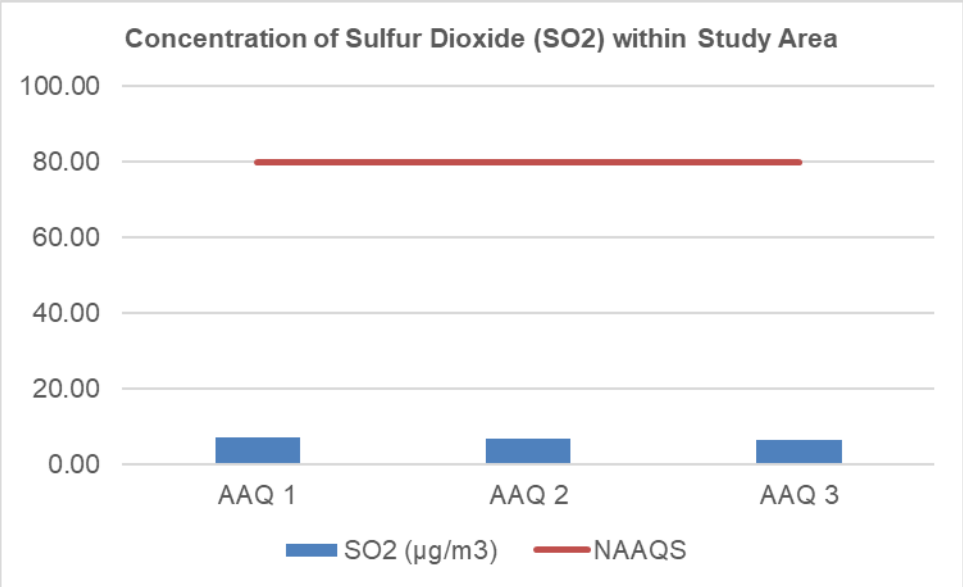


Sulphur Dioxide (SO_2)

The average concentration of Sulphur Dioxide (SO_2) in the study area ranged between 6.28 and 7.10 µg/m3. The average concentration reported across all the three (3) monitoring locations were in

compliance with NAAQS value of 80 µg/m^3 and WHO air quality guideline values of 20 µg/m^3 . Variation of SO_2 values at the monitoring stations are presented in the **Figure 4.13**.

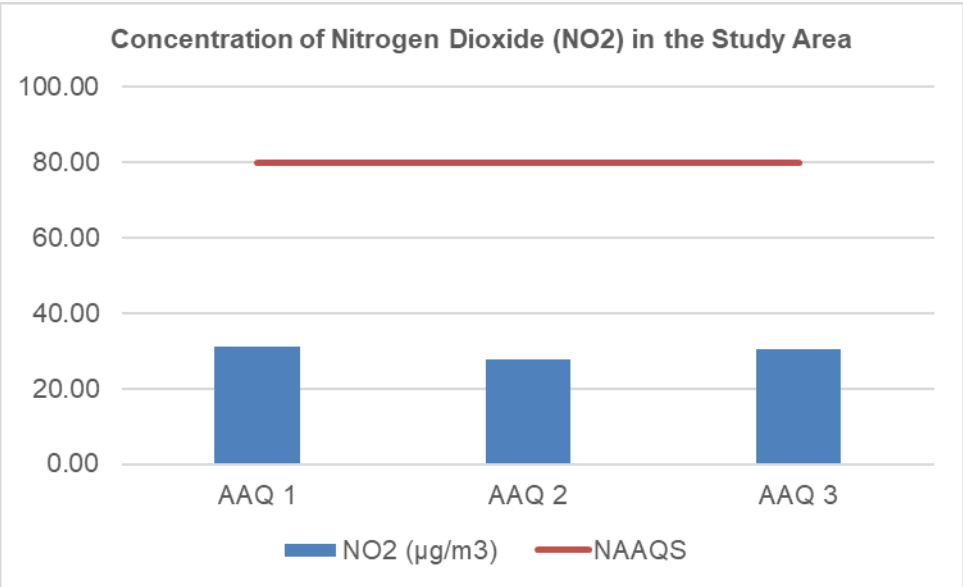
Figure 4.13 Concentration of Sulphur Dioxide (SO_2) in the Study Area



Nitrogen Dioxide (NO_2)

The average concentration of NOx in the study area ranged between 27.68 and 31.28 µg/m^3. The average concentration reported across all the three (3) monitoring locations were below the NAAQS value of 80µg/m^3. WHO air quality guidelines values for NO_2 is 40 µg/m^3 annual mean and 200 µg/m^3 1-hour mean whereas the primary monitoring results were given in 24 hour mean. So, the NO_2 values can not be comparable with WHO air quality guideline values. Variation of NO_2 values at the monitoring stations are presented in the **Figure 4.14**.

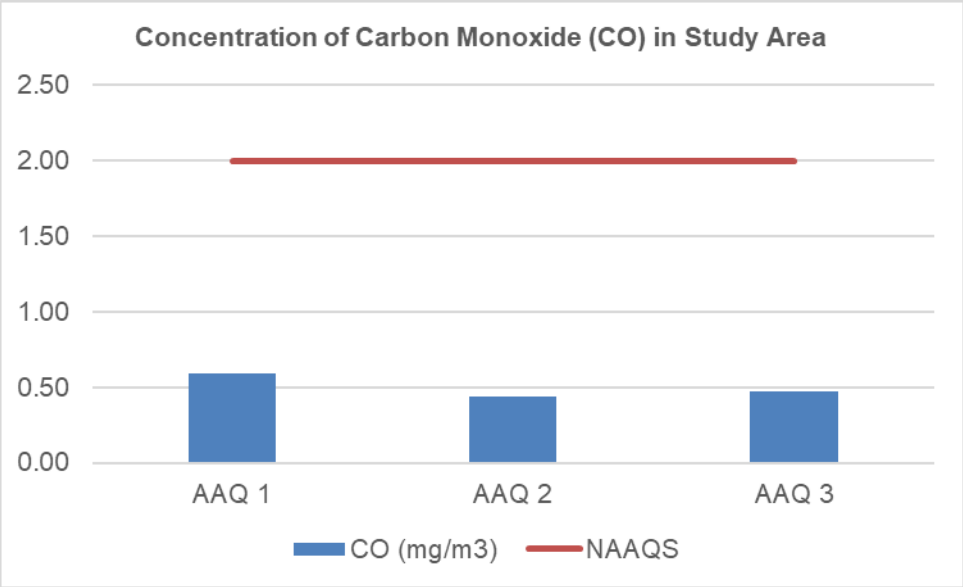
Figure 4.14 Concentration of Nitrogen Dioxide (NO_X) in the Study Area



Carbon Monoxide (CO)

The 8 hour average concentration of Carbon Monoxide in the study area ranged between 0.44 and 0.59 mg/m^3. The average concentration of CO reported across monitoring locations were in compliance the NAAQS value of 2mg/m^3. Variations of CO values in at the monitoring stations are presented in the **Figure 4.15**.

Figure 4.15 Concentration of Carbon Monoxide (CO) in the Study Area



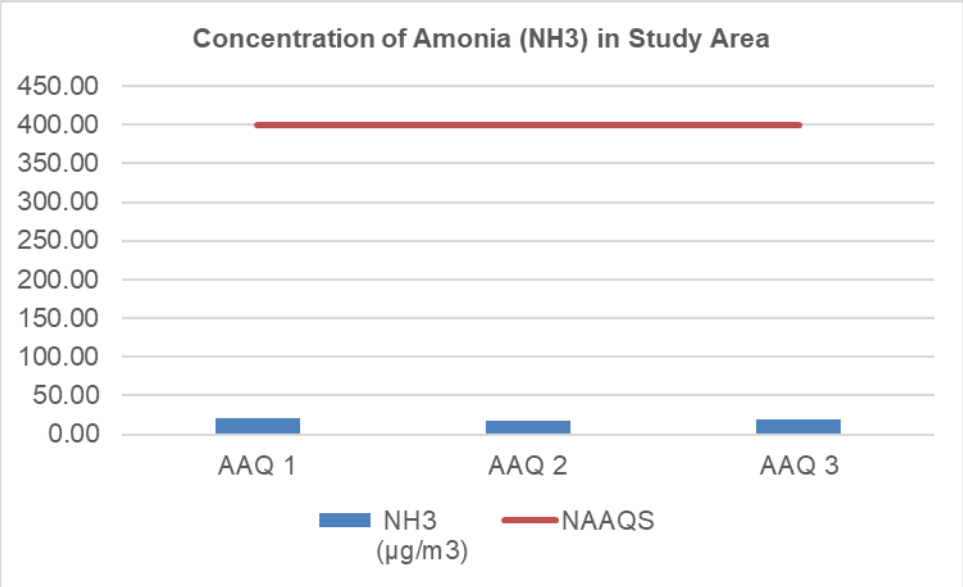
Hydrocarbons

The average methane concentration in the study area ranged between 1.63 and 1.81 ppm. There is no standard value for Methane in NAAQS.

Ammonia

The concentrations of ammonia concentration in the study area ranged between 18.30 and 20.90 µg/m$_3$. The average concentration of NH_3 reported across monitoring locations were in compliance the NAAQS value of 400 µg/m$_3$. Variations of CO values in at the monitoring stations are presented in the **Figure 4.16**.

Figure 4.16 Concentration of Ammonia (NH_3) in the Study Area



Hydrogen Sulphide (H_2S)

The concentrations of H_2S in the study area were recorded less than 10 µg/m^3.

Conclusion

The study area represents rural environmental setting. The source of emission to air include vehicles roads and domestic cooking (use of woods) present within the study area. All the values of pollutants were in compliance with the National Ambient Air Quality Standards.

4.2.7 Noise Quality

Ambient noise monitoring was conducted at four (4) stations within the study area. The noise levels have been monitored at residential zones to assess and evaluate the impact on ambient noise environment. The location of N1 is selected within the MPS facility to predict the noise level prior to project activity. This data will also help to assess the impact on noise environment due to project activity. The location N2 is selected near Bhattanagar road as this road will be used during construction period and near the settlement of the area. The baseline data of these areas will help to estimate the possible effects of extra load during construction will have on the ambient noise quality of the area. The location of N4 is selected close to the proposed STP location to estimate the noise environment in the vicinity. The Location N3 is selected near the dese settlements present at the eastern part of the WSP to estimate the noise environment in the area as this area is a sensitive area. The location of the noise monitoring stations have been presented in **Table 4.8** and depicted in **Figure 4.17** for reference.

Table 4.8: Ambient Noise Monitoring Locations

Sl. No	Monitoring Location	Station Number	Geographical Coordinates		Category of Area/Zone
			Latitude	Longitude	
1.	GAP Office	N-1	22°37'38.24"N	88°18'23.11"E	Residential
2.	Near Bhattanagar Road	N-2	22°37'37.75"N	88°18'37.98"E	Residential
3.	Chakpara	N-3	22°37'45.57"N	88°18'42.97"E	Residential

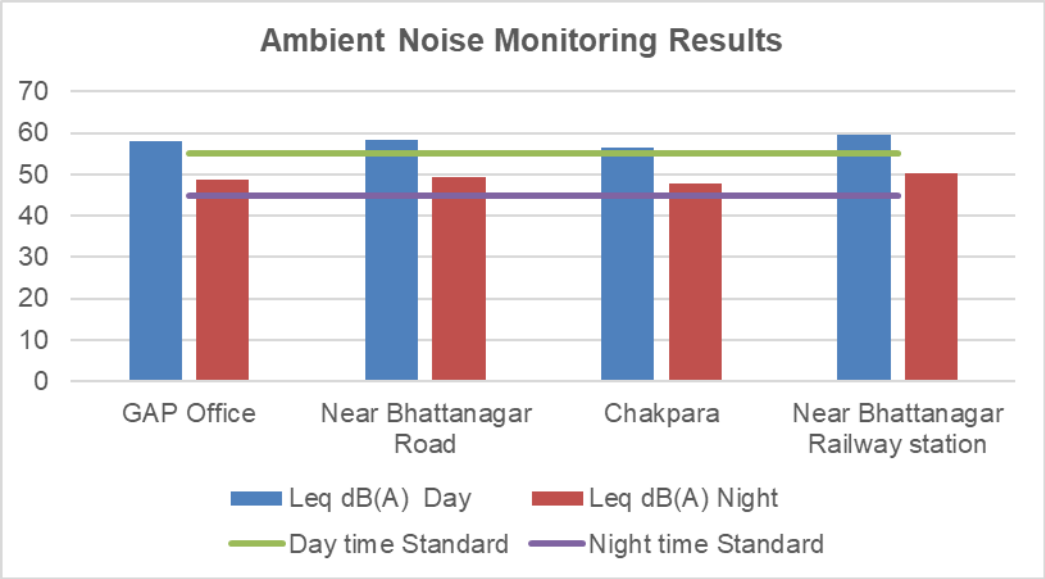
Sl. No	Monitoring Location	Station Number	Geographical Coordinates		Category of Area/Zone
			Latitude	Longitude	
4.	Near Bhattanagar Railway station	N-4	22°37'44.25"N	88°18'17.20"E	Residential

The 24-hour baseline noise monitoring was conducted by using the portable sound meter (Lutron, SL-0423SD, unit: dB (A). Noise level (Leq) were measured and recorded at a one hour interval and averaged at a daily (i.e. 24-hour) interval using the following formula:

Leq = 10*Log 10 (Average (10^ ((X)/10))) where X is measured noise in dB (A). Sound pressure level (SPL) measurements in dB(A) was recorded for 24 hours with the equivalent noise values computed as Leq (Daytime) and Leq (Night time) for each location. Daytime is considered between 06:00 to 22:00 hours and night from 22:00 hours to 06:00 hours. The results so obtained were compared with ambient noise standards specified for respective category under the Noise Pollution (Regulation & Control) Rules, 2000. The summary of noise quality results is presented in **Figure 4.18** below.

Figure 4.17 Ambient Noise Monitoring Location Map

Figure 4.18 Ambient Noise Monitoring Results



4.2.7.1 Interpretation of Primary Noise Monitoring Results

The equivalent noise level as measured at the residential areas range between 56.6 -59.5 dB (A) at day time and between 47.8-50.3 dB (A) at night time. The equivalent day time noise values in all the locations (GAP Office, Near Bhattanagar Road, Chakpara and Near Bhattanagar Railway station) were exceed the NAAQS day time standard of 55 dB(A) for residential areas and WHO day time standard of 55 dB(A) for outdoor living area. The equivalent night time noise values in all the locations (same locations as mentioned for day time) were exceed the NAAQS night time standard of 45 dB (A) for residential areas but all the station except station near Bhattanagar Railway station comply with WHO night time standard of 50 dB(A) for outdoor living area. The noise monitoring stations were close to Bhattanagar Railway station and other communication roads. Railways and vehicles in the roads are the major source Noise in the area. The detailed ambient noise quality results are given in **Appendix F**.

4.2.8 Drainage

The major rivers in Howrah district are Rupnaran-Mundeswari River, Bhagirathi-Hooghly River. The boundaries of the district are naturally defined by these two (2) rivers. Rupnarayan River flows along the West and South-west part of the district and Bhagirathi-Hooghly River flows along East and South-east part of the district. Damodar River flows from north-west boundary of the district. Apart from these rivers there is an artificial canal named as Bally Khal. This artificial canal is present along the north-eastern boundary of the district. The Bally Khal meets the Hooghly River at the North-eastern part of the district. Apart from these rivers and artificial canal at the boundary of Howrah district, there are canals i.e. Howrah Drainage Channel, Mahishdhara khal, Barjola khal, Rajapur khal, Medinipur Main khal, Champa khal, Rampur khal, Gaighata khal etc. which play very important role in flood mitigation and irrigation purpose. Besides the above, other small rivers like Saraswati, Maza Damodar, Kana Damodar etc. serves drainage purpose in the district[20].

Howrah drainage channel flows from the eastern side of the proposed STP facility. Howrah drainage channel flows in south direction before it mixes with Hooghly River at Mourigram. The Howrah drainage channel covers almost entire Howrah district through its distributary channels. Currently the entire sewage drainage load of the channel is discharged without treatment into the River Hooghly.

[20] West Bengal Disaster Management Plan for Howrah District-2018

The channel is used to drain both storm and sewage water from its basin area. The drainage system of the study area is controlled by the Howrah Drainage Channel.

Micro-Drainage: The proposed STP site is located at a low-lying area. In the present site setting, the slope within the proposed STP facility is towards the Howrah Drainage Channel. The drainage map of the study area is given in **Figure 4.19** and **Figure 4.20***.*

Figure 4.19 Drainage Map

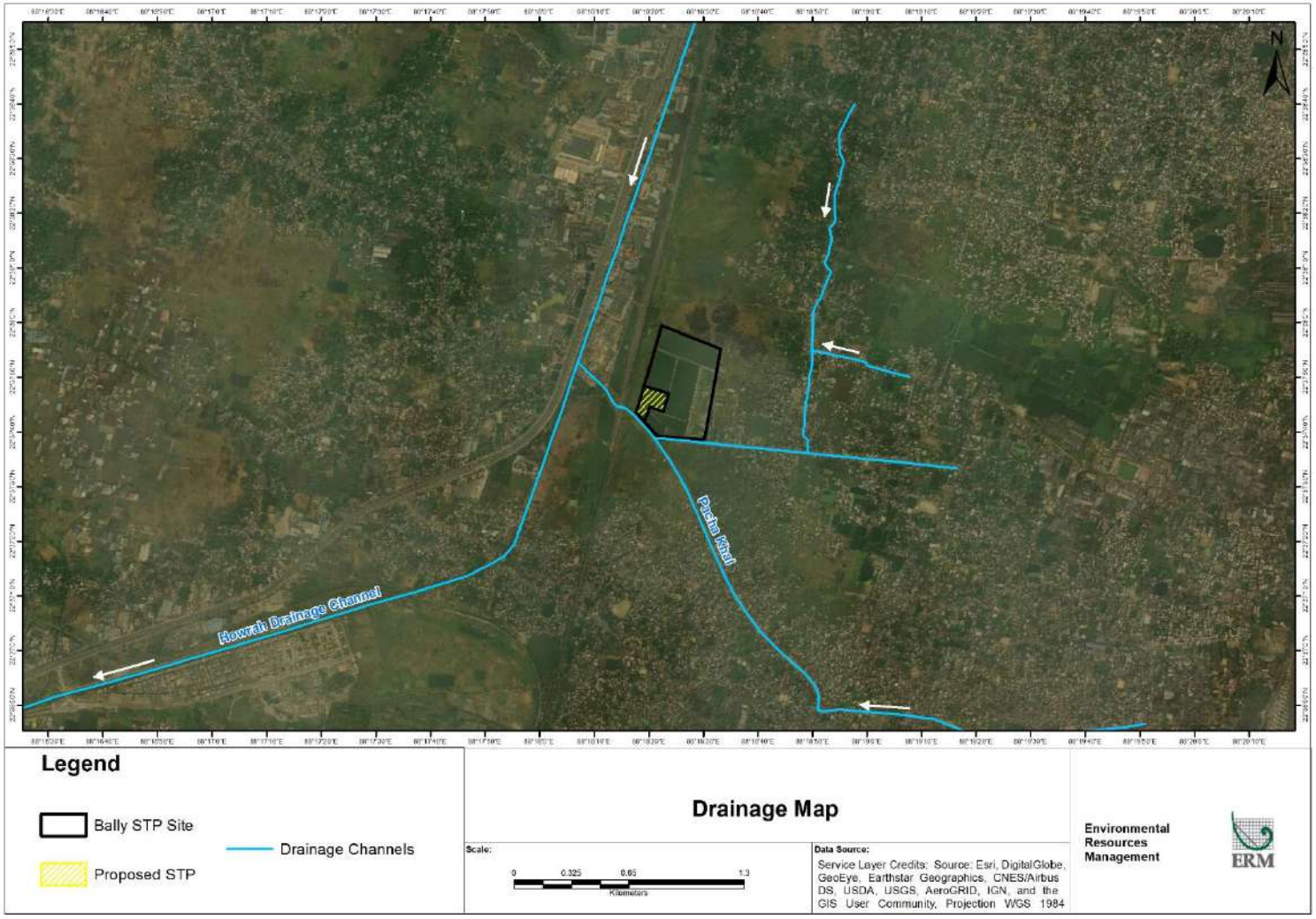
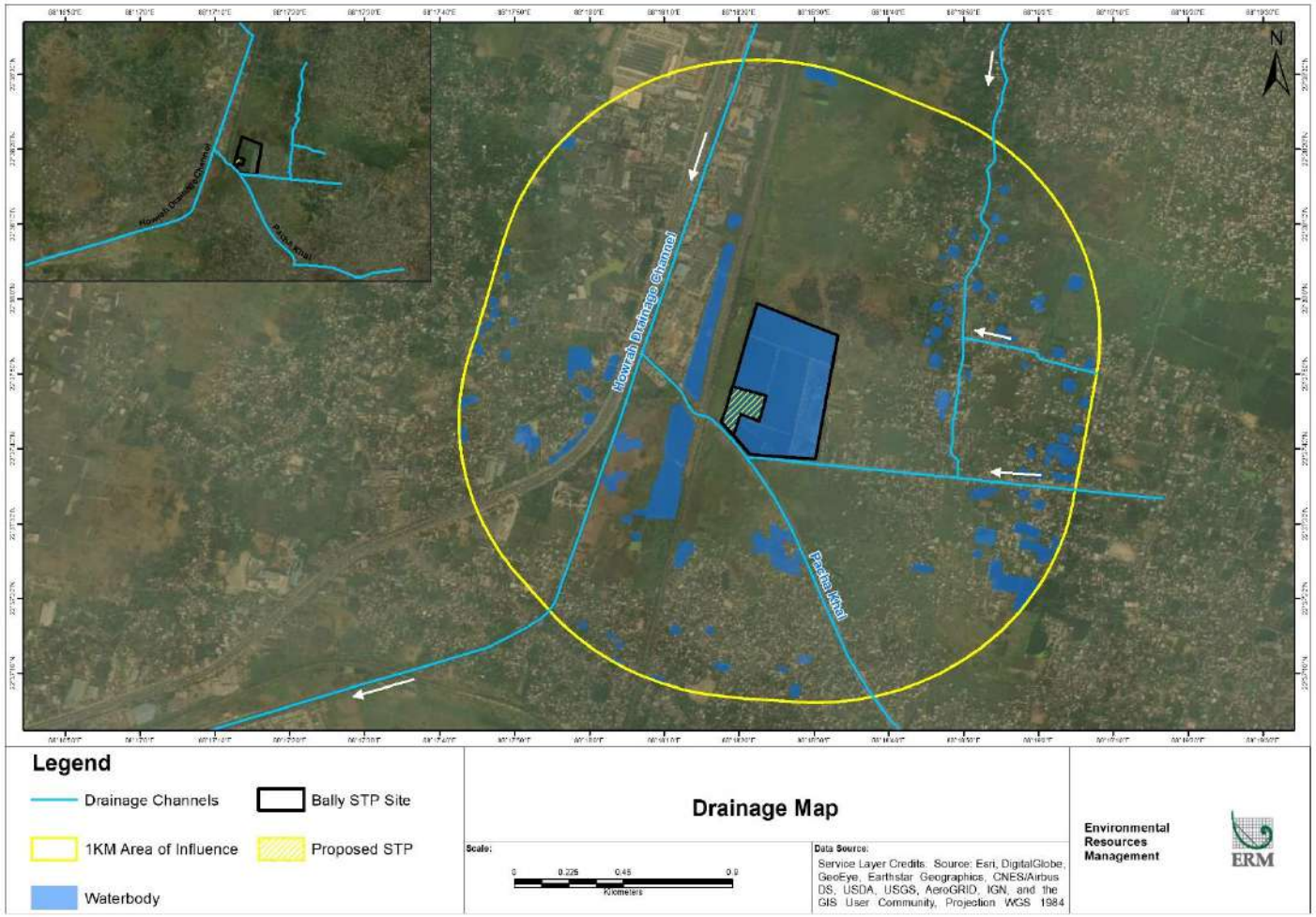


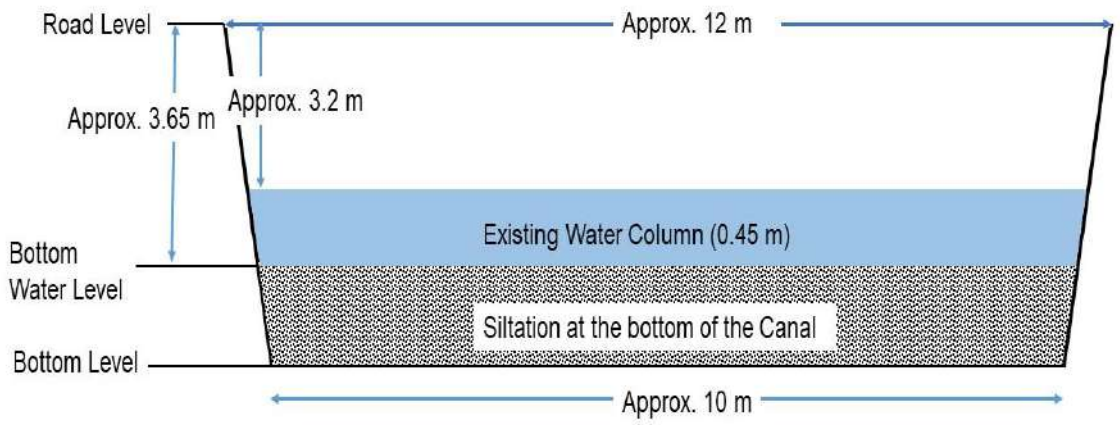
Figure 4.20 Drainage Map within 1 km of Proposed STP



4.2.8.1 Primary Study of Pacha Khal

The initial depth of the khal is not known but according to local people it is supposed to be as 15ft or 4.5m deep initially. During initial Site visit it was observed that the channel was heavily silted. The thickness of the silt bed at the bottom could not be known. The effective depth of the channel was estimated to be approximately 3.65 m below the road level and the current (post-monsoon) height of water column in the canal was estimated to be approximately 0.45 m. It was visually observed that the flow of water in the channel was quite low. The approximate features of the cross sectional area of the canal is outlined in **Figure 4.21***.*

Figure 4.21 Cross-sectional Area of Howrah Drainage Channel



In present scenario the carrying capacity of the channel with existing siltation at the bottom is estimated to be 86989.2 m^3/hour. Presently, the channel is approximately carrying 10032.3 m^3/hour of untreated water, thus approximately carrying capacity 76956.9 m^3/hour will be available for accommodating additional discharge of treated water from the Bally STP & WSP and flood water drainage.

Note:
Dredging/desilting operation schedule **for Pacha Khal and Howrah Drainage Channel canal is under the jurisdiction of** 'West Bengal State Irrigation & Waterways Department' which is an independent department out of KMDA purview. Major desilting activities are undertaken every 5-6 years and it is unlikely that such activities would coincide with construction phase of the STP.

4.2.9 Surface Water Quality

Surface water has been monitored at four locations within the study area. The sampling locations have been designed to capture the water quality of the water bodies within the study area that could be impacted due to the operation of STP. The surface water monitoring locations in detail has been provided in **Table 4.9** and the locations are shown in **Figure 4.22***.*

Table 4.9: Surface Water Monitoring Locations

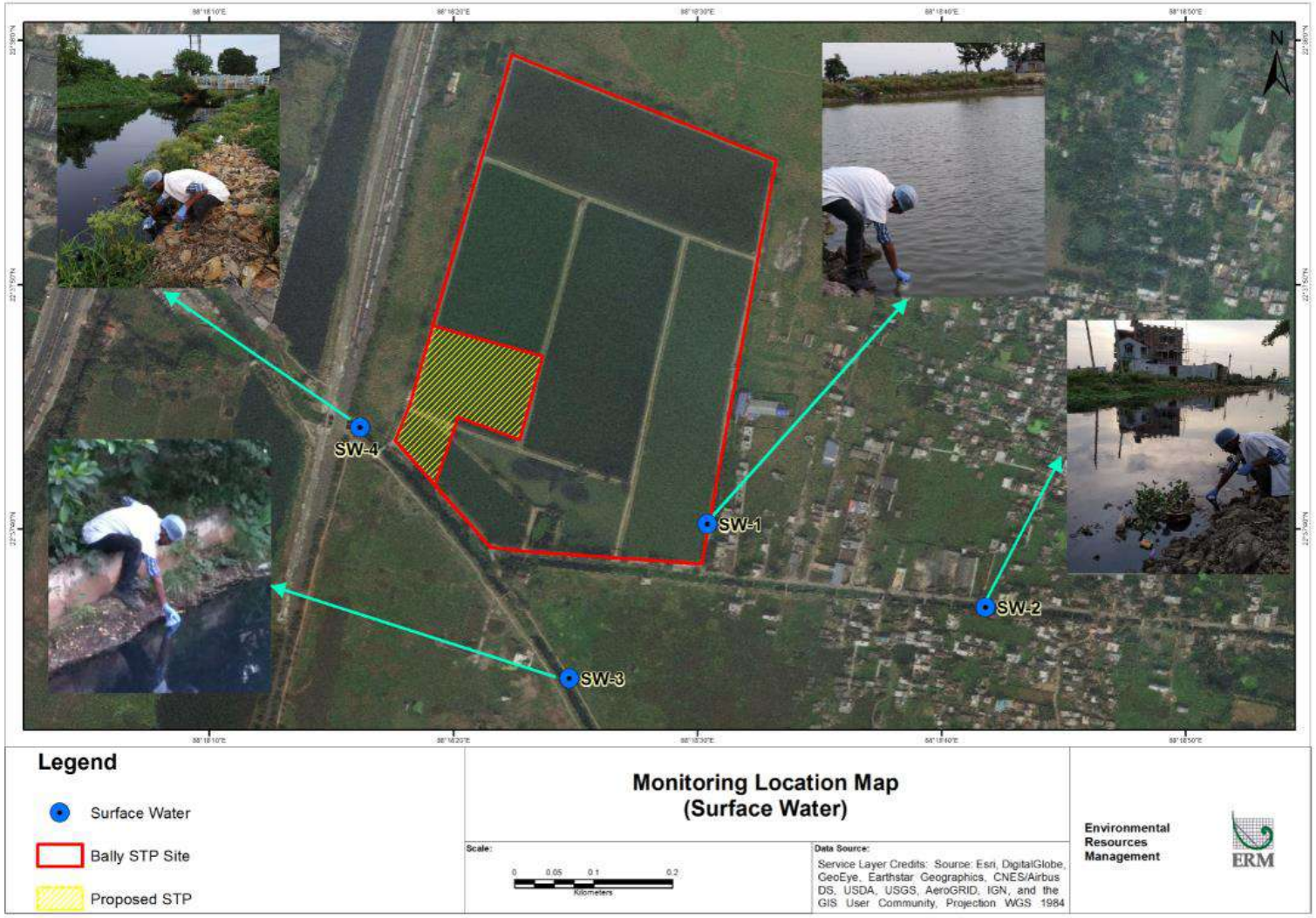
Sl No	Location	Station No	Latitude	Longitude
1	Outlet point of WSP	SW 1	22° 37' 40.22" N	88° 18' 30.41" E
2	Outlet Nala carrying the treated water	SW 2	22° 37' 36.81" N	88° 18' 41.80" E

Sl No	Location	Station No	Latitude	Longitude
3	Pacha Khal Upstream with respect to proposed STP location	SW 3	22° 37' 33.90'' N	88° 18' 24.74'' E
4	Pacha Khal Upstream with respect to proposed STP location	SW 4	22°37'44.18"N	88°18'16.17"E

Water sampling and analysis[21] was done during June 2019 following CPCB standard guidelines for physical, chemical and bacteriological parameters. Field parameters viz. temperature, pH, dissolved oxygen were analysed at the site. The samples are collected from upstream and downstream of the Pacha Khal with respect to the Proposed STP site to estimate the quality of the Pacha Khal prior to the implementation of the project. The samples are also collected from outlet point of maturation pond to estimate possible condition of the ponds which are used for fishing. A sample collected from the Nala carrying the treated water to the Howrah drainage channel to estimate the existing water quality prior to implementation of the project. The results of the samples collected from the surface water bodies in the study area have been discussed below with respect to CPCB's Water Use Criteria. (as provided in **Appendix G**.*)*

[21] http://www.cpcb.nic.in/latest/guidelines-water.doc

Figure 4.22 Surface Water Quality Monitoring Station Location Map



4.2.9.1 Surface water Monitoring Results

The surface water primary monitoring results have been provided in **Table 4.10**

Table 4.10: Surface Water Monitoring Results

Sl No.	Parameter	Location	Bhattanagar	Bhattanagar	Bhattanagar	Bhattanagar
		Sample Code	SW 1	SW 2	SW 3	SW 4
1	pH value	-	7.45 at 25 deg C	7.64 at 25 deg C	7.32 at 25 deg C	7.16 at 25 deg C
2	Turbidity	N.T.U.	24	78	66	12
3	Chloride (as Cl)	mg/l	228	376	267	297
4	Copper (as Cu)	mg/l	<0.02	<0.02	<0.02	<0.02
5	Fluoride (as F)	mg/l	0.20	0.11	0.09	0.08
6	Iron (as Fe)	mg/l	4.4	36	21	1.8
7	Manganese (as Mn)	mg/l	<0.02	0.22	0.33	0.32
8	Nitrate (as NO3)	mg/l	3.2	11	<0.5	<0.5
9	Sulphate (as SO4)	mg/l	68	14	4.8	15
10	Total Hardness (as CaCO3)	mg/l	349	372	238	349
11	Cadmium (as Cd)	mg/l	<0.001	<0.001	<0.001	<0.001
12	Lead (as Pb)	mg/l	<0.005	<0.005	<0.005	<0.005
13	Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001
14	Nickel (as Ni)	mg/l	<0.02	<0.02	<0.02	<0.02
15	Arsenic(as As)	mg/l	<0.005	<0.005	<0.005	<0.005
16	Sodium (as Na)	mg/l	107	149	124	105
17	Electrical conductivity	us/cm	1300	1677	1433	1369
18	Potassium (as K)	mg/l	26	23	20	18
19	Total Nitrogen (as N)	mg/l	2.9	5.8	2.6	2.3
20	Zinc (as Zn)	mg/l	<0.02	<0.02	<0.02	<0.02
21	Hexavalent Chromium (as Cr+6)	mg/l	<0.01	<0.01	<0.01	<0.01
22	Temperature	^{o}C	25	25	25	25
23	Dissolved Oxygen	mg/l	5.8	4.9	5.3	5.6
24	Biochemical Oxygen Demand (as BOD)	mg/l	12	80	52	14
25	Chemical Oxygen Demand (COD)	mg/l	47	270	188	51
26	Salinity	-	0.77 In respect to KCl equivalent salinity 35.	1.0 In respect to KCl equivalent salinity 35.	0.86 In respect to KCl equivalent salinity 35.	0.82 In respect to KCl equivalent salinity 35.
27	Phenol	mg/l	<0.001	<0.001	<0.001	<0.001

Sl No.	Parameter	Location	Bhattanagar	Bhattanagar	Bhattanagar	Bhattanagar
		Sample Code	SW 1	SW 2	SW 3	SW 4
28	Total Alkalinity (as CaCO3)	mg/l	197	228	332	318
29	Total Phosphorous	mg/l	0.17	0.09	0.34	0.50
30	Faecal coliform	MPN/100ml	140	220000	14000	2100
31	Total coliform	MPN/100ml	1100	2200000	350000	140000

4.2.9.2 Interpretation of Surface water Monitoring Results

Results of the water quality sampled from outlet point of WSP, Howrah drainage channel up-stream (with respect to WSP), Pacha Khal and Howrah drainage channel down-stream (with respect to WSP) are discussed below:

- ***pH*** – The range of pH value of the samples collected from 4 locations was 7.16 to 7.64. pH values of the samples indicate slightly alkaline water.
- ***Dissolved Oxygen (DO)***–DO concentrations of the water samples varies from 4.9 mg/l to 5.8 mg/l. Highest DO value was found in the sample taken from outlet point of WSP whereas lowest DO value found in the sample taken from up-stream of Howrah drainage channel.
- ***Biochemical Oxygen Demand (BOD)*** – The concentration of BOD for surface water samples varied from 12 mg/l to 80 mg/l. The lowest BOD value was found in the sample taken from outlet point of WSP whereas highest BOD value found in the sample taken from up-stream of Howrah drainage channel. The variation of BOD value in surface water samples is attributed to the different sources where from the samples were collected.
- ***Chemical Oxygen Demand (COD)*** – The concentration of COD for surface water samples varied from 47 mg/l to 270 mg/l. The lowest COD value was found in the sample taken from outlet point of WSP whereas highest COD value found in the sample taken from up-stream of Howrah drainage channel. The variation of COD value in surface water samples is attributed to the different sources where from the samples were collected.
- ***Faecal Coliform***– Faecal Coliform is present in all the sample. The concentration of faecal coliform in samples are varied from 140 to 220000 MPN/100ml. The lowest concentration of Faecal Coliform was found in the sample taken from outlet point of WSP whereas highest concentration found in the sample taken from up-stream of Howrah drainage channel.
- ***Total Coliform***- The range of the total coliform values found in the sample was 1100 to 2200000 MPN/100ml. The lowest concentration of Total Coliform was found in the sample taken from outlet point of WSP whereas highest concentration found in the sample taken from up-stream of Howrah drainage channel. The variation of Total Coliform concentration in surface water samples is attributed to the different sources where from the samples were collected.
- ***Salinity***-Salinity values in the samples ranges from 0.77 to 1.0.
- ***Turbidity***- turbidity values in the samples were varied from 12 to 78 N.T.U. The lowest value of turbidity was found in down-stream of Howrah drainage channel.
- The concentration of parameters of Copper, Phenol, Cadmium, Lead, Mercury, Nickel, Arsenic, Hexavalent Chromium (as Cr+6), and Zinc were found below the detection limit.
- ***Sodium***- The values Sodium in the samples varied from 105 to 149 mg/l.
- ***Chloride-*** The range of chloride concentration in the samples were found to be 69 to 158 mg/l.

- ***Total Alkalinity (as $CaCO_3$)-*** The alkalinity values of the samples were varied from 228 to 376 mg/l.
- ***Total Nitrogen (as N) and Potassium (as K)*** - The concentration of total nitrogen varied from 2.3 to 5.8 mg/l and for Potassium, it varied from 18 to 26 mg/l. The variation of Total nitrogen and potassium value in surface water samples is attributed to the different sources where from the samples were collected.
- ***Total Hardness (as $CaCO_3$) -*** The values of total hardness in the samples ranges between 238 to 372 mg/l. The variation of total hardness value in surface water samples is attributed to the different sources where from the samples were collected.
- ***Iron and Fluoride***- The values of Iron and Fluoride in the sample varied from 1.8 to 36 mg/l and 0.08 to 0.20 mg/l respectively.
- ***Nitrate and Sulphate***- The values of Nitrate and Sulphate in the sample varied from <0.5 to 11 mg/l and 4.8 to 68 mg/l respectively. The variation of nitrate and sulphate concentration in surface water samples is attributed to the different sources where from the samples were collected.

Due to higher concentration of Total coliform and BOD in SW-2, SW-3 and SW-3 samples, surface water cannot be classified as A, B and C category as per CPCB guideline. The total coliform is less in SW-1 compared to other samples but due to higher concentration of BOD, the sample cannot be classified as A, B, C category as per CPCB.

Note:

This is to be noted that, per NGT, Government of India vide their Order dated 30 April 2019 (Original Application No. 1069/2018 (M.A. No. 1792/2018, M.A. No. 1793/2018, I.A. No. 150/2019 & I.A. No. 151/2019)). The further Notification on any revised effluent discharge standards for STPs is awaited through official gazetted notification from the Ministry of Environment, Forests & Climate Change (Government of India) as on February 2020. Therefore, the surface water quality has been compared against the presently enforced effluent discharge standards for Sewage Treatment Plants as outlined under Environment (Protection) Amendment Rules, 2017.

4.2.10 Hydrogeology

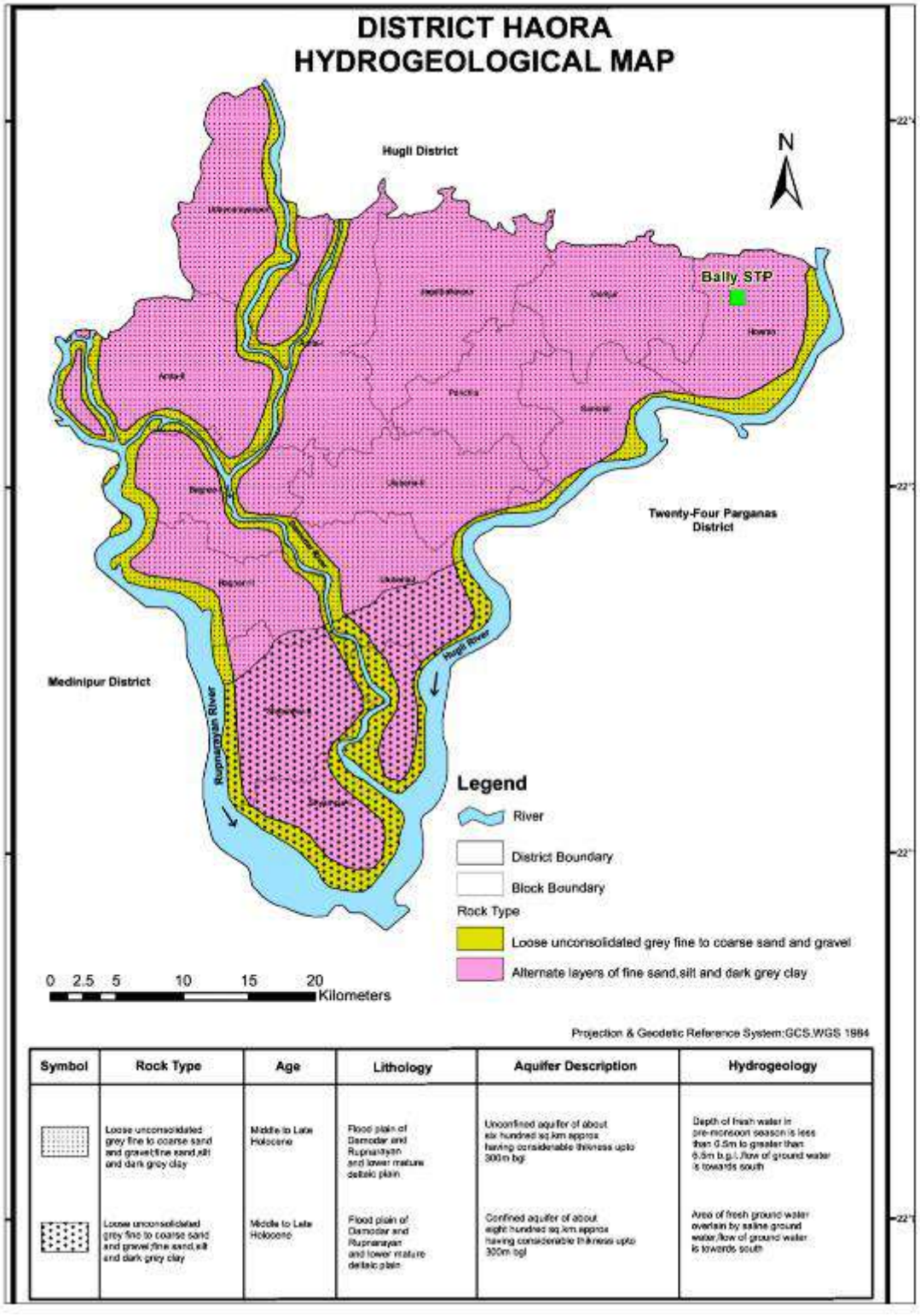
Groundwater occurs in the thick alluvium deposit of Bhagirathi-Hooghly River. The alluvium aquifers have high storage capacity. The aquifers of the study area can be categorized into upper unconfined aquifer and deeper Confined aquifer. The aquifer in some parts of the district occur at 4.235 mbgl near the Hooghly River. The shallow aquifer in the area are tapped by dug well whereas deeper aquifers are tapped by hand pumps and motor-fitted tube wells. The depth of the dug well in this area varies from 5 to 15m. In some parts of the district, the dug wells dried up during summertime. This phenomenon is observed where the dug wells developed in the silty zone or in the area where the aquifers are tapped partially. The aquifers in this district separated thick to thin clay layers. The reported potential aquifer zones ae reported up to a depth of 300m. The alluvium aquifers generally have a high Transmissivity value with high storage capacity.

As per Central Ground Water Board, Government of India, all the blocks of the district are categorized under ‘Safe’ category as the rate of groundwater recharge is more than ground water extraction rate. Some aquifers in the district contain brackish water with high TDS value. As per the Ground Estimation Calculation 1997 method, the total groundwater resource in the area is 33330 mham. The hydrogeological map of the district is shown in **Figure 4.23**.

In study area groundwater related information are collected through field survey and consultation with local people. The study is characterized as one of the high water table area. A number of dug wells present in the study area tapping the shallow aquifer. The water level in these dug wells are within 1.5 mbgl. During pre-monsoon, the water level in these dug wells varies from 1.5 to 2.3 mbgl as per our

discussion with the local people. The shallow aquifer in the area consist of fine to medium grain sand (as per our discussion with the local driller of the area). The shallow aquifer is in unconfined condition and this aquifer has a thickness up to 300 mbgl. A number of ponds present at the study area and these are groundwater-fed ponds.

Figure 4.23 Hydrogeological map of the district



Symbol	Rock Type	Age	Lithology	Aquifer Description	Hydrogeology
	Loose unconsolidated grey fine to coarse sand and gravel,fine sand,silt and dark grey clay	Middle to Late Holocene	Flood plain of Damodar and Rupnarayan and lower mature deltaic plain	Unconfined aquifer of about six hundred sq.km approx having considerable thikness upto 300m bgl	Depth of fresh water in pre-monsoon season is less than 0.5m to greater than 6.5m b.g.l./low of ground water is towards south
	Loose unconsolidated grey fine to coarse sand and gravel,fine sand,silt and dark grey clay	Middle to Late Holocene	Flood plain of Damodar and Rupnarayan and lower mature deltaic plain	Confined aquifer of about eight hundred sq.km approx having considerable thikness upto 300m bgl	Area of fresh ground water overlain by saline ground water,flow of ground water is towards south

Source: CGWB and SWID

4.2.11 Groundwater Quality

The Shallow and deeper aquifers in Howrah district are classified as Sodium-Bicarbonate facies. Presence of brackish water in the aquifers up to a depth of 150 m are reported from some part of the district. Groundwater throughout the district is slightly alkaline with pH varies from 7.90 to 8.40. Arsenic is mainly present in the shallow aquifers to deeper aquifers up to a depth of 50m in some parts of the district. The groundwater of the district is suitable domestic use except few pockets of contaminated groundwater[22].

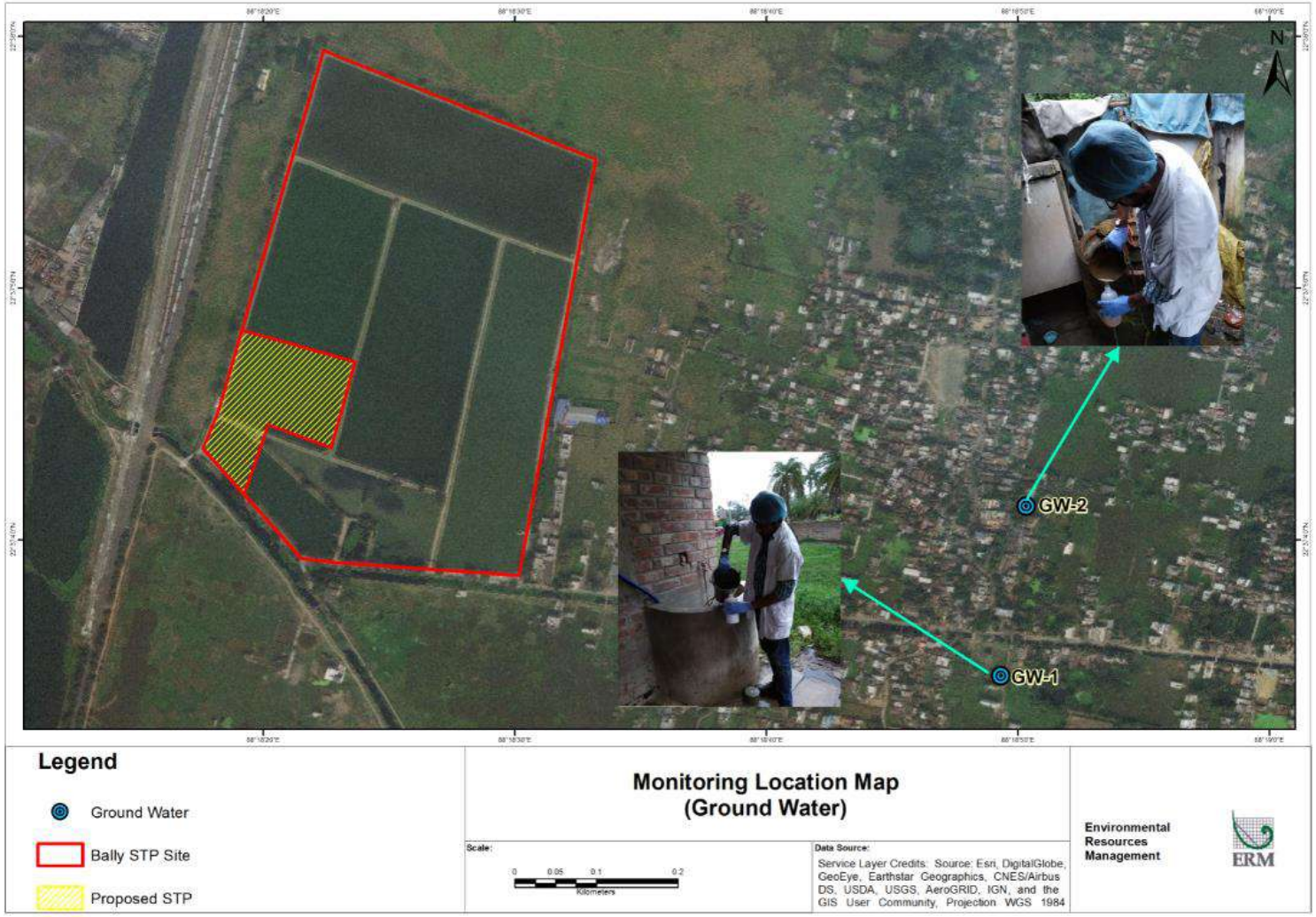
In order to establish the groundwater quality in the area surrounding to STP, monitoring was conducted at two stations near the study area. The ground water sampling has been conducted from dugwells adjacent to the project site to capture the existing quality of the ground water. The results can be used as a reference for future studies during operation phase. The location of the groundwater monitoring stations has been presented in **Table 4.11**.

Table 4.11: Groundwater Monitoring Locations in the Study Area

Sl No.	Monitoring locations	Station No	Latitude	Longitude	Source
1.	Bhattanagar	GW 1	22° 37' 34.61" N	88° 18' 49.32" E	Dug well
2.	Bhattanagar	GW 2	22° 37' 41.3436" N	88° 18' 50.3352" E	Dug well

[22] CGWB district wise report of Howrah.

Figure 4.24 Groundwater Sampling Location Map



4.2.11.1 Groundwater Quality Results

The result of groundwater quality as sampled in the study area has been provided in **Table 4.12**

Table 4.12: Groundwater Monitoring Results

Sl No.	Parameter	Location	Bhattanagar	Bhattanagar
		Sample Code	GW 1	GW 2
1	Colour	Hazen	<1.0	<1.0
2	Odour	-	Unobjectionable	Unobjectionable
3	pH value	-	7.24 at 25 deg C	7.68 at 25 deg C
4	Turbidity	N.T.U.	1.4	26
5	Total Dissolved Solids (as TDS)	mg/l	1720	1240
6	Aluminium (as Al)	mg/l	<0.01	<0.01
7	Anionic Detergents (as MBAS)	mg/l	<0.02	<0.02
8	Barium (as Ba)	mg/l	<0.05	<0.05
9	Boron (as B)	mg/l	<0.5	<0.5
10	Calcium (as Ca)	mg/l	251	116
11	Chloramines (as Cl2)	mg/l	<0.3	<0.3
12	Chloride (as Cl)	mg/l	524	377
13	Copper (as Cu)	mg/l	<0.02	<0.02
14	Fluoride (as F)	mg/l	0.45	0.69
15	Free Residual Chlorine	mg/l	<0.1	<0.1
16	Iron (as Fe)	mg/l	0.45	0.51
17	Magnesium (as Mg)	mg/l	88	37
18	Manganese (as Mn)	mg/l	<0.02	0.66
19	Mineral Oil	mg/l	<0.01	<0.01
20	Nitrate (as NO3)	mg/l	7	51
21	Phenolic Compounds (as C6H5OH)	mg/l	<0.001	<0.001
22	Sulphate (as SO4)	mg/l	283	25
23	Total Hardness (as CaCO3)	mg/l	996	443
24	Cadmium (as Cd)	mg/l	<0.001	<0.001
25	Lead (as Pb)	mg/l	<0.005	<0.005
26	Mercury (as Hg)	mg/l	<0.001	<0.001
27	Nickel (as Ni)	mg/l	<0.02	<0.02
28	Polychlorinated biphenyls (as PCB)	mg/l	<0.0005	<0.0005
29	Polynuclear Aromatic Hydrocarbons (as PAH)	mg/l	<0.0001	<0.0001
30	Arsenic(as As)	mg/l	<0.005	<0.005

Sl No.	Parameter	Location	Bhattanagar	Bhattanagar
		Sample Code	GW 1	GW 2
31	Zinc (as Zn)	mg/l	<0.02	<0.02
32	Hexavalent Chromium (as Cr+6)	mg/l	<0.01	<0.01
33	Sulphide (as S)	mg/l	<0.01	<0.01
34	Ammonia (as NH3)	mg/l	<0.1	<0.1
35	Total Alkalinity (as CaCO3)	mg/l	529	461
36	Faecal coliform	/100ml	Detected	Detected
37	Total coliform	/100ml	Detected	Detected

Source: ERM Primary Monitoring

4.2.11.2 Interpretation of Monitoring Results of Groundwater Quality

- pH of the groundwater samples were 7.24 and 7.68 for GW 1 and GW 2 respectively. The pH values of ground water samples were in compliance to the IS: 10500, 2012 drinking water standard of 6.5 to 8.5.
- Turbidity values of the groundwater samples were 1.4-26 NTU for GW 1 and GW 2 respectively. Turbidity value in GW 1 was within the permissible limit of 5 NTU but the turbidity value in GW 2 was exceed the permissible limit. The variation in turbidity values in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.
- Total Dissolved Solids –Concentration of total dissolved solids in groundwater samples were 1720 and 1240 mg/l GW 1 and GW 2 respectively. The values were above the acceptable limit of 500 mg/l but below the permissible limit of 2000 mg/l. Both the samples have higher TDS values compared to the WHO limit of 1000 mg/l.
- Total hardness (as $CaCO_3$) –The values of total hardness in groundwater samples were 996 and 443 mg/l GW 1 and GW 2 respectively. The value of GW 2 was below the permissible limit 600 mg/l but the total hardness value of GW 1 was above the permissible limit. The variation in total hardness value in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.
- Chlorides – The concentration of chlorides ranged between 524 and 377 mg/l. Chloride concentrations in both the sample is above the acceptable limit but below the permissible limit of 1000 mg/l.
- Total Alkalinity (as $CaCO_3$)–The alkalinity of the water samples monitored at study area ranged between 529 and 461 mg/l. Alkalinity were reportedly within the permissible limit (600 mg/l) for both the locations.
- Fluoride-Fluoride levels in the groundwater samples were 0.45 and 0.69 mg/l for GW 1 and GW 2 respectively. The samples were found to be in compliance to the acceptable limit of 1.0 mg/l.
- Sulphate-Sulphate concentrations in the groundwater samples were below the detectable limit of <0.01 mg/l for both the samples.
- Nitrate-Nitrate concentrations in all groundwater samples were found to be 7 and 51 mg/l for GW 1 and GW 2 respectively. Nitrate concentrations in GW 1 samples was found to be within the acceptable nitrate concentration limit of 45 mg/l but in case of GW 2 where the nitrate concentration was found to exceed the limit of acceptable limit. The variation in Nitrate

concentration in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.

- Nitrate if consumed, is reduced within the body to nitrite, which is considered unsafe at much lower levels than nitrate. Nitrite is further reduced in the body to N-nitroso compounds that are widely considered to cause cancer and contribute to a variety of health problems which includes Blue-baby syndrome, birth defects, cancers, thyroid problems and a variety of other health concerns. It is therefore recommended to treat the groundwater of Bayjiahowa before consumption[23].
- Iron- The concentration of iron monitored at 2 locations were found to be 0.45 and 0.51 mg/l for GW 1 and GW 2 respectively. Iron concentrations in both GW 1 & GW 2 were found to be exceeding the acceptable iron concentration limit of 0.3 mg/l. The variation in Iron concentration in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.
- Calcium- The concentration of calcium were 251 and 116 mg/l for GW 1 and GW 2 respectively. Calcium levels at all sample were found to be above to the acceptable limit of 75 mg/l but the Calcium concentration in GW 2 was within the permissible limit. The calcium concentration in both the samples exceeds WHO limit of 75 mg/l. The variation in Calcium concentration in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.
- Magnesium – The concentration of magnesium were observed to be 88 and 37 mg/l for GW 1 and GW 2 respectively. Magnesium levels in both the samples exceed the acceptable limit of 30mg/l as well WHO limits but below the permissible limit of 100 mg/l. The variation in Magnesium concentration in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.
- Manganese – The concentration of manganese were observed to be <0.02 and 0.66 mg/l for GW 1 and GW 2 respectively. Manganese levels at GW 1 were found to be in compliance to the acceptable limit of 0.1 mg/l and in GW 2 the Manganese concentration was above the permissible limit of 0.3 mg/l. The variation in Manganese concentration in the groundwater samples were observed as the samples were taken from different aquifers as stated above under this sub-section.
- Levels of Chloramines (as Cl2) (<0.3 mg/l), phenolic compounds (<0.001 mg/l), Polychlorinated biphenyls (as PCB) (<0.0005 mg/l), Polynuclear Aromatic Hydrocarbons (as PAH) (<0.0001 mg/l), Mineral oil (<0.01 mg/l) were found to be below detection limits in all the groundwater samples.
- Concentrations of metals Cd, Cu, Hg, Pb, Ni, As, B, Ba and Hexavalent Chromium were found to be below detection limits in the groundwater samples.
- Total and faecal coliforms were detected in both the groundwater samples collected from the study area.

The presence of Total coliform bacteria is not likely to cause illness, but their presence indicates that the water supply may be vulnerable to contamination by more harmful microorganisms. Escherichia coli (E. coli) are the only member of the total coliform group of bacteria that is found only in the intestines of mammals, including humans. The presence of E. coli in water indicates recent faecal contamination and may indicate the possible presence of disease-causing pathogens, such as

[23] NITRATE IN DRINKING WATER: A Public Health Concern For All Iowans, Iowa Environmental Council, September2016, Executive Summary.

* Detection of coliforms in drinking water and its effect on human health - A Review, international Letters of Natural Sciences Online:2014-06-30 ISSN: 2300-9675, Vol. 17, pp 122-131 doi:10.18052/www.scipress.com/ILNS.17.122 © 2014 SciPress Ltd., Switzerland

bacteria, viruses, and parasite. Therefore, it is advised to properly treat the groundwater prior to consumption.

Conclusion

The Concentration of majority of the parameters analysed were within the permissible limit of IS 10500, 2012 standard. pH values of groundwater samples were found to be below drinking water standard of IS 10500, 2012. The high values of Chloride, Nitrate, Faecal Coliform and Total Coliform as detected in both the samples indicate mixing of waste water with groundwater. In most of the area on the eastern part of the HMC show red colour Dugwell platform which indicates presence of higher concentration of iron in the groundwater of the area. The higher value of iron in the groundwater in many part of the Howrah district is also indicated in MDWS website. This to be noted that groundwater quality analysis was done instantaneous single sample basis from two random sources within the study area wherein some chemical parameters show variations. The reason for the variation required detailed study of the same aquifers with more than two samples along with seasonal variations.

4.2.12 Traffic and Transport

Traffic monitoring station was selected at the up and down direction of STP area. Traffic survey was conducted continuously for 24 hours, one time during the study period. The traffic survey was done for both way movement of vehicles and categorized as heavy motor vehicles (truck, bus, dumper, tanker and trailer), light motor vehicle (car, jeep, van, matador, tractor, tempo and mini bus), two/three wheelers (scooter, motor cycle, auto, moped) and non-motorized vehicles (bicycle, tricycle). Summary of traffic observed in the study area is presented in **Table 4.13**, detail result is provided in **Appendix H**.

Table 4.13: Traffic Values observed in the Project study area

Description	Bhattanagar (Up)	Bhattanagar (Down)
Heavy Motor Vehicles (in Number), 24 hours	0	0
Light Motor Vehicle (in Number), 24 hours	0	0
Two/Three Wheelers (in Number), 24 hours	70	66
Non-motorized Vehicles	83	82
Total PCU (Nos.) in 24 Hours (To & From)	94	90.5
Average PCU Flow/Hr	3.92	3.77
Max PCU (Nos)/Hr	10.5	11
Min PCU (Nos)/Hr	0	0
Maximum PCU Hours	17:00-18:00	07:00-08:00

4.2.12.1 Interpretation of Traffic Survey Results

Total 94 PCU and 90.5 PCU was recorded at the traffic monitoring station at Bhattanagar Up and Down Road respectively. As per observation made for traffic density, on an average 3.92 PCU and 3.77 PCU was recorded per hour at the locations, respectively. It was also noticed that contributor of the vehicular traffic at Bhattanagar Up and Down Road was Non-motorized vehicle and Two/three wheelers (Scooter, M.Cycle, Auto, Moped).

Figure 4.25 illustrates contribution of different type of vehicle towards total vehicular traffic at Bhattanagar Up and Bhattanagar Down

Figure 4.25 Ambient Noise Monitoring Results

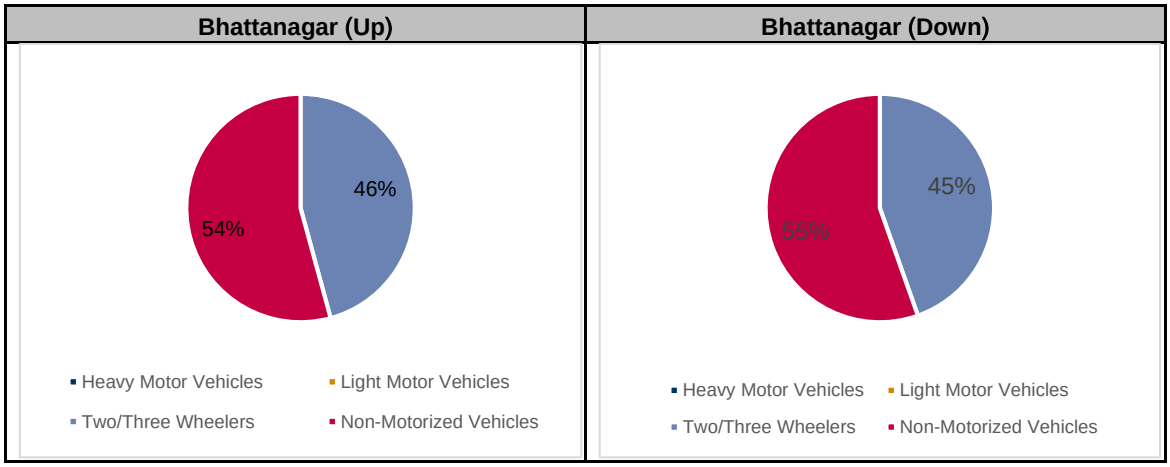


Figure 4.26 Road Traffic Monitoring Location Map

4.2.13 Natural Hazards

West Bengal is vulnerable to natural calamities like Flood, Cyclonic Storms, Earthquake, Landslides, Drought and Embankment erosion. The most prevalent hazards of Howrah district are Flood, Cyclone and Earthquake.

***Flooding*:** In view of its geographical location, presence of various rivers and streams vulnerable to major natural hazards, such as Floods. Howrah District is surrounded on three sides by three major rivers, namely Hooghly River, Mundeswari River and Rupnarayan River. In addition there are so many khals, channel and other small rivers serves drainage purpose in the district. Total length embankment/ channel under Howrah Irrigation Division in Howrah District is 826 km. This makes part of the district prevalently flood prone. Flood generally occurs during the month of late August to early part of the month of October. Besides flooding water logging is a major hazard in the Blocks and Municipal / Corporation areas. Congestion in drainage channels and unplanned growth has exacerbated the problems to a great extent. Floods during the year 1978, 2000, and 2015 played havoc on the lives and properties.

The area within 1 km of proposed STP facility experience water-logging situation during heavy rainfall as expressed by the local people. The area has good drainage, as the local people do not experience prolonged water-logging after heavy rainfall.

Future Climate Change Induced Flood risk Scenario:

Based on the report prepared by Climate Central on 29th October 2019 referring to the peer-reviewed paper published by Nature Communications[24], it is estimated that 237 million people in six Asian countries are at risk due to coastal flooding by 2050[25]. West Bengal and coastal Odisha are projected to be particularly vulnerable, as is the eastern city of Kolkata. It is estimated that by 2050, a major part of Kolkata urban area and its surroundings could lie in the annual coastal flood risk zone[26].

As per the CoastalDEM image provided under the Climate Central report, for future flood vulnerability projections during 2050, it appears that the proposed project location is vulnerable to flood, post completion of Concession period of 15 years and if appropriate mitigation measures are not adopted. Hence, as stated earlier the proposed project has minimum chances of experiencing such flood related vulnerability scenario even with respect to climate change throughout Concession period i.e. 15 years from the date of project inception.

[24] Kulp, S.A., Strauss, B.H. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. Nat Commun 10, 4844 (2019). https://doi.org/10.1038/s41467-019-12808-z

[25] The referenced scientific article has considered the reference timeframe for projected Climate Change Induced Flood Risk Scenario by 2050

[26] https://www.climatecentral.org/news/report-flooded-future-global-vulnerability-to-sea-level-rise-worse-than-previously-understood

Figure 4.27 Future Flood vulnerability map of Study Area, 2050

Earthquake: As per seismic hazard map the district of Howrah, lies in Zone III, which comes under Moderate risk zone (MSK VII)[27]. Zone III comprises of regions which have the risk of an earthquake with the maximum expected intensity of around 7.0 on MM scale.

4.3 Biological Environment

The study area has high population pressures and low ecological sensitivity. The study area falls under the lower Gangetic Delta. The proposed project and study area (1.0 km around the proposed STP) comprises of a modified ecological habitat, influenced considerably by urban pressures on land use as well as on flora and fauna. The predominant land use-land cover of the study area includes urban settlements, surface waterbodies, road, railway and plantation (homestead, besides the road and railway line and industry).

4.3.1 Ecological Habitats of Conservation Importance

4.3.1.1 Terrestrial Habitat

The study area can be categorised as urban area, settlement with homestead plantation, plantation besides the canal, road and railway line side. The terrestrial habitat in the study area is a modified ecosystem due to anthropogenic interference.

4.3.1.2 Aquatic Habitat

The surface waterbodies are located within the project site and in the study area. The surface water bodies are mostly man-made and some natural depression area. These surface water bodies are mostly used for pisci-culture (common carps, tilapia and nylontica).

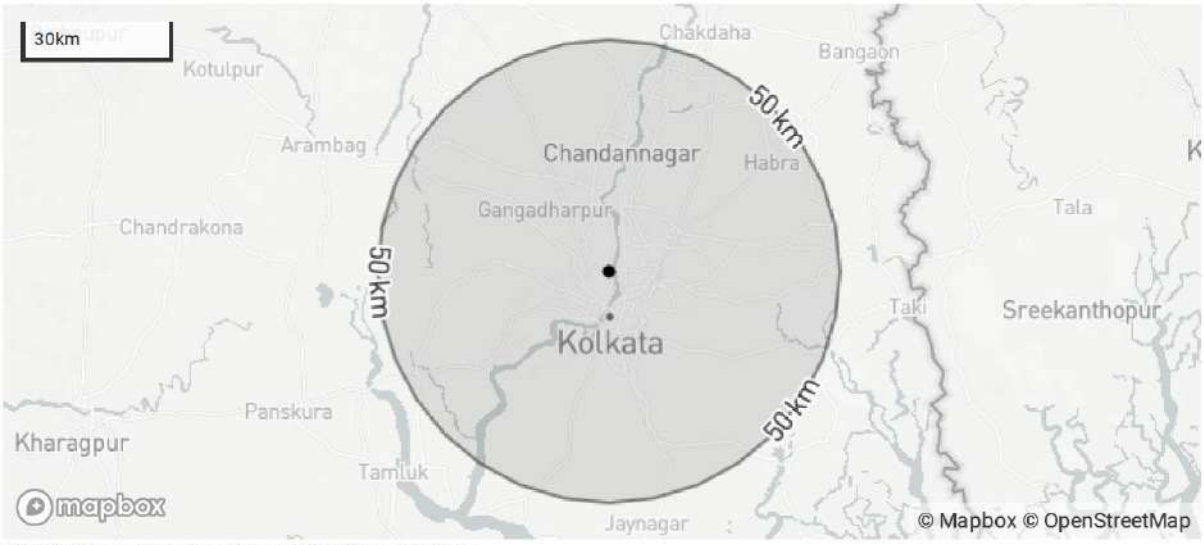
[27] West Bengal Disaster Management Plan for Howrah district- 2018

4.3.1.3 Legally protected areas for terrestrial and aquatic ecosystem

There are no legally Protected Areas like Wildlife Sanctuary, National Park, Tiger Reserve, etc. in the study area (1.0 km around the STP) as well as within 10km radial area around the proposed STP.

4.3.1.4 IBAT Assessment

A basic risk screening on biodiversity related sensitivity was undertaken utilising the Integrated Biodiversity Assessment Tool (IBAT), that draws together information on globally recognised biodiversity information drawn from a number of IUCN's Knowledge Products: IUCN Red List of Threatened Species, Key Biodiversity Areas (priority sites for conservation) and Protected Planet/The World Database on Protected Areas (covering nationally and internationally recognised sites, including IUCN management categories I–VI. The proximity analysis identified two protected areas within 50 kms radius from the site – East Kolkata Wetlands, a Ramsar site and Chintamani Kar Bird Sanctuary, Narendrapur. No key biodiversity areas (KBAs) was found to be resent within 50 kms radius of the STP site.



Displaying project location and buffers: 50.0 km

4.3.2 Terrestrial Ecosystem

4.3.2.1 Flora

4.3.4.1.2 Project Site

The proposed STP will be constructed in the existing FP, AP and MP ponds of the Bally WSP. Ecological survey was carried out on 1st week of September 2019. The vegetation including mature trees were recorded along the periphery bunds of the AP, FP and MP ponds.

The predominant tree species recorded during site visit were *Lagerstroemia speciose, Eucalyptus spp., Trema orientalis, Swietenia macrophylla, Dalbergia sissoo, Bombax ceiba, Delonix regia, Swietenia macrophylla, Phoenix dactylifera, Cocos nucifera, Lagerstroemia speciose, etc. The shrubs and herbs species recorded during site visit were Caesalpinia pulcherrima, Calotropis procera, Amaranthus spinosus, Boerhavia repens, Cassia sophera, Cassia tora, Ervatamia divaricate, Jatropha curcas, Hibiscus rosa-sinensis, Tabernaemontana divaricate, Pennisetum purpureum* etc.

Figure 4.28 Photographs of Vegetation at the STP Facility

Vegetation in the bank of existing Ap, MP, FP Ponds

Vegetation in the bank of existing Ap, MP, FP Ponds

Vegetation in the bank of existing AP, MP, FP Ponds

4.3.4.1.3 Study Area

The major habitats in the study area are homestead land vegetation, riparian vegetation, road and railway side plantation. Habitat wise pre-dominant vegetation are as follows:

- ***Homestead land vegetation:*** In the homestead land vegetation linked with settlements include tree species like mango (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*), coconut *(Cocos nucifera),* neem (*Azadirachta indica*), Indian Palm (*Borassus flabellifer*), siris (*Albizia lebbeck*), date Palm (*Phoenix sylvestris*), guava (*Psidium guajava*), sajina (*Moringa oleifera*), tamarind (*Tamarindus indica*), arjun (*Terminalia arjuna*), chhatim (*Alstonia scholaris*), jam (*Syzigium cumini*), radhachura (*Peltophorum pterocarpum*), simul (*Bombax ceiba*), sisoo (*Dalbergia sisoo*), rain Tree (*Samanea saman*), debdaru (*Polyalthia longifolia*), Bel (*Aegle marmelos*) Ata (*Annona squamosa*), Jam (*Syzygium cumini*) Kul (*Zizyphus mauritiana*), Teak (*Tectona grandis*) etc. The shrubs and herbs includes *Desmodium gangeticum, Ervatamia divaricate, Gardenia jasminoides, Gossypium herbaceum, Hibiscus rosa-sinensis, Ixora coccinea, Jasminum multiflorum, Jatropha curcas, Musa paradisiaca*, etc.
- ***Riparian Vegetation:*** The banks of canals and surface waterbodies within the study area have some riparian vegetation. The dominant species of riparian vegetation are *Alstonia scholaris, Syzygium cumini, Cocos nucifera, Trema orientalis, Casuarina equisetifolia, Bombax ceiba* etc.
- ***Road and Railway side vegetation:*** The plantation was also recorded besides the road and railway side as well as railway yard. Major tree species are *Acacia Arabica, Acacia auriculiformis, Albizia lebbeck, Albizia procera, Alstonia scholaris, Annona squamosal, Anthocephalus chinensis, Azadirachta indica, Bauhinia racemose, Bombax ceiba, Borassus flabellifer, Cassia siamea, Dalbergia sissoo, Delonia regia, Eucalyptus globosus, Ficus benghalensis, Ficus racemose, Ficus religiosa, Lagerstroemia speciose, Leucaena leucocephala, Mangifera indica, Mimus opselengi, Moringa oleifera, Peltophorum pterocarpum, Phoenix sylvestris, Polyalthia*

longifolia, Pongamia glabra, Sesbania grandiflora, Samanea saman, Spathodea campanulata, Spondias mangifera, Swietenia mahagoni, Syzygium cumini, Tamarindus indica, Tectona grandis, Terminalia arjuna, Trema orientalis. The shrubs and herbs are Adhatoda vasica, Caesalpinia pulcherrima, Calotropis procera, Cassia tora, Caesalpinia bonduc, Datura metel, Desmodium gangeticum, Jatropha curcas, Lantana camara, Ricinus communis, Thevetia peruviana, Vitex negundo, etc.

Figure 4.29 Photographs of Vegetation Present at the Study Area

Road side vegetation

Marshy Land with vegetation

Riparian vegetation around pond

Riparian vegetation around the pond

Homestead land Vegetation

Homestead land Vegetation

4.3.2.2 Fauna

There is no natural forests in the entire study area. The diversity of fauna (mammals, birds, reptiles and amphibian) species recorded in the modified habitat was low. The species recorded and reported in the study area has been presented in following table.

Table 4.14: Faunal Species Recorded/ Reported in Study Area

S. No.	Common Name	Scientific Name	Wildlife Schedule	IUCN Status (2017-3)
A.	**Mammals**			
1.	Lesser Bandicoot Rat	*Bandicota bengalensis*	V	LC

S. No.	Common Name	Scientific Name	Wildlife Schedule	IUCN Status (2017-3)
2.	Five Stripped Palm Squirrel	*Funambulus pennatti*	-	LC
3.	Little Indian Field Mouse	*Mus booduga*	V	LC
4.	House Mouse	*Mus musculus*	V	LC
5.	Indian Flying Fox	*Pteropus giganteus*	V	LC
6.	Small Indian Civet	*Viverricula indica*	II	LC
7.	Common Palm Civet	*Paradoxurus hermaphroditus*	II	LC
8.	Golden Jackal	*Canis aureus*	II	LC
9.	Indian Grey Mongoose	*Herpestes edwardsii*	II	LC
B.	**Avi-fauna**			
10.	Jungle Myna	*Acridotheres fuscus*	IV	NT
11.	Common Myna	*Acridotheres tristis*	IV	LC
12.	Common Kingfisher	*Alcedo atthis*	IV	LC
13.	White-breasted Kingfisher	*Halcyon smyrnensis*	IV	LC
14.	White-breasted Waterhen	*Amaurornis phoenicurus*	IV	LC
15.	Asian Openbill Stork	*Anastomus oscitans*	IV	LC
16.	Indian Pond Heron	*Ardeola grayii*	IV	LC
17.	Spotted Owlet	*Athene brama*	IV	LC
18.	Cattle Egret	*Bubulcus ibis*	IV	LC
19.	Purple Sunbird	*Cinnyris asiaticus*	IV	LC
20.	Common Pigeon	*Columba livia*	IV	LC
21.	Oriental Magpie-Robin	*Copsychus saularis*	IV	LC
22.	House Crow	*Corvus splendens*	IV	LC
23.	Asian Palm Swift	*Cypsiurus balasiensis*	IV	LC
24.	Black Drongo	*Dicrurus macrocercus*	IV	LC
25.	Little Egret	*Egretta garzetta*	IV	LC
26.	Intermediate Egret	*Egretta intermedia*	IV	LC
27.	Asian Koel	*Eudynamys scolopacea*	IV	LC
28.	Coppersmith Barbet	*Megalaima haemacephala*	IV	LC
29.	Green Bee eater	*Merops orientalis*	IV	LC
30.	Black Kite	*Milvus migrans*	I	LC
31.	Common Tailorbird	*Orthotomus sutorius*	IV	LC
32.	House Sparrow	*Passer domesticus*	IV	LC
33.	Little Cormorant	*Phalacrocorax niger*	IV	LC
34.	Baya Weaver	*Ploceus philippinus*	IV	LC
35.	Rose-ringed Parakeet	*Psittacula krameri*	IV	LC
36.	Red-vented Bulbul	*Pycnonotus cafer*	IV	LC
37.	Red wattled Lapwing	*Vanellus indicus*	IV	LC
38.	Pied kingfisher	*Ceryle rudis*	IV	LC

S. No.	Common Name	Scientific Name	Wildlife Schedule	IUCN Status (2017-3)
C.	**Reptiles**			
39.	Common garden lizard	*Calotes versicolor*	-	LC
40.	House gecko	*Hemidactylus flaviviridis*	-	LC
41.	Common Skink	*Mabuya carinata*	IV	LC
42.	Common Rat snake	*Ptyas mucosus*	II	LC
43.	Buff striped keelback	*Amphiesma stolatum*		LC
44.	Checkered keelback	*Fowlea piscator*		LC
45.	Bengal monitor	*Varanus bengalensis*		LC
D.	**Amphibians**			
46.	Common Indian Toad	*Duttophrynus melanostictus*	IV	LC
47.	Indian Bull Frog	*Hoplobatrachus tigerinus*	IV	LC

4.3.3 Aquatic Ecosystem

4.3.3.1 Aquatic Vegetation

Aquatic macrophytes are mainly recorded in the surface waterbodies and marshy land in the study area. Major species recorded in these habitats were *Ipomea aquatica, Ipomoea carnea, Alternanthera sessilis, Enhydra fluctuens, Typha angustifolia, Lemna perpusilla, Phragmites karka, Pistia stratiotes, Typha angustifolia, Wolffia arrhizal* etc.

4.3.3.2 Aquatic Fauna

4.3.5.2.1 Fishes

The canal system in the study area are mostly used for discharge of untreated sewage from the urban area and drainage of surface runoff during monsoon season. The canals are not suitable habitat for aquatic fauna, especially for fishes. The fishes are mostly reported from the surface water bodies (ponds) in the study area:

Anguilla bengalensis bengalensis (Ban), *Amblypharyngodon mola* (Morala), *Anabas testudineus* (Koi), *Catla catla* (Catla), *Channa punctatus* (Lata), *Channa striatus* (Shol), *Cirrhina mrigala* (Mrigel), *Clarius batrachus* (Magur), *Glossogobius giuris* (Beley), *Heteropneustes fossilis* (Singi), *Hypopthalmicthys molitrix* (Silver carp), *Labeo bata* (Bata), *Labeo calbasu* (Calbaush), *Labeo rohita* (Rui), *Mystus tengara* (Tengra), *Oreochromis mossambicus* (Tilapia), *Oreochromis niloticus* (Nilotica), *Puntius chola* (Puti), *Puntius ticto* (Puti), etc.

4.3.5.2.2 Birds

The aquatic birds were recorded in the study area *Alcedo atthis, Amaurornis phoenicurus, Egretta garzetta, Egretta intermedia, Phalacrocorax niger, Halcyon smyrnensis, Ceryle rudis* etc.

4.3.4 Ecological Species of Conservation Importance

The Black Kite (*Milvus migrans*) is only the faunal species is Schedule I species under Indian Wildlife Protestation Act 1972. The other floral and falunal species recorded/ reported from the study area are not protected under Wildlife Protestation Act 1972 or IUCN Red List.

4.4 Socio-economic Environment

4.4.1 Approach and Methodology for Socio-economic Study

This section establishes the socio economic baseline of the project area for the Sewage Treatment Plant (STP) to be located in Bally, which is located in Howrah Municipal Corporation (HMC), and falls under the Howrah District in West Bengal. Bally was previously a municipality until it merged with Howrah Municipal Corporation in 2015. Baseline data is collected from the 2011 Census of India before Bally merged with Howrah Municipal Corporation (HMC), therefore the 2011 census data from Bally Municipality will be analysed, as it will give a more accurate profile of the demography in the project area. This baseline will thus provide a context for assessing the impacts of the project on the socio-economic environment of the area where the STP will be established.

The socio economic baseline study has been carried out through collection and analysis of primary data (based on a structured tool and provided as **Appendix I**) as well as secondary data. Over 25 households (HHs) residing in proximity to the STP and its linked facilities in Bally were surveyed during the month of August, 2019.

4.4.2 Study Area

4.4.2.1 Study Area for Primary Socio-Economic Survey

The study area for the primary socio-economic baseline has been established as the one kilometre radius around the Bally STP. Since the WSP-based STP is located in Bally Jagacha C&RD Block, for analysis of the baseline condition within the one km radius of the STP facility, the concerned census towns under Bally Jagacha C&RD Block, has been considered for the study, which include Chamrail, Chakpara and Khaliya. As per the one km radius drawn on google earth, it is observed that only a certain percentage of the town area fall within the one km radius (refer **Figure 4.30**). The percentage was calculated based on the google earth map and accordingly the percentage of the population was considered out of the total population given in Census 2011. For example, 80% of Chakpara CT has been considered, so the total population representation is 80% of the total population in Chakpara CT as per Census 2011.

4.4.2.2 Study Area for Socio-economic Status of Settlements near STP

A socio- economic baseline has been conducted on the settlements situated within one-kilometre radius of the Bally WSP. Available primary information through site assessments as well as secondary data from the 2011 Census of India reports were analysed to ascertain the socio-economic parameters and trends of the study area. Since the WSP-based STP is located in Bally Jagacha C&RD Block, for analysis of the baseline condition within the one kilometre radius of the STP facility, concerned census towns under Bally Jagacha C&RD Block, has been considered for the study. The main settlements in the vicinity of the Bally WSP site are Chamrail, Chakpara and Khaliya, which are census towns. Since a proportion of Chakpara falls outside the defined radius of one-kilometre from the STP, the proportion for the study has been defined accordingly, based on google imagery analysis. Therefore, 80% of the population in Chakpara settlement will be considered for the study, while 100% of both Chamrail and Khaliya populations, will be considered for the study **(Table 4.15)**.

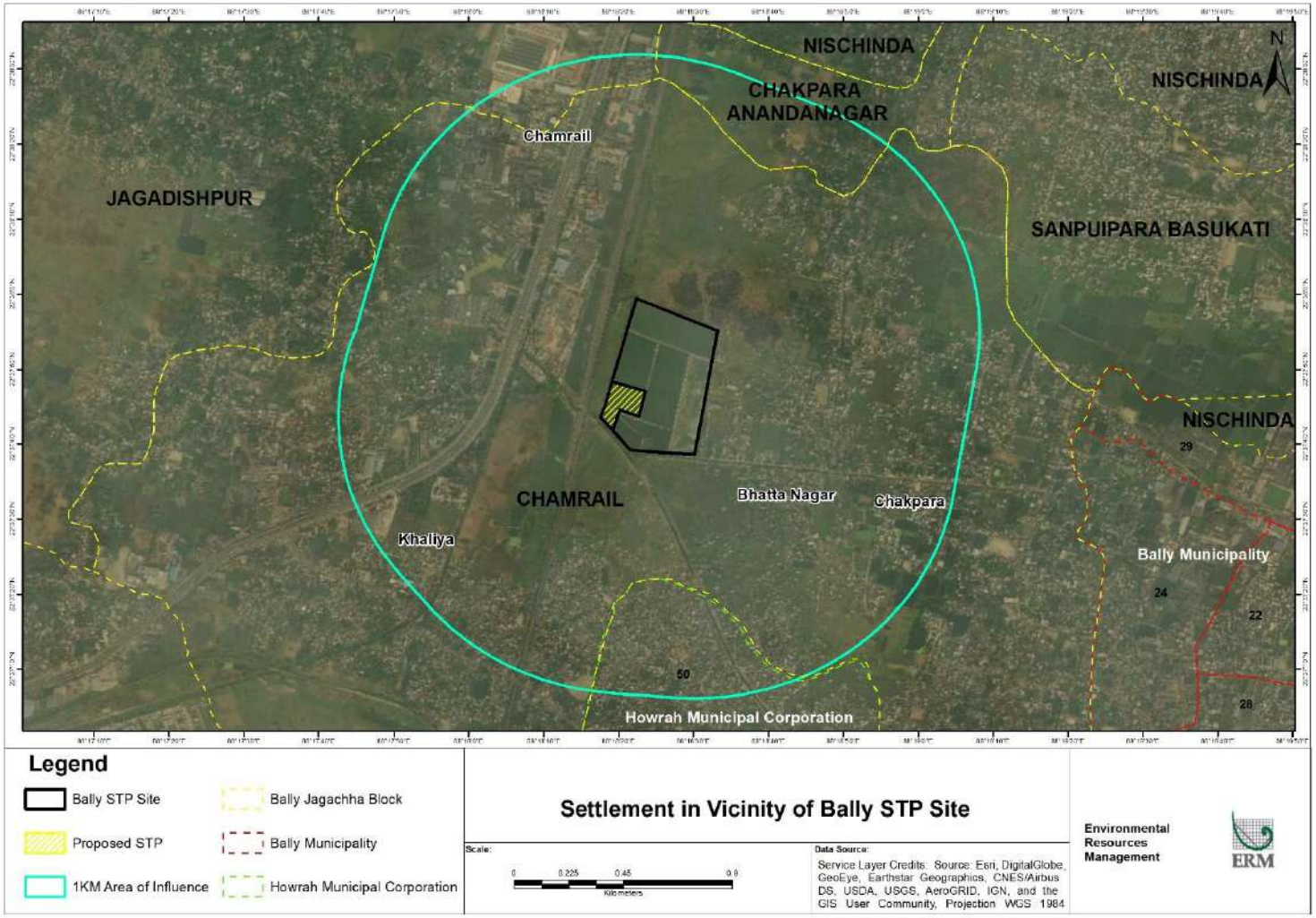
Table 4.15: Settlements and Percentage for Consideration for Baseline Study

STP Location	Settlement Name	% Considered for Baseline Study
Bally	Chakpara	80%
	Chamrail	100%

STP Location	Settlement Name	% Considered for Baseline Study
	Khaliya	100%

The settlements in the vicinity of the Bally WSP are presented in **Figure 4.30** below.

Figure 4.30 Settlements in Vicinity of Bally STP Site



4.4.2.3 Study Area for Socio-economic Status of Settlements along Sewer Lines

A socio- economic baseline has been conducted on the settlements situated within a 500 metre buffer on each side of the sewer line alignment. Available primary information through site assessments as well as secondary data from the 2011 Census of India reports were analysed to ascertain the socio-economic parameters and trends of the study area. These settlements are located in various wards across Bally Municipality and Howrah Municipal Corporation (HMC). Demographic data from these settlements has been sourced from the 2011 Census of India reports and since some proportion of the settlements fall outside the defined 500 metre buffer from the sewer line alignment, the proportions have been defined accordingly based on google imagery analysis.

In Bally Municipality, the settlements along the sewer line alignment include ward numbers 1, 2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,26, and 27.

In HMC, the settlements along the sewer line alignment include wards numbers 1,2,3,4,5,11,12,13,14 and 15.

An analysis of the google earth map (**Figure 4.31**) indicates that a proportion of the settlements in the wards are located outside the 500 metre buffer zone, therefore, based on the analysis, proportionate percentages of the respective municipal wards have been considered for the baseline study which have been detailed in **Table 4.16**.

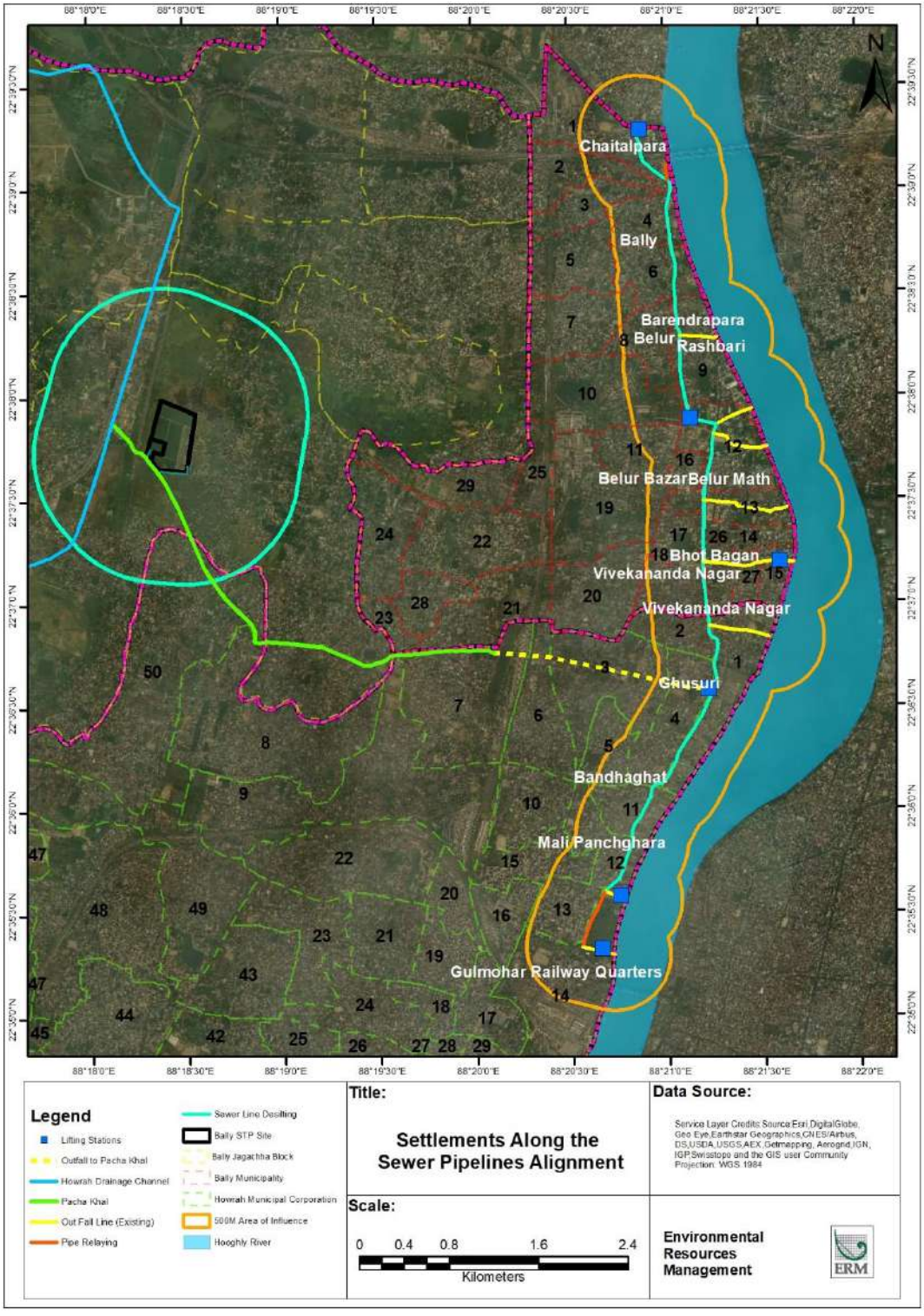
Table 4.16: Settlements and Percentage of Respective Municipal Wards near along Sewer Lines, under Baseline Study

STP Location	Municipality	Ward Number	% Considered for Baseline Study
Bally STP Location	Bally	1	60%
	Bally	2	40%
	Bally	3	40%
	Bally	4	95%
	Bally	6	100%
	Bally	7	10%
	Bally	8	90%
	Bally	9	100%
	Bally	10	30%
	Bally	11	40%
	Bally	12	100%
	Bally	13	100%
	Bally	14	100%
	Bally	15	100%
	Bally	16	100%
	Bally	17	100%

STP Location	Municipality	Ward Number	% Considered for Baseline Study
	Bally	18	90%
	Bally	19	20%
	Bally	20	5%
	Bally	26	100%
	Bally	27	100%
	HMC	1	100%
	HMC	2	80%
	HMC	3	20%
	HMC	4	100%
	HMC	5	40%
	HMC	11	100%
	HMC	12	80%
	HMC	13	95%
	HMC	14	20%
	HMC	15	30%

The ward level data of the population along the sewer lines have been presented in Figure 4.31 below.

Figure 4.31 Settlements Along Sewer Line



4.4.3 Administrative Structure

The Bally WSP-based STP and its linked facilities are dedicated for the sewerage system of Bally, which is the north-eastern part of Howrah Municipal Corporation (HMC). Prior to 2015, Bally was a separate municipality; therefore the broader level contextual setting of the baseline conditions, 2011 Census Data from Bally Municipality has been considered. Additionally, since the WSP-based STP is located in Bally Jagacha C&RD Block, for analysis of the baseline condition within the one- kilometre radius of the STP facility, concerned census towns under Bally Jagacha C&RD Block, has been considered.

4.4.3.1 Howrah District

Howrah district covers a total area of 1467 sq. km. The northern part of the district shares a boundary with Hooghly district, the eastern boundary is shared with the Hooghly River, North 24 Parganas and South 24 Parganas districts, the southern boundary is shared with Purba Medinipur district and the western boundary is shared with Paschim Medinipur District. The district consists of two sub-divisions i.e. Haora Sadar sub-division and Uluberia sub division. It has 14 Community Development blocks, one Municipal Corporation i.e. the Howrah Municipal Corporation and Uluberia Municipality. The district has a total of 650 villages and 138 census towns.

4.4.3.2 Bally Municpality

Bally is situated in the north-eastern part of HMC, along the banks of the Hooghly River, towards its eastern side. Towards the north, Bally locality is surrounded by Bally Khal, a canal, towards the west is Belanagar and towards the south is Belur. During the years 1882-83, a portion of HMC separated and formed into Bally Municipality, however, in August 2015, Bally Municipality re-merged with HMC. Bally is close to Kolkata city and is also in the jurisdiction of Kolkata Metropolitan Development Authority (KMDA). The town has over 449 kms in road length and has both open and closed drains. Historically, Bally had many jute mills.

4.4.4 Demographic Profile of the Study Area

4.4.4.1 Howrah District

As per the 2011 Census of India, the total population of Howrah district is 4,850,029 comprising of 1,061,336 households (**Table 4.17**). Out of the total population, 2,500,819 are men and 2,349,210 are women. The total number of Schedule Caste (SC) population is 718,951, with 367,053 men and 351,898 women. The total number of Schedule Tribe (ST) population however is 15,094 with 7,761 men and 7,333 women. Moreover, as per the 2011 Census of India, the average annual growth of the population in the HMC was 1.35% as the population was 838,520 in 2001 and increased to 1,061,336 in 2011.

Table 4.17: Population Trends of Howrah District

Index	2011	2001
Total Households	1,061,336	838,520
Total Population	4,850,029	4,273,099
Population Density Per Sq. K.M	3,306	2,913
Sex Ratio	939	906
Average Annual Increase	1.35	1.46
Average Household (HH) size	4.6	5.1

Source: Census of India 2011

4.4.4.2 Bally Municipality

As per the 2011 Census of India, Bally has a total population of 293,373 individuals residing in 55,619 households and constitutes approximately 6% of the district's population. Out of the total population, men constitute 156,911 while women constitute 136,462. The population density is 24,841 individuals per square kilometre, which is much higher than the district average i.e. 3,306 individuals per square kilometre. The average annual growth of the population in Bally Municipality was 1.24% as the population was 260,906 numbers in 2001 and increased to 293,373 numbers in 2011 (**Table 4.18**).

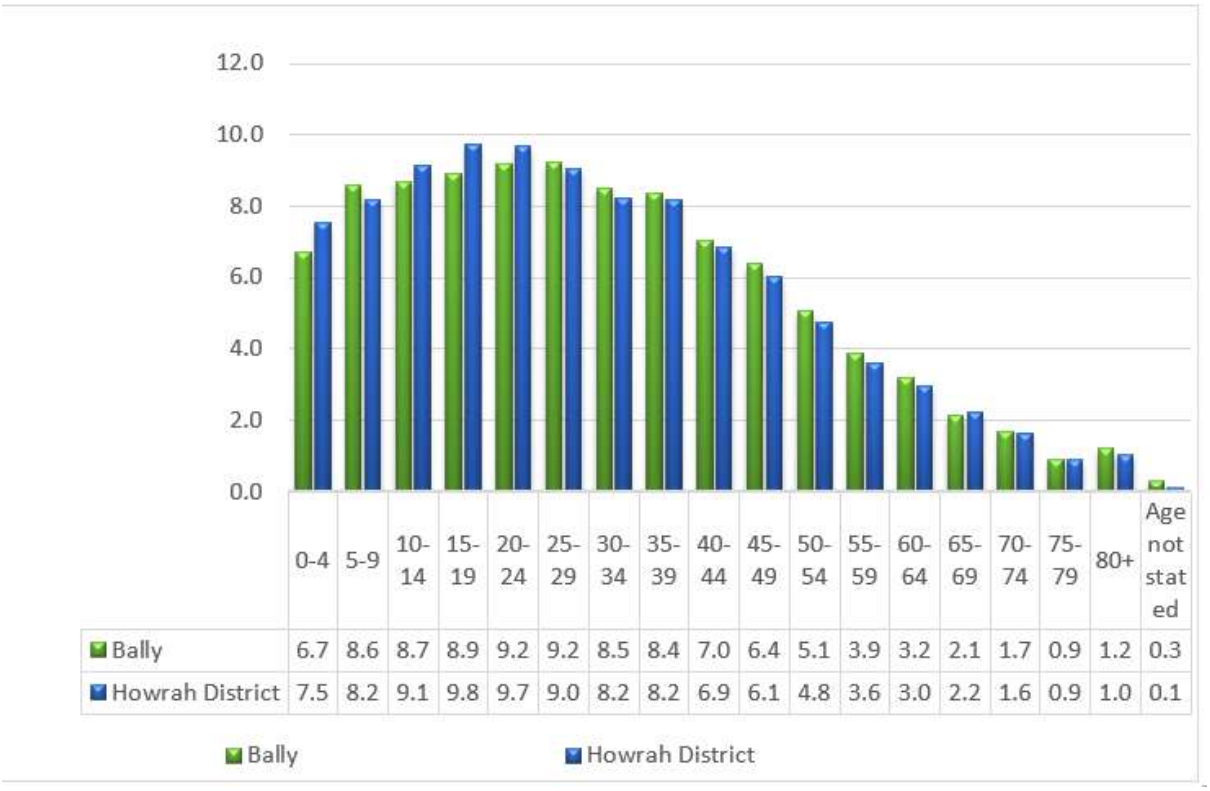
Table 4.18: Population Trends of Bally Municipality

Index	2011	2001
Total Households	55,619	49,897
Total Population	293,373	260,906
Population Density Per Sq. K.M	24,841	22,092
Sex Ratio	870	744
Average Annual Increase	1.24	4.14
Average Household (HH) size	5.27	5.22

Source: Census of India 2011

The figure below **(Figure 4.32**) presents the age wise distribution among the population in Bally Municipality as well as the Howrah district. At both the district and municipal level, it can been seen that the age category with the highest population is 25-29 at 8.9%, followed by the age category of 20-24 at 9.2% for Bally and 9.0% for Howrah district.

Figure 4.32 Age Wise Distribution of Population



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Age not stated
Bally	6.7	8.6	8.7	8.9	9.2	9.2	8.5	8.4	7.0	6.4	5.1	3.9	3.2	2.1	1.7	0.9	1.2	0.3
Howrah District	7.5	8.2	9.1	9.8	9.7	9.0	8.2	8.2	6.9	6.1	4.8	3.6	3.0	2.2	1.6	0.9	1.0	0.1

Source: Census of India 2011

4.4.4.3 Demographic Profile of Settlements near STP

The main settlements in the vicinity of the Bally WSP based STP are Chakpara, Chamrail and Khaliya. Presented below (**Table 4.19**) is the demographic profile of the census towns within one kilometre radius of the STP, as per the 2011 Census of India. An analysis of the data indicates that there are approximately 11,491 HHs and a population of 46,414 persons, collectively within the defined radius. Out of 46,414 persons, 52% (23,930) are male, and 48% (22,484) are female and the average HH size is 4.1.

Table 4.19: Demographic Data of Settlements around Bally STP based on Percentage of Respective Municipal Wards Considered under Study Area

Settlement	Total HHs	Total Population	Average HH Size	Male	%	Female	%
Chakpara	7,018	28,226	4.0	14,682	52	13,544	48
Chamrail	3,008	11,923	4.0	6,083	51	5,840	49
Khaliya	1,465	6,265	4.3	3,165	51	3,100	49
Total	**11,491**	**46,414**	**4.1**	**23,930**	52	**22,484**	48

Source: Census of India 2011

4.4.4.4 Demographic Profile of Settlements along Sewer Lines

The ***Table 4.20*** below presents the demographic profile of the municipal wards and settlements within the 500 metre buffer of the sewer line alignment, as per the Census 2011. An analysis of the percentage of ward area considered under the study area and proportionally the percentage population of the respective municipal wards, indicates that there are approximately 49,126 HHs and a population of 241,787 persons, collectively, within the defined buffer zone. Out of 241,787 persons, 54% (131,581) are male, and 46% (110,206) are female and the average HH size is 4.9. It is observed that ward number 13 of HMC has the highest population density with 23,177 persons, followed by ward number 1, also in HMC, with 21,685 persons. It is observed that ward number 20 in Bally Municipality has the lowest population density within the buffer zone, with 479 persons, followed by ward number 7, also in Bally Municipality, with 640 persons.

Table 4.20: Demographic Data of Settlements around Bally STP based on Percentage of Respective Municipal Wards Considered under Study Area

Municipality	Ward No	Total HHs	Total Population	Average HH Size	Male	%	Female	%
Bally	1	799	3988	5.0	2024	51	1963	49
Bally	2	683	4267	6.2	2428	57	1839	43
Bally	3	689	3042	4.4	1575	52	1467	48
Bally	4	1168	5317	4.6	2677	50	2640	50
Bally	6	2497	11433	4.6	5701	50	5732	50
Bally	7	142	640	4.5	325	51	315	49
Bally	8	1388	6568	4.7	4063	62	2506	38

Municipality	Ward No	Total HHs	Total Population	Average HH Size	Male	%	Female	%
Bally	9	2739	13758	5.0	7214	52	6544	48
Bally	10	566	2474	4.4	1229	50	1245	50
Bally	11	790	3824	4.8	1949	51	1874	49
Bally	12	2292	10631	4.6	5412	51	5219	49
Bally	13	1079	6323	5.9	3298	52	3025	48
Bally	14	1075	6182	5.8	3311	54	2871	46
Bally	15	1800	7998	4.4	4537	57	3461	43
Bally	16	1049	6716	6.4	3621	54	3095	46
Bally	17	810	5571	6.9	3051	55	2520	45
Bally	18	708	5678	8.0	3046	54	2633	46
Bally	19	296	2037	6.9	1119	55	918	45
Bally	20	78	479	6.1	251	52	228	48
Bally	26	976	7311	7.5	4460	61	2851	39
Bally	27	1445	6518	4.5	3509	54	3009	46
HMC	1	4811	21685	4.5	13328	61	8357	39
HMC	2	1660	7024	4.2	4135	59	2889	41
HMC	3	1175	5312	4.5	2783	52	2529	48
HMC	4	3216	13789	4.3	7483	54	6306	46
HMC	5	1018	4663	4.6	2409	52	2254	48
HMC	11	3677	16686	4.5	8699	52	7987	48
HMC	12	2987	13059	4.4	6883	53	6176	47
HMC	13	4376	23177	5.3	12409	54	10768	46
HMC	14	415	1765.2	4.3	1038.8	59	726.4	41
HMC	15	2722	13871	5.1	7613	55	6258	45
	Total	**49126**	**241,787**	**4.9**	**131,581**	**54**	**110,206**	**46**

Source: Census of India 2011

4.4.5 Literacy Profile

4.4.5.1 Howrah District

As per the 2011 Census of India, the overall literacy rate of Howrah District is 81% with a male literacy rate of 83% and a female literacy rate of 79%. The male literacy rate is thus higher than the female literacy rate (**Figure 4.33***).*

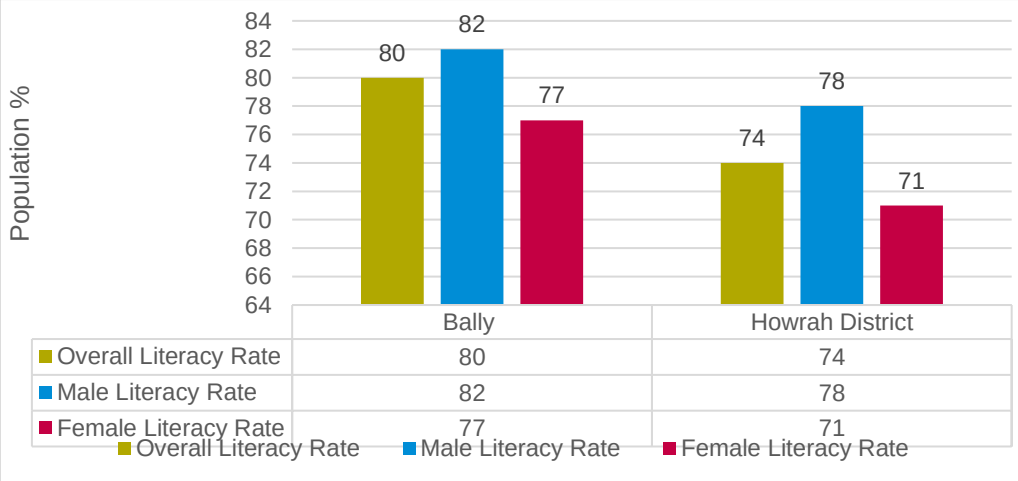
Out of the total literate population at the district level i.e. 3,605,206 numbers, 4% (157,077 numbers) are literate without any education level, 23% (827,106 numbers) have below primary level education and 25% (898,201 numbers) have completed their primary education. Over 19% (688,347 numbers) have completed their middle level education, 10% (348,989 numbers) have completed secondary education and 10% (352,120 numbers) have completed their higher secondary education. Over 0.3% (10160 numbers) have completed technical education and 9% (312,823 numbers) are graduates. Approximately 0.3% (10,403) have an education level that has not been classified (**Table 4.24**).

4.4.5.2 Bally Municipality

As per the 2011 Census of India, the overall literacy rate of Bally is 80% and it is higher than Howrah district's literacy rate of 74%. Moreover, the literacy rate of men is higher than the literacy rate of women at both the district and municipal level. The literacy rate of men in Bally is 82% while the literacy rate of women is 71 %. The literacy rate of men in Howrah District is 78% while the literacy rate of women is 71%.

Out of the total literate population at the municipal level, i.e. 233,702 numbers, 5% (11,939 numbers) are literate without any education level, 16% (27,237 numbers) have below primary level education and 17% (39,121 numbers) have completed their primary education. Over 17% (40,091 numbers) have completed their middle level education, 15% (34,239 numbers) have completed secondary education and 14% (32,671 numbers) have completed their higher secondary education. Over 0.7% (1,577 numbers) have completed technical education and 15% (36,100 numbers) are graduates. Approximately 0.3% (727) have an education level that has not been classified.

Figure 4.33 Literacy Profile of Population in District and Municipal Level



Source: Census of India 2011

Table 4.21: Education Level at District and Municipal Level

Location	Literate w/o education level		Below Primary		Primary		Middle		Secondary		Higher Secondary		Technical/ Diploma		Graduate		Not Classified	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Howrah District	157077	4	8,27,106	23	8,98,201	25	6,88,347	19	3,48,989	10	3,52,120	10	10,160	0	3,12,823	9	10,403	0
Bally	11,939	5	37,237	16	39,121	17	40,091	17	34,239	15	32,671	14	1,577	1	36,100	15	727	0

Source: Census of India 2011

4.4.5.3 Literacy Profile of Settlements in Near STP Area

This section presents the literacy profile of the settlements and the municipal wards within the one kilometre radius of the STP; it is observed that the average literacy rate of the settlement and wards within the one km radius is 78% (36,292 numbers). The overall male literacy rate is 81% (19, 477 numbers) and the overall female literacy rate is 82% (16,815 numbers).

Chakpara and Chamrail census towns both have the highest literacy rate at 79% and 78% respectively, Khaliya has a literacy rate of 78% (**Table 4.21**).

Comparative analysis of the literacy rates at the district, municipal and at census town level, reveal that the municipal level's overall literacy rate i.e. 80% is much higher than the district level which is 74%, and the census town level which is 78%. The literacy rate for women is lower than the men's literacy rate at the district level, the municipal level and the ward level.

Table 4.22: Literacy Profile of Settlements

Census Town	Total Population	Total Male Population	Total Female Population	Literate Population	Male Literate Population	Female Literate Population	Total Literacy Rate %	Male Literacy Rate %	Female Literacy Rate
Chakpara	28226	14682	13544	22318	12073	10245	79	82	76
Chamrail	11923	6083	5840	9278	4886	4392	78	80	75
Khaliya	6265	3165	3100	4696	2518	2178	75	80	70
Total	**46414**	**23930**	**22484**	**36292**	**19477**	**16815**	**78**	**81**	**75**

Source: Census of India 2011

4.4.5.1 Literacy Profile of Settlements along Sewer Lines

This section presents the literacy profile of the settlements and the municipal wards within the 500 metre buffer on each side of the sewer line alignment. It is observed that the average literacy rate of the settlement and wards within the defined buffer zone is 87.8% (192,479 numbers), the male and female literacy rate is 89.4% (107,304 numbers) and 85.9% (85,175 numbers) respectively. Wards number 8 and 10 in Bally Municipality has the highest literacy rate within the buffer zone at 96% However, ward number 16 in HMC and ward number 14 in Bally Municipality has the lowest literacy at 71% and 72% respectively. It is thus observed that the overall literacy rate of the settlements along the sewer lines i.e. 87% are higher than the average of the settlements within the 1 km radius i.e 78%.

Table 4.23: Literacy Profile of Settlements along Sewer Lines

Municipality	Ward No.	No. of HHs.	Total Population	Total Male Population	Total Female Population	Literate Population	Male Literate Population	Female Literate Population	Total Literacy Rate %	Male Literacy Rate %	Female Literacy Rate %
Bally	1	799	3988	2024	1963	2951	1561	1390	82	85	79
Bally	2	683	4267	2428	1839	3212	1960	1253	86	90	80
Bally	3	689	3042	1575	1467	2590	1355	1235	93	94	93
Bally	4	1168	5317	2677	2640	4380	2250	2131	91	92	90
Bally	6	2497	11433	5701	5732	10010	5056	4954	95	96	95
Bally	7	142	640	325	315	555	287	268	94	96	92
Bally	8	1388	6568	4063	2506	5980	3790	2190	96	98	94
Bally	9	2739	13758	7214	6544	11693	6241	5452	93	94	91
Bally	10	566	2474	1229	1245	2223	1112	1111	96	97	95
Bally	11	790	3824	1949	1874	3217	1686	1531	94	96	92
Bally	12	2292	10631	5412	5219	9352	4842	4510	95	96	93
Bally	13	1079	6323	3298	3025	4989	2666	2323	89	91	88
Bally	14	1075	6182	3311	2871	4808	2660	2148	89	90	87
Bally	15	1800	7998	4537	3461	6343	3725	2618	87	89	85
Bally	16	1049	6716	3621	3095	3990	2232	1758	71	71	70
Bally	17	810	5571	3051	2520	3642	2076	1566	77	79	75
Bally	18	708	5678	3046	2633	4035	2273	1761	82	84	79
Bally	19	296	2037	1119	918	1301	753	548	76	78	74
Bally	20	78	479	251	228	353	195	159	84	88	80
Bally	26	976	7311	4460	2851	5753	3669	2084	88	90	84
Bally	27	1445	6518	3509	3009	5309	3033	2276	89	95	83
HMC	1	4811	21685	13328	8357	14487	8981	5506	75	75	76
HMC	2	1660	7024	4135	2889	5173	3084	2089	81	81	81

Municipality	Ward No.	No. of HHs.	Total Population	Total Male Population	Total Female Population	Literate Population	Male Literate Population	Female Literate Population	Total Literacy Rate %	Male Literacy Rate %	Female Literacy Rate %
HMC	3	1175	5312	2783	2529	4386	2377	2009	89	92	86
HMC	4	3216	13789	7483	6306	11488	6405	5083	89	92	86
HMC	5	1018	4663	2409	2254	3919	2064	1856	91	93	89
HMC	11	3677	16686	8699	7987	13603	7372	6231	88	92	84
HMC	12	2987	13059	6883	6176	11248	6025	5223	92	94	90
HMC	13	4376	23177	12409	10768	19557	10727	8829	93	95	90
HMC	14	415	1765.2	1038.8	726.4	1187.6	697.2	490.4	72	71	73
HMC	15	2722	13871	7613	6258	10744	6149	4594	86	90	82
Total		**49126**	**241787**	**131581**	**110206**	**192479**	**107304**	**85175**	**87.8**	**89.4**	**85.9**

Source: Census of India 2011

4.4.6 Religious Composition

4.4.6.1 Howrah District

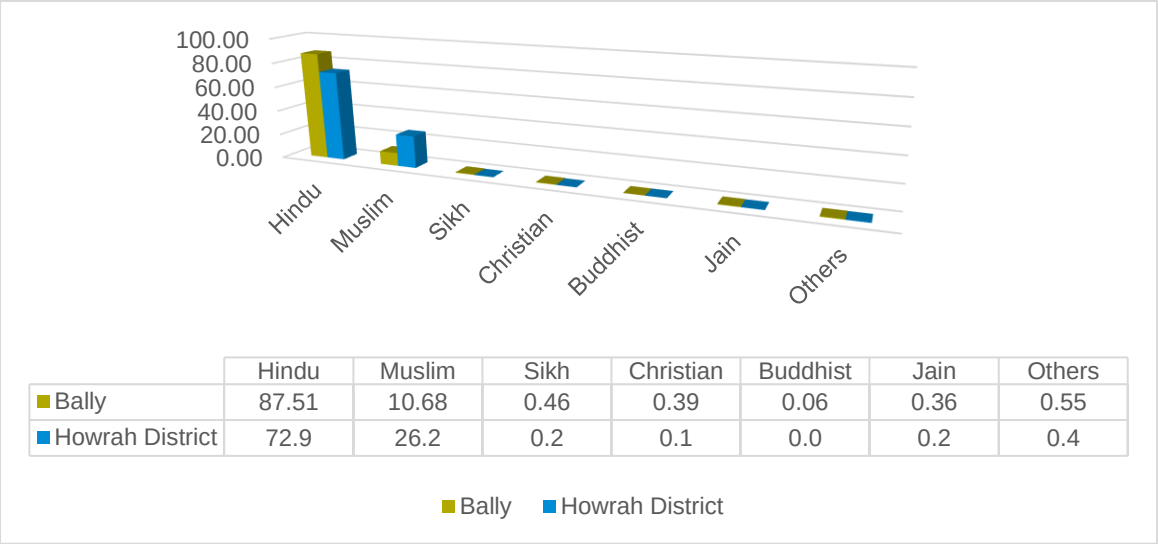
In Howrah district however, 72.9% (3,535,844 numbers) are Hindus, 26.2% (1,270,641 numbers) are Muslims, 0.18% (8,666 numbers) are Christian, 0.09% (4,380 numbers) are Sikh, 0.03% (1,258 numbers) are Buddhist, 0.2% (9,699 numbers) are Jain and 0.4% (19541 numbers) are listed as others.

4.4.6.2 Bally Municipality

As per the 2011 Census of India, the total Schedule Caste (SC) population in Bally is 7,161 with 3,811 men and 3,350 women. The total Scheduled Tribe (ST) population is 1,348 with 708 men and 604 women.

With regard to the religious composition in Howrah municipality, 87.51% (256,733 numbers) of the population are Hindus, 10.68% (31,340 numbers) are Muslims, 0.46% (1,343 numbers) are Sikhs, 0.39% (1,137 numbers)are Christian, 0.06% (163 numbers) are Buddhists, 0.36% (1,044 numbers) are Jain, while 0.55% (1,613 numbers) are listed as others. In Howrah district however, 72.9% (3,535,844 numbers) are Hindus, 26.2% (1,270,641 numbers) are Muslims, 0.18% (8,666) are Christian, 0.09% (4,380 numbers) are Sikh, 0.03% (1,258 numbers) are Buddhist, 0.2% (9,699 number) are Jain and 0.4% (19,541 number) are listed as others (**Figure** *4.34*).

Figure 4.34 Religious Composition



	Hindu	Muslim	Sikh	Christian	Buddhist	Jain	Others
Bally	87.51	10.68	0.46	0.39	0.06	0.36	0.55
Howrah District	72.9	26.2	0.2	0.1	0.0	0.2	0.4

Source: Census of India 2011

4.4.7 Employment and Occupational Profile in the Study Area

4.4.7.1 Howrah District

As per the 2011 Census of India reports, main workers account for 31% (1,496,267 numbers) of the total population at Howrah District, where men comprise 87% (1,304,435 numbers) and women comprise 13% (191,832 numbers). Marginal workers account for 7% (193,735 numbers) of the total district population, with 60% (193,735 numbers) men and 40% (129,843 numbers) women. Non-workers however account for 62% (3,030,184 numbers) of the total district population thereby

constituting a majority, with 33% (1,002,649 numbers) men and 67% (2,027,535 numbers) women (**Table 4.24***).*

Table 4.24: Employment in Howrah District

Type of Workers	Total	%	Men	%	Women	%
Main Workers	1,496,267	31	1,304,435	83.8	13,792	16.2
Marginal Workers	323,578	7	193,735	56.6	2,874	43.4
Non Workers	3,030,184	62	1,002,649	33.3	102,360	66.7
Total	**4,850,029**		**2,500,819**		**2,349,210**	

Source: Census of India 2011

Moreover, out of 1,819,845 workers at Howrah District, 8% (80,575 numbers) are cultivators out of which 3.9% (71,163 numbers) are men and 1.2% (9,412 numbers) are women. Moreover, 10% (181,662 numbers) are agricultural labourers, with 8.8% (160,530 numbers) men and 1.2% (21,132 numbers) women. 16% (297,774 numbers) are engaged in household industries, with 10.9% (198,995 numbers) men and 5.4% (98,779 numbers) women. Additionally, over 69.2% (1,259,834 numbers) are engaged in other activities, with 58.7% (1,067,482 numbers) men and 10.6% (192,352 numbers) women. Since Howrah District mainly comprises of urban settlements, majority of the population are therefore engaged in commercial activities as well as the service sector for their source of income. Additionally, very few women are engaged in the workforce (**Table 4.25**).

Table 4.25: Sector Wise Employment in Howrah District

Type of Workers	Total	%	Men	%	Women	%
Cultivators	80,575	4.4	71,163	3.9	9,412	0.5
Agricultural Laborers	181,662	10.0	160,530	8.8	21,132	1.2
Household Industries	297,774	16.4	198,995	10.9	98,779	5.4
Other	1,259,834	69.2	1,067,482	58.7	192,352	10.6
	1,819,845		**1,498,170**		**321,675**	

Source: Census of India 2011

4.4.7.2 Bally Municipality

As per the 2011 Census of India, main workers account for 35% of the population in Bally with 39,647 individuals. Out of this, 83.9% (33,296 numbers) are men and 16.1% (6,378 numbers) are women. Marginal workers account for 3.4% (3,869 numbers) of the population, with 52.6% (2,034 numbers) being men and 47.4% (1,835 numbers) women. The non-workers account for 61.6% (69,834 numbers) of the population, with 33.2% (23,200 numbers) men and 66.8% (46,634 numbers) women. The data thus shows that women account for majority of the non-working population. (**Table 4.26**).

Table 4.26: Employment in Bally Municipality

Type of Workers	Total	%	Men	%	Women	%
Main Workers	39,674	35.0	33,296	83.9	6,378	16.1
Marginal Workers	3,869	3.4	2,034	52.6	1,835.0	47.4
Non Workers	69,834	61.6	23,200	33.2	46,634	66.8
Total	**113,377**		**58,530**		**54,847**	

Source: Census of India 2011

it is observed that majority of the population are engaged in activities other than cultivation, agricultural labour and household industries The table below highlights the population breakdown according to sector as well as well as highlighting the gender disaggregated data for each sector. 1% (1,127 numbers) of the population are engaged as cultivators, with 0.6% (613 numbers) men and 0.5% (514 numbers) women. Over 0.5% (506 numbers) of the population are engaged as agricultural labourers, with 0.3% (337 number) being and 0.2% (169 numbers) women. Around 2% (2,143 numbers) of the population are engaged in household industries, with 1.1% (1,243 number) men and 0.8% (900 numbers) women. Over 96.5% (104,376 numbers) individuals which constitute a majority of the population, are engaged in other activities, with 80.5% (87,023 numbers) men and 16% (17,353 numbers) women.

Table 4.27 below presents the sector wise employment data for Bally Municipality.

Table 4.27: Sector Wise Employment in Bally Municipality

Type of Workers	Total	%	Men	%	Women	%
Cultivators	1,127	1.0	613	0.6	514	0.5
Agricultural Labourers	506	0.5	337	0.3	169	0.2
Household Industries	2,143	2.0	1,243	1.1	900	0.8
Other	1,04,376	96.5	87,023	80.5	17,353	16.0
Total	**1,08,152**		**89,216**		**18,936**	

Source: Census of India 2011

4.4.7.3 Work Participation Ratio at Settlements near STP

This section presents the occupational profile of the settlements in the area. The Work Participation ratio (WPR) is defined as the percentage of total workers including main and marginal workers out of the total population of the study area. Out of the total population of 46,414 persons, approximately 39% (17,903 numbers) are participating in the workforce. Approximately 91% (17903) are main workers and approximately 9% (1854) are marginal workers. It is observed that Chakpara and Chamrail census towns have a WPR of 43%, while Khalia has WPR of 34%. As the study area is an urban settlement, the numbers of persons engaged in agricultural and household industries are negligible (**Table 4.28**).

Table 4.28: Work Participation Ratio of Settlements near STP

Census Town	WPR%	Total Population	Total Workers	Main Workers	%	Marginal Workers	%
Chakpara	43	28226	12207	10981	39	1226	4
Chamrail	43	11923	5110	4667	39	443	4
Khalia	39	6265	2440	2255	36	185	3
Total	**43**	**46414**	**19757**	**17903**	91	**1854**	9

Source: Census of India 2011

A comparative analysis of the data reveals that majority of the population at Howrah municipal level as well as the district level, are engaged in non-agricultural activities, which include commercial activities and the service sector. Being urban settlements, there are very few households engaged in cultivation, agricultural labour as well as household industries.

Bally municipal level has a higher number of main workers (35%) than Howrah District (31%), while Howrah District has a higher number of marginal workers (7%) than the municipal level (3.4%). There is a higher percentage of non-workers at the district level (62%), than at the municipal level.
At the census town level, over 39% of the population in the settlements near the STP location are participating in the workforce where 91% are main workers and only 9% are marginal workers.

4.4.7.4 Work Participation Ratio at Settlements along Sewer Lines

This section presents the occupational profile of the settlements in the area. The Work Participation ratio (WPR) is defined as the percentage of total workers including main and marginal workers out of the total population of the study area. Out of the total population of 241,787 persons with the defined buffer zone, approximately 38% (91,385 numbers) are participating in the workforce. Approximately 90.5% (82,710 numbers) are main workers and approximately 9.5% (8,675) are marginal workers. It is observed that ward number 26 of Bally Municipality has the highest WPR within the defined radius at 49% and wards number 11 and 19 in Bally Municipality and Ward number 13 in HMC have the lowest WPR at 33%. As the study area is an urban settlement, the numbers of persons engaged in agricultural and household industries are negligible (**Table 4.29**).

Table 4.29: Work Participation Ration of Settlements along Sewer Lines

Municipality	Ward No	WPR%	Total Population	Total Workers	Main Workers	Main Workers %	Marginal Workers	Marginal Workers %
Bally	1	39	3988	1565	1485	94.9	80	5.1
Bally	2	36	4267	1548	1415	91.4	133	8.6
Bally	3	41	3042	1250	1096	87.7	154	12.3
Bally	4	40	5317	2140	1920	89.7	220	10.3
Bally	6	34	11433	3836	3469	90.4	367	9.6
Bally	7	44	640	279	220	79.0	59	21.0
Bally	8	37	6568	2461	2273	92.4	188	7.6
Bally	9	35	13758	4803	4289	89.3	514	10.7
Bally	10	42	2474	1048	794	75.8	254	24.2
Bally	11	33	3824	1270	1102	86.8	167	13.2
Bally	12	35	10631	3765	3103	82.4	662	17.6
Bally	13	34	6323	2163	1954	90.3	209	9.7
Bally	14	38	6182	2320	2149	92.6	171	7.4
Bally	15	42	7998	3328	3205	96.3	123	3.7
Bally	16	37	6716	2514	2166	86.2	348	13.8
Bally	17	34	5571	1875	1689	90.1	186	9.9
Bally	18	35	5678	1981	1807	91.2	174	8.8
Bally	19	33	2037	669	576	86.0	93	14.0
Bally	20	39	479	185	151	81.5	34	18.5
Bally	26	49	7311	3571	2614	73.2	957	26.8
Bally	27	43	6518	2828	1561	55.2	1267	44.8

Municipality	Ward No	WPR%	Total Population	Total Workers	Main Workers	Main Workers %	Marginal Workers	Marginal Workers %
HMC	1	41	21685	8938	8658	96.9	280	3.1
HMC	2	42	7024	2981	2855	95.8	126	4.2
HMC	3	39	5312	2062	1925	93.4	137	6.6
HMC	4	41	13789	5600	5371	95.9	229	4.1
HMC	5	40	4663	1886	1763	93.5	123	6.5
HMC	11	39	16686	6489	6073	93.6	416	6.4
HMC	12	36	13059	4754	4519	95.1	235	4.9
HMC	13	33	23177	7627	7425	97.4	201	2.6
HMC	14	45	1765.2	796	698.2	87.7	97.8	12.3
HMC	15	35	13871	4853	4385	90.3	469	9.7
Total			**241787**	**91385**	**82710**	**90.5**	**8675**	**9.5**

Source: Census of India 2011

4.4.8 Housing, Sanitation & Drinking Water Access

4.4.8.1 Howrah District

As per the 2011 Census of India, over 79.22% (815,217 numbers) HHs in Howrah District are permanent, 17.85% (183,705 numbers) HHs are semi- permanent, 2.59% (26,614 numbers) HHs are temporary structures. Moreover, approximately 12.6% (129,715 numbers) HHs have closed drainage systems, 27.83% (284,404 numbers) HHs have open drainage systems while 59% (616,995 numbers) HHs have no drainage systems.

As per the Census of India 2011, out of 1,029,114 HHs, 28.13% (289,518 numbers) HHs have access to tap water from a treated source, 3.88% (39,955 numbers) have access to tap water from an untreated source, 0.61% (6,266 numbers) HHs have drinking water access from a covered well, while 0.53% (5,450 numbers) HHs have access to uncovered wells. Additionally, 43.35% (466,683 numbers) HHs have access to hand pumps, 21.06% (216,717 numbers) HHs have access to tube wells and/or boreholes, 0.03% (260) HHs have access to springs and 0.04% (423 numbers) HHs have access to rivers and/or canals. Over 0.12% (1,255) HHs have access to tanks, ponds and/or lakes, while 0.25% (2,587) HHs have access to other sources for their drinking water (**Table** 4.30).

4.4.8.2 Bally Municipality

As per 2011 Census of India, over 94.5 % of the housing structures in Bally municipal area are permanent, 4.8% are semi-permanent, and 0.2% are temporary structures. Moreover, the households in Bally have both open and closed systems of drainage. There are 13,905 HHs with latrine pits, while 6953 HHs have been listed as others.

Out of 44,152 HHs, 90.8% (40094 numbers) have drinking water access through taps from a treated source, while 3.5% (1,527 numbers) HHs have access to tap water from an untreated source. 0.8% (335 numbers) HHs have access to covered wells while 0.5% (201 numbers) HHs have access to un-covered wells. Moreover, 1.1% (497 numbers) HHs have access to hand pumps while 3.1% (1,359 numbers) HHs have access to tube wells/ boreholes. Over 0.1% (47 numbers) HHs have access to springs for their drinking water source and only 9 HHs have access to rivers and canals for their

drinking water sources. Around 0.1% (28 numbers) HHs have access to tanks/ponds and lakes for their drinking water source and 0.1% (55 numbers) HHs have access to other sources of drinking water (Table 4.30).

Table 4.30: Drinking Water Access

Area Name	Total No of HHs	Tap water from treated source		Tap water from untreate		Covered well		Un-covered well		Hand pump		Tube well/ Borehol		Spring		River/ Canal		Tank/Pond/Lake		Other sources	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No
Howrah District	1,029,114	289,518	28.13	39,955	3.88	6,266	0.61	5,450	0.53	466,683	43.35	216,717	21.06	260	0.03	423	0.04	1,255	0.12	2,587	0.25
Bally (M)	44,152	40094	90.8	1527	3.5	335	0.8	201	0.5	497	1.1	1359	3.1	47	0.1	9	0.0	28	0.1	55	0.1

Source: Census of India 2011

It is observed that majority of the housing structures at both the district and municipal level are permanent structures i.e. 79% and 94.5% respectively. Additionally, over 90.8% of the HHs at the municipal level have access to drinking water through taps from a treated source, while at the district level, only 28% of the HHs have access to tap water from a treated source and over 43% HHs utilise hand pumps, for their drinking water source.

4.4.9 Educational Facilities

As per the 2011 Census of India, there are 52 government primary schools, 1 government middle school, 14 government secondary schools and 12 government senior secondary schools in Bally. Bally also has 2 government arts, science and commerce colleges.

4.4.10 Health Facilities

With regard to access to health institutions, the 2011 Census of India indicates that Bally has 13 hospitals, 54 dispensaries/ health centres and 96 Family Welfare Centres

4.4.11 Financial Institutions & Transportation

As per the 2011 Census of India, Howrah Municipal Corporation (HMC) has 18 nationalised banks, 54 dispensaries and 96 family welfare centres.

Bally is connected by three main railway lines, the Bardhhaman Chord, Howrah-Bardhhaman and Sealdah Dankuni, which serves the inhabitants of Bally Main, Bally Ghat, Bally Halt, Belanagar.

4.4.12 Cultural and Historical Heritage

Howrah has a history dating back to five hundred years, and has been considered to be an important sea faring business hub during the period of the East India Company. Additionally, the Howrah Railway Station was established in 1854 which catalysed industrial development in the area as raw material was being brought in from other parts of the country, to be processed in the factories in Howrah. During that period, several flour and jute mills were set up in the area. As majority of the population are Hindus, festivals such as Durga Puja, Diwali, Bhai Dooj, Shivatri and Holi are

celebrated. Bally is also known for its religious spots such as Kalyaneshwar Mandir, a 500 year old temple devoted to Lord Shiva. Another important cultural site is the Belur Math, which is the headquarters of Ramakrishna Mission. There are no recorded cultural heritage sites in the vicinity of the STP and the linked facilities.

4.4.13 Potential Area of Sensitivity near STP Location

The potential areas of sensitivities are defined as congested settlements with poor access, housing structure and sanitation facilities. As observed during the site assessment, the road leading to the WSP at Kona, i.e. Bhattanagar Road is approximately 12ft in length and is a congested area.Since there are no proposed renovation and upgradation works along these identified sensitive locations, the potential social impacts are negligible. For the potential environmental impacts, please refer to sections 5.4.1 on Visual Aesthetics and Odour Nuisance, 5.4.3 on Ambient Air Quality, 5.4.4 on Ambient Noise and 5.4.8 on Road Traffic.

4.4.14 Potential Area of Sensitivity near Sewer Lines

The potential areas of sensitivities along the sewer lines have also been identified, which include congested settlements. The laying of the sewer pipelines may potentially cause impacts such as access disruption and temporary income loss to receptors situated along the alignment of the pipes.

The laying of the gravity sewer line will cause temporary access disruption to receptors at several locations along the sewer line, which include Outfall 3- BOC Ground and Outfall 5- Rashbari Ghat (Mahendra Bagchi Road), where there are approximately 11 kiosks and a mandir. Additionally, at Lifting Station 4-Panchanantala, there is a mandir and a daily market comprising of approximately 15 vegetable and fruit vendors, who may be potentially affected by access disruption due to the laying of the gravity sewer line. At Outfall 2- Jayabibi Road, there is a factory, temple and cattle shed situated nearby, which will also be potentially affected by the laying of the gravity sewer line. Access disruption may also take place at Salt Gola- Lifting Station 5, due to laying of the gravity sewer line, as well as at Lifting Station 6-Golabari, due to the laying of the rising main; it may be noted that a school and ferry transportation is situated nearby LS 6.

The gravity sewer pipelines, which will be laid at B.K Pal Temple road which is located near Lifting Station 4, will cause temporary livelihood loss to some receptors. The proposed work will entail excavation of these roads and as observed during the site visits, there are several shops located along these stretches. A detailed analysis of these impacts are highlighted in Chapter 5, sections 5.5 and sub-sections 5.5.1 and 5.5.2. The potential area of sensitivities along the sewer lines are presented in Table 4.31.

Table 4.31: Potential Areas of Sensitivities along Sewer Lines

BOC Ground- Outfall 3

Kiosks along Temple Road (Mahendra Bagchi Road) near Rashbari Ghat-Outfall 5

Temple Road (Mahendra Bagchi) near Rashbari Ghat/Mandir- Outfall 5

Lalababu Shaire Street- Outfall 6

Ram Lochan Shaire Street, near Outfall 7

Fruit and Vegetable Vendors along Panchanantala

Cattle Shed near Outfall 2, Jayabibi Road

Temple Near Outfall 2, Jayabibi Road

Pathway to Lifting Station 6- Golabari

Ferry Transportation near Lifting Station 6- Golabari

4.5 Primary Socio Economic Survey

A socio-economic survey was conducted on the population residing within 100 meters of the alignment (50 m on each side) of the proposed replacement or laying of the sewer pipelines, therefore those who may potentially be impacted directly by the project either through loss of income or access and traffic disruption have been assessed. In addition, receptors in the vicinity of the locations of the proposed pipeline work have also been considered for the survey as they may be indirectly impacted by the project activities. The survey was conducted through random sampling which includes 25 households across the project footprint and potentially at those locations where physical work will be undertaken. The locations where the primary survey and consultations were conducted are presented in **Figure 4.35** below.

The locations of the primary socio-economic surveys and number of Project Affected Households (PAHs), among the HHs surveyed, are presented in below **Table 4.32**.

One surveyed HH is situated near Lifting Station 1- Ghusri and seven surveyed HHs are situated near Lifting Station 3- Bally Khal. Four surveyed HHs are situated near Lifting Station 4 Panchanantala and three surveyed HHs are situated near Jaya Bibi Road out of which two are potential PAHs. One surveyed HH which is also a PAH is situated near Outfall 5 Rashbari Ghat. Therefore out of the 25 surveyed HHs, three are PAHs.

The locations and number of participants in the stakeholder consultations are presented in **Table 4.32** below. The stakeholder consultations were attended by 68 participants.

Table 4.32: Locations of Surveyed Population

Component	Location	HHs Surveyed	Project Affected Households (PAH)	Location Photo
Lifting Station 1	Ghusri	1	-	
Lifting Station 3	Bally Khal	7	-	

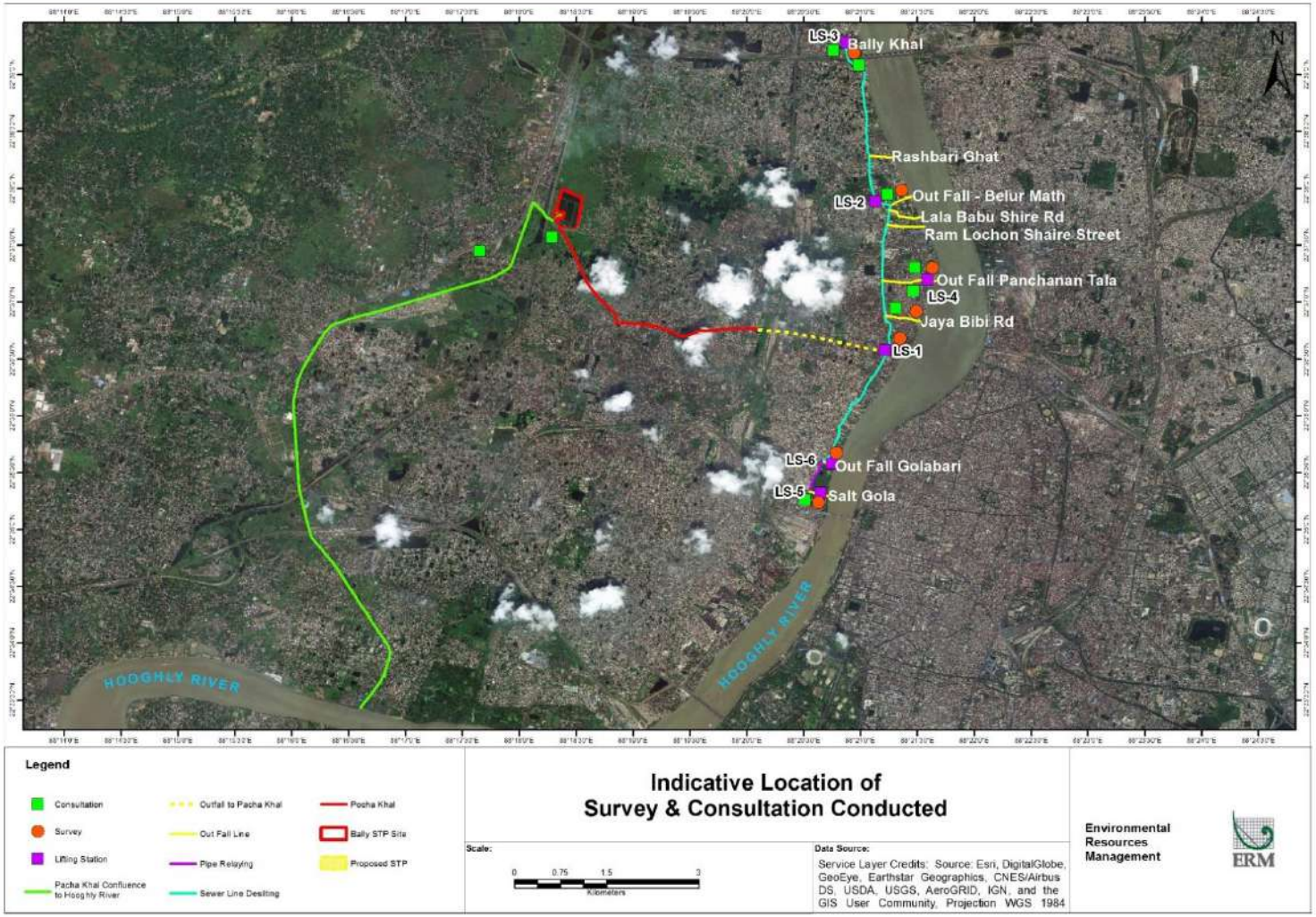
Component	Location	HHs Surveyed	Project Affected Households (PAH)	Location Photo
Lifting Station 4	Panchanantala	4	-	
Lifting Station 6	Golabari	9	-	
Outfall 2	Jaya Bibi Road	3	2	
Outfall 5	Rashbari Ghat	1	1	
Total		**25**	**3**	

Table 4.33: Number of Participants in Stakeholder Consultations

Stakeholder Group	Location	Date	Number of Participants	No. of PAH
Existing Pump Operators Contractual Workers	Belur Lifting Station (LS)	21st June 2019	3	Nil
Existing Contractual Worker at Ghusuri Lifting Station and Golabari	Ghusuri Howrah Municipal Corporation	21st June, 2019	4	Nil
Existing Contractual Worker at Bally Khal Lifting Station	N.K. Pal lane, Howrah	21st June 2019	3	Nil
Existing Contractual Worker at Salt Gola Lifting Station	Salt Gola, Howrah	5th July, 2019	4	Nil
Committee Members of the Jaganath Temple	Belur Panchanan Tala Jagannath temple	17th July, 2019	5	Nil
Local Community residing near the Kona WSP	Ananda Nagar and Bhatta Nagar	22nd June 2019	2	Nil
Local Market Users	Belur	27th August 2019	2	2
Committee Members of the Temple	Bimal Ghat, Jay Bibi Road	24th August, 2019	2	2
Block Development officer of Bally Jagacha Block	Block Development Office, Madhya Para, Ghosipara, Bally	28th August 2019	10	
Fishermen Groups at WSP Kona	Kona Waste Stabilization Pond, North Howrah, Bally	9th September, 2019	2	2
Fishermen Groups at WSP Kona	Kona Waste Stabilization Pond, North Howrah, Bally	14th September, 2019	6	6
Workers at Bally WSP and Associated Facilities	Chittaranjan Bayam Samiti, Howrah	17th of September 2019	25	Nil
Disclosure meeting with the Howrah Municipal Corporation – Urban Local Body (ULB)	Howrah Municipal Corporation (HMC) Office	12th November 2019	3	Nil
Information Disclosure Meeting with the local community	B.K. Pal Temple Road, Kalachand Bazar	7th November 2019	11	Nil
Fishermen Groups at WSP Kona	Kona Waste Stabilization Pond,	18th January 2020	8	5

Stakeholder Group	Location	Date	Number of Participants	No. of PAH
	North Howrah, Bally			
Broad Community Support Consultation with the Affected fishermen Groups	Youth Club Office, Belur Panchanantala	22nd January 2020	5	5
Local Community along Jayabibi Road	Jayabibi Road	13 February 2020	5	Nil
Local Community at Panchanantala	B.K Pal Temple Lane	13 February 2020	15	Nil
Local Community near Kona WSP	Paschim Ghughupara	13 February 2020	6	Nil
Total			**119**	

Figure 4.35 Locations for Primary Survey and Consultations Conducted



4.5.1 Family Size, Social Categorisation and Religion

The total 25 HHs surveyed constitutes a total population of 122, out of which 53% (65 numbers) are males and 47% (57 numbers) are females. **Table 4.34** below presents the family details and the social categorization of the households surveyed. The average family size of the 25 HHs is 4.9. Majority of the HHs, i.e. 96% (24 numbers) belong to the General category while 4% (1 number) HH belongs to the Scheduled Caste category. None of the HHs belong to the Scheduled Tribe (ST) and Other Backward Classes (OBC) category.

Table 4.34: Family Details and Social Categorization

Location	Total HHs	Average Family Size	Social Categorization			
			Gen	%	SC	%
Bally	25	4.9	24	96%	1	4%

Source: ERM socio-economic survey

The table **(Table 4.35)** below presents the religious affiliation of the households considered under the primary survey; 88% (22 numbers) of the surveyed HHs are Hindu while only 12% (3 numbers) HHs are Muslim.

Table 4.35: Religious Affiliation of the Surveyed Households

Location	Hindu		Muslim		Total
	No.	%	No.	%	
Bally	22	88%	3	12%	25

Source: ERM socio-economic survey

4.5.2 Age and Sex Composition

Out of 122 persons, over 53% (65 numbers) are male and 47% (57 numbers) are female. The age category with the highest frequency is between 19 to 60 years i.e 66% (80 numbers) followed by 6 years and below i.e. 13% (16 numbers). 9% (11 numbers) of the surveyed population are between ages 7 and 14 years and 10% (12 numbers) are between ages 15 and 18 years. Only 2% (3 numbers) are above 60 years old. **Table 4.36** below highlights the sex composition while **Table 4.37** below highlights the age composition.

Table 4.36: Sex Composition of the Surveyed Persons

Location	Male		Female		Total
	No.	%	No.	%	
Bally	65	53%	57	47%	122

Source: ERM socio-economic survey

Table 4.37: Age Composition of the Surveyed Persons

Location	<=6		07 to 14		15-18		19-60		>60		Total Persons
	No.	%	No.	%	No.	%	No.	%	No.	%	
Bally	16	13%	11	9%	12	10%	80	66%	3	2%	122

Source: ERM socio-economic survey

4.5.3 Education Profile

Over 39% (47 numbers) of the surveyed population are illiterate, while 41% (50 numbers) have completed their primary education. Only 7% (9 numbers) have completed their secondary education and 10% (12 numbers) are not presently of school going age. Moreover, all the surveyed HHs have access to primary, secondary and college institutions.

The surveyed population has a higher rate of individuals who have completed their primary education i.e. 50%, as compared to the district level (23%), as well as at the municipal level (16%). Moreover, over 7% of the surveyed population have completed their secondary education, which is higher than the district level (10%) as well as the municipal level (15%). Over 4% of the surveyed population have completed their higher education, which includes graduates. However, over 10% of the population at the municipal level have completed their higher education which includes higher secondary and graduate education. **Table 4.38** below presents the literacy profile of the surveyed population.

Table 4.38: Education Profile of the Surveyed Persons

Location	Illiterate		Primary Education		Secondary		Higher		Not School Going Age		Total Persons
	No.	%	No.	%	No.	%	No.	%	No.	%	
Bally	47	39%	50	41%	9	7%	4	3%	12	10%	122

Source: ERM socio-economic survey

4.5.4 Occupational Profile

The table 4.39 below presents the occupational patterns. Out of 122 surveyed persons, 51 individuals are presently working. Over 47% (24 numbers) of the surveyed population are working as daily labourers, out of which 17 persons are male and 7 are female. Over 16% (8 numbers) are shop owners and all of them are male. Over 6% (3 numbers) are tea and food stall owners, 4% (2 numbers) are engaged in trading and 10% (5 numbers) are engaged in private service and all of them are male. 18% (9 numbers) are engaged in other activities which include two (2) drivers, two (2) female domestic workers, one (1) rickshaw puller, three (3) in small scale household industries and one (1) watchman.

Table 4.39: Occupational Patterns

Location	Daily Labour		Food & Tea Stall		Shop Owner		Trading		Private Service		Other		Total Persons
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	
Bally	7	17	-	3	-	8	-	2	-	5	2	7	
	24		3		8		2		5		9		51
	47%		6%		16%		4%		10%		18%		

Source: ERM socio-economic survey

4.5.5 Workforce Participation

The working age is categorised between ages 19 and 60 and the table below presents the workforce participation of the population that is of working age. Out of the 120 surveyed individuals, 80 individuals are of working age i.e. between 19 and 60 years, and 20 individuals are not of working age i.e. they are either below 19 years of age, or above 60 years of age. It may be noted that there are four working individuals who are below 19 years of age and one working individual who is above 60 years of age. The total number of working individuals out of the 120 surveyed individuals is 51 (**Table 4.40**) and as five working individuals do not fall within the working age bracket (19 -60 years), there are thus a total of 46 working age individuals (**Table 4.40***).*

Out of those 80 individuals of working age, 57.5% (46 numbers) are a presently working and 42.5% (34 numbers) are presently not working. Out of the working population, 83% (38 numbers) are male and only 17% (8 numbers) are female. However, out of the non-working population, 18% (6 numbers) are male and 82% (28 numbers) are female, therefore majority of women who are of working age, are presently not working. The consultations also revealed that majority of the women are engaged in unpaid domestic work. **Table 4.40** below presents the workforce participation data of the surveyed population.

Table 4.40: Workforce Participation

Location	Yes- Total Working Population (Age 19-60)						No- Total non-working Population (Age 19 - 60)						Total Working Age Population
	Female		Male		Total		Female		Male		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Bally	8	17	38	83	46	57.5	28	82	6	18	34	42.5	80

Source: ERM socio-economic survey

4.5.6 Income Distribution Pattern

The monthly family incomes of the HHs are represented below. Out of the surveyed HHs, 68% (17 numbers) have an income between Rs. 5,000 and 10,000, 32% (8 numbers) have an income between Rs.10, 001 and 20,000. Rs.17, 600 is the highest income among the surveyed population.

Additionally, none of the surveyed HHs fall within the BPL category. [28] **Table 4.41** below presents the monthly family incomes of the surveyed HHs.

Table 4.41: Monthly Income

Location	Rs. 5000-10000		Rs. 10001-Rs. 20000		Total HHs
	No.	%	No.	%	
Bally	17	68	8	32	25

Source: ERM socio-economic survey

4.5.7 Drinking Water & Electricity Access

All the HHs source their drinking water from tap water, supplied by the municipality and table below presents the drinking water access. 8% (2 numbers) have access to their own source of drinking water (individual connection) while 92% (23 numbers) share their drinking water source with other HHs (**Table 4.42**). The survey also revealed that all of the 25 HHs have access to an electricity connection.

Table 4.42: Drinking Water Ownership

Location	Owned by the HH		Shared Source		Total HHs
	No.	%	No.	%	
Bally	2	8	23	92	25

Source: ERM socio-economic survey

4.5.8 Sanitation

Table 4.43 below highlights the sanitation arrangement of the HHs and over 28% (7 numbers) HHs have access to a non- sanitary toilet, 8% (2 numbers) have a sanitary non-water sealed toilet, 12% (3 numbers) have a septic tank, 44%(11 numbers) utilise public toilets and 8% (2 number) still practice open defecation. None of the HHs have access to a sanitary water-sealed toilet.

Table 4.43: Sanitation Arrangement

Location	Open Defecation		Non-Sanitary		Sanitary Non-Water Sealed		Septic Tank		Public Toilet		Total HHs
	No.	%	No.	%	No.	%	No.	%	No.	%	
Bally	2	8%	7	28%	2	8%	3	12%	11	44%	25

Source: ERM socio-economic survey

[28] Kulp, S.A., Strauss, B.H. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. Nat Commun 10, 4844 (2019). https://doi.org/10.1038/s41467-019-12808-z

[28] The referenced scientific article has considered the reference timeframe for projected Climate Change Ind

4.5.9 Health

4.5.9.1 Access to Health Care Facilities

An analysis of the access to health care facilities reveals all household have access to government hospitals for their health care facilities.

4.5.9.2 Problems with Chronic Health & Vector Borne Diseases

Out of the 25 HHs surveyed, only one HH indicated having a chronic health problem i.e. diarrhoea. In addition, none of the HHs indicated having faced any water or air-borne diseases. (

Table 4.44). None of the HHs indicated having faced any water and air borne diseases.

Table 4.44: Chronic Problems Faced

Location	Yes		No		Total HHs
	No.	%	No.	%	
Bally	1	4	24	96	25

Source: ERM socio-economic survey

4.5.10 Water Logging

Over 60% (15 numbers) of the surveyed HHs indicated waterlogging as a problem in their locality, while 40% (10 numbers) HHs have no problems with waterlogging. The 10 HHs that indicated water logging as a problem in their locality during the rainy season are located near Lifting Station 3 Bally Khal, Lifting Station 4 Panchanantala and Lifting Station 6 Golabari. 5 HHs located at Lifting Station 6 Golabari also indicated that the water logging takes place when the pumping station is in operation. Consultation with the local community at Panchanantala revealed that the waterlogging is caused by the clogged drain connecting to the high drain. As a result, the water from the low drain overflows and causes waterlogging. This has also led to many residents contracting diseases such as dengue. (**Table 4.45**).

Table 4.45: Water Logging Problems

Location	Yes		No		Total HHs
	No.	%	No.	%	
Bally	15	60%	10	40%	25

Source: ERM socio-economic survey

4.5.11 Gender & Vulnerability

At Bally project area, out of the 25 HHs, 5 are woman-headed HH and 3 are located near Lifting Station 6 Golabari and 2 are located near Lifting Station 3 Bally Khal. All of the women headed HHs are squatters and have an average family income of INR 12866. The primary survey revealed that none of the HHs have any members who are living with any form of disability. [29]

uced Flood Risk Scenario by 2050

[29] https://www.climatecentral.org/news/report-flooded-future-global-vulnerability-to-sea-level-rise-worse-than-previously-understood

[29] West Bengal Disaster Management Plan for Howrah district- 2018

ic disadvantage, and dependence on unique natural resources.

Over 39% (47 numbers) of the surveyed population are illiterate out of which 21% (25) are women and 18% (22) are men. Over 41% (50 numbers) have completed their primary education out of which 20% (24) are women and 21% (26 numbers) are men. Only 7% (9 numbers) have completed their secondary education, with 1% (1 number) women and 6% (8 numbers) men. Over 3% (4 numbers) have completed their higher education out of which 1.5% (2 numbers) are women and 1.5% (2 numbers) are men. 10% (10 numbers) of the surveyed population are not of school going age. It is thus observed that there is a higher percentage of women who are illiterate. Moreover, majority of the surveyed population have only completed their primary education, with women having a lower percentage than men.

An analysis of the workforce participation of the surveyed population indicates that majority of the women are not participating in the workforce and the consultations also revealed that majority of the women are engaged in unpaid domestic work. Similarly, a review of the workforce participation at the Bally WSP and linked facilities reveal that all the workers are male workers. Therefore women are almost entirely unrepresented in the workforce (Tale 4.46)

Table 4.46: Gender Disaggregated Literacy Profile of Study

Location	Gender	Illiterate		Primary Education		Secondary		Higher		Not School Going		Total Persons
		No.	%	No.	%	No.	%	No.	%	No.	%	
Bally	Women	25	21%	24	20%	1	1%	2	1.50%	5	4%	57
	Men	22	18%	26	21%	8	6%	2	1.50%	7	6%	65
Overall		**47**	**39%**	**50**	**41%**	**9**	**7%**	**4**	**3%**	**12**	**10%**	**122**

Source: ERM socio-economic survey

4.6 Existing Manpower at Bally WSP

This section presents the details of the existing manpower at the Bally WSP. Presently, there are two O&M agencies engaged, the Associated Cooperative Labour Contractor and Construction Society Ltd and Ganga Action Plan Contract Workers Co-operative Society Ltd since 2009 and 2006 respectively.

Associated Cooperative Labour Contractor and Construction Society Ltd has a total of twenty-nine (29) workers engaged at LS 1 Belur Math, LS 3 Bally Khal, LS 4 Liluah, LS 5 Salt Gola, LS 6 Golabari and the MPS at Kona. Ganga Action Plan Contract Workers Co-operative Society Ltd has three (3) workers engaged at LS 2 Belur Math. The details of the O&M agencies engaged are presented in Table **4.47** below.

Table 4.47: O&M Agencies at Bally WSP & Linked Facilities

O&M Agency	Time Period
Associated Cooperative Labour Contractor and Construction Society Ltd	2009 to present
Ganga Action Plan Contract Workers Co-operative Society Ltd.	2006 to present

Source: Stakeholder Consultation with Workers on 17th of September 2019

During the stakeholder consultation which was conducted with the workers in the presence of representatives from KMDA, VA Tech Wabag and ERM[30], the list of workers shared by KMDA (hereinafter stated as "KMDA list"), was verified against those workers present during the consultation. Those who could not attend the consultation were verified by the representatives of their respective agencies, as well as by their co-workers at their respective facilities. Furthermore, the KMDA list only mentions the name of only one O&M agency i.e. Ganga Action Plan Contract Workers Co-operative Society. The verification however revealed that Associated Cooperative Labour Contractor and Construction Society Ltd are also the O&M agencies at these facilities. Reportedly, the security guards working at the facilities are directly engaged by KMDA, and KMDA has its own plan to relocate the guards, as per their requirement.

Based on the information shared by KMDA, there are total thirty-two (32) contracted workers are presently deployed, belonging to semi-skilled and un-skilled category workers. The present workforce of total 32 workers falls under age group ranging from 24 to maximum 59 years and there are total nine (9) worker are falling in the age bracket of 55 – 59 years. The service duration of the total existing workforce are ranging from minimum 3 years to maximum 26 years and with average 20 years.

As per the circular from the Labour Commissioner, Government of West Bengal, the minimum wage rate for workers employed in a manufacturing activity[31] as defined under Section 2(k) of the Factories Act, 1948 is Rs. 8005 for the period between 1st of January, 2019 and 30th of June, 2019. However this minimum wage rate has been revised to Rs. 8177 for employment period between 1st July 2019 and 31st December 2019.

The workers at the Bally WSP and linked facilities are earning Rs. 11,775 per month, therefore in compliance with the revised minimum wage rate as per government of West Bengal. The workers are also enrolled in the Employee Provident Fund (EPF) and Employee State Insurance (ESI) schemes.

The site assessments and consultations with the workers at the facilities also indicated that they are enrolled in the PF and ESI schemes and are engaged in three shifts i.e. morning, day and night shift, along with the general working hours. Additionally, none of the workers indicated having received any training on Health & Safety and they were not utilizing any Personal Protective Equipment (PPE). The details of the existing workers and contractors are presented in **Table 4.48** below.

[30] Stakeholder Consultation with Workers of Bally STP and LinkedFacilities on 17th of September, 2019

[31] As per the section 34 (m) factory means any premises whereon ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power. Section 34 k (ii) of the Factory Act, manufacturing process refer to pumping oil, water, sewage or any other substance

Table 4.48: Details of Existing Workers and Contractors

STP & Facilities	Project Components	Location	Contractor	Manpower Involvement
Bally	LS-1	Ghusuri, Hanuman Jute Mill	Associated Cooperative Labour Contractor and Construction Society Ltd	6
	LS-3	Bally Khal		4
	LS-4	Liluah, Panchanantala		4
	LS-5	Salt Gola		4
	LS-6	Golabari		4
	MPS-Kona	Kona		7
	LS-2	Belur Math	Ganga Action Plan Contract Workers Co-operative Society Ltd.	3
	Total			32

Source: KMDA (List of Existing Manpower) & Stakeholder Consultation with Workers on 16th of September, 2019

4.6.1 Contract Agreement between KMDA and Contractor

The contract agreements between Kolkata Metropolitan Water & Sanitation Authority (KMW&SA) and the O&M Agencies engaged at the Arupara STP and linked facilities i.e. Associated Co-operative Labour Contract & Construction Society Ltd, Ganga Action Plan Contract Workers Co-operative Society Ltd., and MCE Construction, have been shared for review. All of these contract agreements are for the years 2013-2014 and it is specified that the agreements are renewed on basis of mutual terms. The agreements further specified the following with regard to the workers' terms of employment, benefits and compliance with statutory regulations:

- Each member of the Co-operative Society engaged under the KMW&SA are to be paid the daily rate wages as declared by the State Government (Clause 1).
- None of the co-operative members are allowed to work for more than the maximum man days of work as per the calendar month (28/29/30/31 days as the case may be) on a no work no pay basis and double payment will not be allowed either (Clause 2).
- The agreement also specifies that the duties of the operational personnel will be allotted by observing the applicable State labour laws and specifies that the EPF and ESI amounts will be reimbursed to the personnel as per the statutory rates and provision. (Clause 2) Additionally, the agreement also specifies compliance with statutory provisions for bonus and ex-gratia. (Clause 8).
- Additionally, the agreement specifies that in the event of any cessation of membership of any member, due to illness or death, the member's next of kin may be deployed in his/her place, with prior approval from the KMW&SA (Clause 10).
- The agreement also specifies that the maximum age allowed for work is 60 years and benefits will be provided as per State Government Rules.

4.7 Fishermen Utilising Kona WSP

In Bally the existing sewage treatment system comprises of the waste stabilisation pond (WSP) on 20.13 hectare area and with a capacity to treat 30 MLD of sewage/waste water. The WSP comprises of two (2) anaerobic ponds, two (2) facultative ponds and two (2) maturation ponds. Going forward the plan is to establish 62 MLD sewage treatment facility, part of which will be 40

MLD STP and 22 MLD WSP. The present capacity of the WSP is 30 MLD which will be reduced to 22MLD. Part of one anaerobic pond and one facultative pond will be filled-up to create space for new 40 MLD STP that will be constructed.

As reported during stakeholder consultations there are 4 fishing cooperative groups, who undertake fishing in the WSP ponds through lease agreement floated by the Panchayat Samiti, under Bally-Jagacha Block. A list of the group's details is provided in Table 3.4. Reportedly these cooperative societies are informal groups and none of the groups have been registered and neither have a bank account in the group's name. These groups are informally formed for the purpose of carrying out collective fishing in the WSP. These four groups had been conducting fishing activities for the last 3-4 years in these WSP ponds, at the time when the WSP pumping station is in operational, and continued their fishing activities inside the WSP even post the shutdown of the WSP pumping station. Fishing has been carried out based on annual renewable commercial lease agreement (since 2015-16) with the BDO and the Panchayat Samity of Bally Jagacha. KMDA did not have any role in this arrangement, in spite of being the owner of the waste water bodies, or any approval was not taken from them prior to the commercial lease agreement. Reportedly a commercial lease agreement was signed between Bally-Jagacha Panchayat Samity and the four fishermen group leaders for using the ponds in 2017-2018. This lease agreement is followed by a yearly payment made by the fishermen to the Panchayat Samiti for using the ponds for fish farming. Presently the commercial leases with each of the groups have expired in October 2018 and the WSP ponds have benn handed over to MDA in 2019 by Block Development Office, Bally-Jagacha (which was entrusted take care and look after the WSP ponds). However, the fishermen have continued fishing activities without formal rights. Reportedly the fishermen group had paid the lease amount for 2017-2018, 2018-2019. The lease period starts from September of each year and ends in August. Out of the four groups only Maa Ganga Cooperative reported to have paid 40% advance of the lease amount dated 06th September 2019 for the year 2019-20. None of the other groups had paid the lease amount for the financial year 2019-2020.

In the WSP the main types of fish cultivated are Rohu *(Labeo rohita*), *Catla (Catla catla*), Kalbose *(Orangefin Labeo),* Briget, Lailantika *(Tilapia),* Silver Carp *(Hypophthalmichthys molitrix*), Black Carp *(Mylopharyngodon piceus*), Pangas (*Pangasius*), Mrigal *(Circinus cirrhosis*). Details of the fishing community and the ponds used is provided in **Table 4.49** below.

Reportedly, before fish farming in the WSP ponds the fishermen were engaged into other occupation (some of them were into the business of supply of construction materials while for some fishing was the primary occupation and a minuscule number of cooperative members have alternate livelihood such as daily labour, fish monger and truck helper etc.).They are dependent on aquaculture for income throughout the year presently. As reported during consultation, the average monthly income of each group member ranges between INR 25,000-INR 30,000. A list of the group's details is provided in **Table 4.49**

Table 4.49: Fishermen Cooperatives and Pond Used

Fishing Group	No. of Members	Ponds Used for Fishing
Maa Ganga Fishing	9 Members	Pond 1- Maturation Pond
Jivan Jivika Fishing	13 Members	Pond 6- Anaerobic Pond 3- Facultative Pond
Maa Kali Fishing	14 Members	Pond 4- Maturation Pond Pond 5- Anaerobic Pond
Maa Tara Fishing	10 Members	Pond 2- Facultative Pond

Source: Stakeholder Consultation dated 14th September 2019

Figure 4.36 Diagrammatic Representation of WSP Fishing Pond

Two meetings were held under Chairmanship of the District Magistrate, Howrah involving representation from WBSPMG, KMDA, VA Tech WABAG and NMCG on 28th July 2020 and 4th August 2020 respectively. Representatives of the fishermen groups engaged in fish farming activities with temporary lease in the waste stabilization ponds were also invited.

During the meeting held on 28th July, 2020, District Magistrate Howrah intimated the representatives of the fishermen groups about the upcoming project, which was welcomed by the fishermen group members with assurance to cooperate with the government agencies in execution of the project. The fishermen group members admitted that they have no legal claim on the WSP ponds.

Thereafter, a second meeting was held on 4th August, 2020 through video conferencing under the Chairmanship of District Magistrate that was attended by Joint Secretary (Works) and other representatives from KMDA representatives of fishermen group members, District Land and Land Reforms Officer, Howrah, BDO, Bally-Jagacha, representatives from NMCG and VA Tech Wabag. The government wanted to clarify the status of the commercial lease agreement – the fishermen group heads/members present confirmed that the last formal agreement for undertaking fishing at the STP site was valid for the tenure of 2017 – 18. Thereafter, though one of the fishing groups showed interest in renewing the lease in September, 2019 by making a part submission of the lease money,

the agreement was not mutually formalized by the concerned parties (Maa Ganga Fishery and Jagacha Panchayat Samity). Fishing group members pointed out that they have continued with the fishing practice till January, 2020 in spite of there being no lease agreement – the reason, being that they had not received any formal communication to discontinue the activity till then. However, on being informed of the proposed development by the Panchayat Samity in the beginning of 2020, they have made a final fish catch and no further fishing has been done since that time.

On being asked about their present livelihood status, several of the members stated that they are pursuing alternative livelihood options at present and fishing from the ponds was a supporting livelihood for most of them. The fact that there would be a livelihood loss was not brought forward by any of the group head or members. The group head/ members pointed out that they would currently not claim any stake in the ponds for continuing fishing activities – they understand that the land would be used for the government's STP project and they would be keen to support the project from their side(s). It was mentioned in the meeting that any future claim regarding livelihood restoration arising out of this project site would be scrutinized as per the parameters an conditions laid down by the donor agency in this regard after due verification of the claims and if found justified, it would be sent to the Urban Development Departent, Government of West Bengal and KMDA for necessary action as per law. The minutes of the two meeting are appended in **Appendix A.**

5. IMPACT ASSESSMENT AND MITIGATION MEASURES

5.1 Introduction

This section identifies and assesses the potential impacts to the physical, biological and socioeconomic environment that can be expected from the proposed project at Bally. The impacts due to the Project activities have been identified and assessed. Impacts are identified and predicted based on the analysis of the information collected from the following:

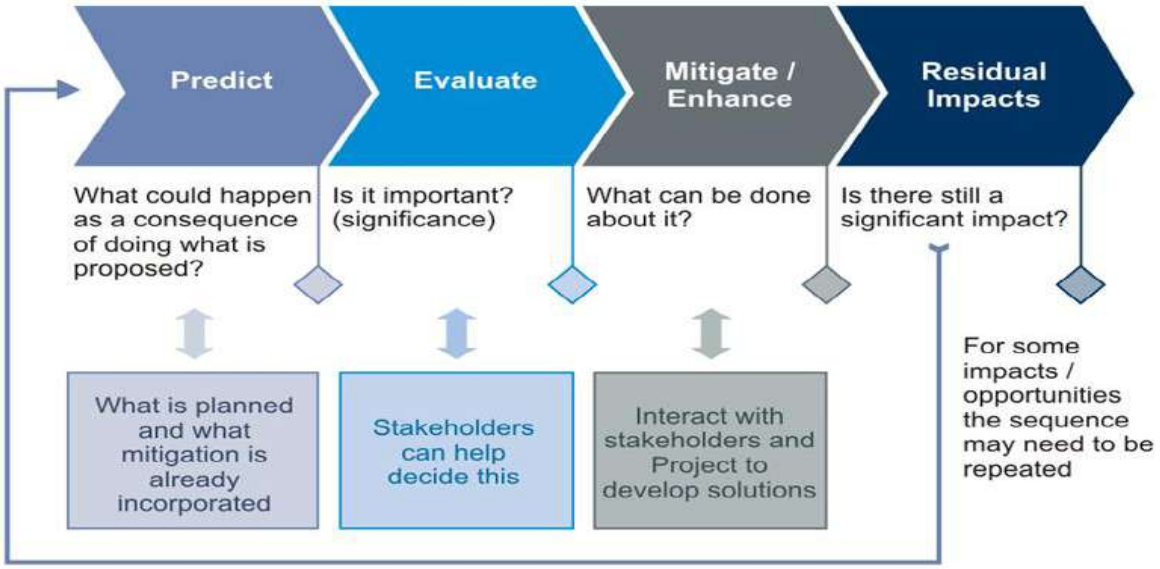
- Project site information (*as outlined in* **Section 2**)**;**
- Baseline information (*as outlined in* **Section 4**).

5.2 Impact Assessment Methodology and Approach

The identification of likely impacts during construction and operation phases has been carried out based on understanding of activities and their consequent impacts on various environmental and socio-economic resources or receptors. Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process (IAP).The principal impact assessment (IA) steps are summarized and comprise:

- **Impact prediction**: to determine what could potentially happen to resources/receptors as a consequence of the Project and its linked activities;
- **Impact evaluation**: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;
- **Mitigation and enhancement**: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts;
- **Residual impact evaluation**: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure 5.1 Impact Assessment Process



5.2.1 Prediction of Impacts

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the project and its linked activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the Project and the baseline environment are identified. From these potential interactions, the potential impacts to the various resources/receptors are identified, and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques. The nature and types of impacts that has been addressed in this ESIA is defined below.

Box 5.1: Nature & Type of Impacts Considered for Impact Assessment

- **Negative:** when impact is considered to represent adverse change from the baseline or introduced a new undesirable factor;
- **Positive or beneficial:** when impact is considered to represent improvement to baseline or introduced a new desirable factor;
- **Direct:** impacts that result from a direct interaction between the project and a resource/ receptor;
- **Indirect:** impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment; and
- **Induced:** impacts that result from other activities (which are not part of the project) that happen as a consequence of the project.

5.2.2 Evaluation of impacts

Evaluation of significance of an impact is assessed by ascertaining a) magnitude and b) sensitivity/vulnerability/importance of resource/receptor likely to be impacted as defined in the following description:

a) Determining Magnitude of an Impact

Magnitude, i.e. severity of an impact or degree of change caused by a project activity is a function of interaction characteristics of Scale, Extent and Duration. The criteria that have been evolved for each of these key elements resulting in degree of change with corresponding ranking/level of impacts (low, medium and high) on the environmental component are presented in **Table 5.1.**

Table 5.1: Impact Prediction Criteria

Impact Elements	Criteria	Ranking
Scale: Degree of damage that may be caused to the environmental components concerned	■ **Irreversible damage to natural environment** and/or likely difficult or may not to revert back to earlier stage with mitigation; ■ **Major changes in comparison to baseline conditions** and / or likely to regularly or continually exceed the standard;	High
	■ **Reversible damage to natural environment** but likely to easily revert back to earlier stage with mitigation; ■ Perceptible change from baseline conditions but **well within acceptable norms**.	Medium
	■ Effect is **within the normal range** of natural variation; ■ **No perceptible or readily measurable change** from baseline conditions;	Low
	■ Project site and the entire study area i.e. beyond Project influence area.	National

Impact Elements	Criteria	Ranking
Extent: Spatial or geographical extent of impact due to a project and related activities	■ Project site & its surroundings (2.0 km from Project components	Regional
	■ Project site & its immediate vicinity (0.5 km from Project components	Local
Duration: Temporal scale of the impact in terms of how long it is expected to last	■ Spread beyond the lifecycle of the project	Long Term
	■ Spread across several phases of the project lifecycle	Medium Term
	■ Only during particular activities or phase of the project lifecycle	Short Term

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. The magnitude combines the impact characteristics of Extent, Duration and Scale and is a multiplicative factor of these three criteria set. Based on the above understanding magnitude of impact is assessed as per the **Table 5.2.**

Table 5.2: Assessing Magnitude of Impact

Scale	Extent	Duration	Magnitude
Low	Local	Short Term	**Negligible**
Low	Regional	Short Term	**Small**
Low	Local	Medium term	
Medium	Local	Short Term	
Low	National	Short Term	
Low	Local	Long term	
High	Local	Short Term	
Low	Regional	Medium term	
Medium	Regional	Short Term	
Medium	Local	Medium term	
Low	National	Medium term	**Medium**
Medium	National	Short Term	
Low	Regional	Long term	
High	Regional	Short Term	
Medium	Local	Long term	
High	Local	Medium term	
Medium	Regional	Medium term	
Low	National	Long term	
High	National	Short Term	
High	Local	Long term	
Medium	National	Medium term	**Large**
Medium	Regional	Long term	
High	Regional	Medium term	
Medium	National	Long term	
High	National	Medium term	

High	Regional	Long term	
High	National	Long term	

b) Determining Sensitivity/ Importance/ Vulnerability of Receptor

In addition to ascertaining magnitude of impact, the other principal step necessary to assign significance for an impact is to define the sensitivity/vulnerability/ importance of the impacted resources/ receptor. There are a range of factors to be taken into account when defining the sensitivity/ vulnerability/ importance of the resource/ receptor, which may be physical, biological, cultural or human as per the following understanding:

- Where the resource is physical (for example, fresh water body) its quality, sensitivity to change and importance (on a local, regional, national importance) are considered;
- Where the resources/ receptor is biological or cultural (for example, sea turtle habitat and nesting site), its importance (for example local, regional or national importance) and its sensitivity to the specific type of impact are considered;
- Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Definition as defined in **Table 5.3** has been adopted to determine sensitivity/ importance/ vulnerability of environmental resources or receptor.

Table 5.3: Sensitivity/Importance/ Vulnerability Criteria

Sensitivity	Contributing Criteria
High	■ Existing physical environment quality is already under stress; ■ Ecologically sensitive/ protected area, provides habitat for globally protected species; ■ Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the project. ■ Human receptors/ vulnerable community are located within the project footprint and directly affected by the project ■ Resource exclusive for community use
Medium	■ Existing physical environment quality shows some sign of stress; which is sensitive to change in quality or physical disturbance; ■ Natural habitat provides habitat for wildlife, which are protected under National regulations; ■ Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the project; ■ Human receptors/ vulnerable community are located adjacent the project site and likely to be affected by the project; ■ Alternative resource available with community.
Low	■ Existing physical environment quality is good; ■ Modified habitat provides habitat for common species; ■ Human receptors are located away and are not likely to be affected due to the project related activities

c) Evaluating Significance of Impacts

Based on interaction of magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor likely to be impacted, the significance of impact is assigned for each impact using the matrix shown in **Figure 5.2**

Figure 5.2 Assessing Significance of Impact due to Proposed Project Related Activities

		Sensitivity /Vulnerability / Important Resource / Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The context of various impact significance ratings is defined in ***Box 6.2.***

Box 5.2 Context of Impact Significance

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

5.2.3 Identification of mitigation and enhancement measures

Once the significance of an impact is assessed, the next step is to evaluate what mitigation and enhancement measures are warranted. In this ESIA, following Mitigation Hierarchy has been adopted:

- Avoid or Reduce at Source: avoiding or reducing at source through the design of the project;
- Abate on Site: add something to the design to abate the impact;
- Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site;
- Repair or Remedy: some impacts involve unavoidable damage to a resource and these impacts can be addressed through repair, restoration or reinstatement measures;
- Compensate in kind, compensate through other means: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate.

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the linked Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation and enhancement measures are declared, the next step in impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

5.2.4 Management and monitoring

The final stage in the impact assessment process is to define the management and monitoring measures that are needed to identify whether: a) impacts or their linked Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

Environmental Management Plan summarises all actions (including mitigation/enhancement and compensatory measures) which the Project Proponent has committed to executing with respect to environmental/social/ health performance for the Project, is also included as part of the ESIA report. The Plan also includes monitoring measures to assess performance of the actions

5.3 Assessment of Environmental and Social impacts and Mitigation Measures

The potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) linked with the Project have been considered with respect to their potential to interact with environmental and social resources or receptors. In addition to the project components like the existing STP, proposed STP, existing and proposed sewage lines, existing LS and Main pumping station (MPS) has also been considered for the purpose of this current assessment.

The interaction matrix enables a methodical identification of the potential interactions each Project activity may have on the range of resources/ receptors within the Area of Influence i.e. the study area for the Project.

Table 5.4: Impact Identification Matrix for Bally STP and Linked Facilities

Project Activities	Potential Impacts																									
	Environmental Resources											Ecological Resource				Social-Economic Resources									
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora (Inland & Marine)	Aquatic Fauna (Inland & Marine)	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Livelihood Loss of Existing Workers	Physical Displacement	Land Use (Economic Displacement)	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health & safety
I. Construction Phase																										
Mobilization and Operation of earthmoving equipment				■	■						■					■			■			■				■
Land preparation (cleaning and grading)			■				■									■			■							
Land excavation			■				■									■			■							
De-watering of excavated area			■				■									■			■							
On-site handling and storage of excavated material	■		■	■		■	■									■			■							
On-site handling and storage of construction waste including concrete residue	■		■	■		■	■									■			■							■
Off-site disposal of construction waste including concrete residue	■	■	■	■			■									■			■							
Installation of STP structures					■											■			■							■
Installation of electro-mechanical equipment																■			■							■

Project Activities	Potential Impacts																								
	Environmental Resources											Ecological Resource				Social-Economic Resources									
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora (Inland & Marine)	Aquatic Fauna (Inland & Marine)	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Livelihood Loss of Existing Workers	Physical Displacement	Land Use (Economic Displacement)	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health & safety
Operation of DG sets (standby)				■		■										■			■						
Use of water for construction activities							■		■							■			■						
Wastewater generated during construction activities			■			■										■			■					■	■
Vehicular Movement *(*RMC Trucks, raw material unloading vehicles, waste disposal trucks etc.*)*				■	■						■					■			■					■	■
II *(a). Activities at Linked Sewage Infrastructures*																									
Land preparation for sewer pipeline renovation(clearing and grabbing)	■			■	■						■					■		■			■	■			
Mobilization and operation of earthmoving equipment for sewer pipeline renovation																■									
Desilting of sewer pipelines	■				■	■										■	■	■			■	■			■
Laying of New sewer pipelines	■			■	■						■					■	■	■			■	■			■
On-Site storage and handling of silt/sludge	■					■					■					■									■
Off-Site disposal of silt/sludge	■		■				■		■	■						■									■

Project Activities	Potential Impacts																								
	Environmental Resources											Ecological Resource				Social-Economic Resources									
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora (Inland & Marine)	Aquatic Fauna (Inland & Marine)	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Livelihood Loss of Existing Workers	Physical Displacement	Land Use (Economic Displacement)	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health & safety
Dismantling of Electro-Mechanical equipment at linked facilities (MPS, LS structures, etc.)	■															■									■
Renovation of linked facilities (installation of electro-mechanical structures)	■											■				■									■
On-Site handling and Storage of waste generated at linked facilities.(Hazardous and Non-Hazardous)				■			■									■									■
Off-Site disposal of waste generated at linked facilities.(Hazardous and Non-Hazardous)			■	■			■				■					■									■
II. Operation Phase																									
STP operation	■			■	■		■	■								■								■	■
On-Site handling and storage of Bio-Solids	■		■													■									■
Off-Site disposal of Bio-Solids	■		■													■									■
Biogas flaring and flue gas venting (from Biogas engine).				■												■									
Handling and Storage of Chlorine				■												■									■

Project Activities	Potential Impacts																								
	Environmental Resources											Ecological Resource				Social-Economic Resources									
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora (Inland & Marine)	Aquatic Fauna (Inland & Marine)	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Livelihood Loss of Existing Workers	Physical Displacement	Land Use (Economic Displacement)	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health & safety
Hazardous and Non-Hazardous Waste Storage, Handling and Disposal at STP			■			■										■									■
Hazardous and Non-Hazardous Waste Storage, Handling and Disposal at off-site location			■													■									■
DG Set operation (standby)				■	■											■									

□ = Represents “no” interactions is reasonably expected

■ = Represents interactions reasonably possible but none of the outcome will lead to significant impact impacts

■ = Represents interactions reasonably possible with one of the outcomes may lead to potential significant impact

5.4 Potential Environmental Impacts

As per Impact Identification Matrix for Bally STP and Linked Facilities (**refer Table 5.4**) proposed project activities have an interaction following environmental resources:

- Visual Aesthetics & Odour Nuisance
- Soil Quality
- Ambient Air quality
- Ambient Noise
- Drainage
- Surface Water
- Ground Water
- Road Traffic
- Community Health and Safety
- Occupational Health and Safety

Detailed impacts linked to above mention have been assessed and respective mitigation measures have be analysed further in this section.

5.4.1 Visual and Aesthetics

Construction Phase

Visual and Aesthetics

The proposed facility will be developed by filling up of anaerobic pond and facultative pond ***(*Refer Section 2.1)** During this phase multiple activities will be undertaken within the STP Site, starting from cleaning and grading of land, mobilization of construction equipment, land excavation/filling and piling for making base foundation, etc. Waste generated from these activities will have to be stored within the STP Site temporarily, till they are disposed or reutilized for backfilling purpose. These waste will be stacked at designated place. Continuous stacking builds heaps of these waste along with temporary labour camps which are not soothing for human eye or residents of nearby area. This may have a detrimental effect on the perceived beauty of the place. Potential impacts on the receptors may be medium to high as the STP is in direct line of vision for the receptors. Another visual and aesthetic impact which is envisaged during this phase may arise due transportation of construction material and waste by trucks, tippers and dumpers through the only access road i.e. Bhattanagar road impacting receptors of Chakpara, Bhattanagar and Anandanagar. Thus overall impact for this phase ***Negligible*** due presence of open low marshy land around the proposed STP Site in all direction.

Embedded Control System:

- As per the C&D waste management plan shared by M/s VA Tech Wabag the building of covered shed for storage of C&D waste

Mitigation Measures: The mitigation measures to minimize the above mentioned impacts are as follows:

- All the construction and activities will be restricted within the designated site
- Use of covered trucks, tippers or dumper, if not, then Wabag has to make sure that materials are not moved without putting a cover on them.
- On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility.

- Quick disposal of Sludge/de-silt material from sewer network.

Impact Significance	Potential Impact on Visual and Aesthetics during Construction Phase			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered ***Negligible***			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered ***Negligible.***			

Residual Impact: Considering the implementation of above mentioned mitigations measures the significance of residual impact is assessed as **Negligible.**

Operational Phase

Visual and Aesthetics

Presence of newly build STP will have a positive effect, as new structures will be constructed, painted, labelled will be built improving the overall aesthetic of proposed STP area.

Mitigation Measures: The mitigation measures to minimize the above mentioned impacts are as follows:

- Designated area for temporary Sludge/Bio-solid storage.
- Developing a solid waste management plan for the Bally STP and linked facility.

Impact Significance	Potential Impact on Visual and Aesthetics during Operational Phase			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered ***Negligible***			

Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered ***Negligible.***			

Residual Impact: Considering the implementation of above mentioned mitigations measures the significance of residual impact is assessed as **Negligible.**

5.4.2 Ambient Air Quality and Odour

Air Quality

Construction Phase

During this phase major source of potential impact on ambient air quality is firstly, due fugitive dust emissions from storage and handling of construction waste. During normal conditions these fugitive dust emissions are likely to spread within a range of ~100 -150 m radially, only during windy condition radial spread of fugitive emission will increase to ~200-250 m and affecting receptors within ~250-300m m from STP site. Nearest settlements from STP Site is at distance of ~350 m South-east direction.STP Site is surrounded by low marshy land (~350 m) on the northern and southern boundary. On the western boundary STP Site has industrial area (~500 m) which is also a source of fugitive emissions along with Kona Expressway running along the western side of the STP Site. Based on the baseline condition (**refer section 4.2.7**) which is not stressed and magnitude of fugitive emissions from construction phase impacting the receptor will be minor in nature.

All actives during construction phase will be carried using grid connection and portable DG set will only be used in case of emergency as back source of electricity. Stack emissions from these portable DG sets and vehicular emissions have HC, NOx, PM and CO. Referring to the baseline condition for the site (**refer section 4.2.7),** additional load from construction phase will have potential impact on the air quality of the surrounding and radial spread is will not be more than ~200-250 m.

Another set of activities affecting ambient air quality is vehicular emissions due to movement of trucks carrying construction material and mobilization of construction. Estimated movement of trucks per day for delivering construction material and removal of construction waste ~10 PUC/day. The site has Kona expressway on western side having heavy traffic influx which will be adding to baseline condition along with fugitive emission stated above.The potential impact on the receptors is envisaged to minor to negligible as the nearest receptors i.e residents of Anandanagar are at an aerial distance of ~400m which is more than the radial spread as discussed above. A major factor for spreading of fugitive and vehicular emission is prevailing wind direction, which is in south to north direction, majority of the area is low marshy land **(refer figure 5.3)** carrying away from the receptors surrounding the STP.

Odour Nuisance

During construction phase only source of odour that can be envisaged is solid waste generated from labour camp, grit chambers of MPS and LS. To assess the impacts due to sources stated above we focus on existing environment **(refer figure 5.3)** and field visit, we can infer that there were odour issue within the area of influence due to improper management of solid waste by the local body and absence proper drainage system for the surrounding area. Duration of impact from above aspects are short term and impact magnitude will be negligible to minor in nature.Odour nuisance along the sewer line will have potential impact on residents, shops and markets (**refer section 2.5)** due to temporary storage of de-silted material/solid waste from grit screen of LS, along the roadside. Duration of temporary storage may be up to 48hrs maximum which is comparatively short, hence the overall impact will be of ***Negligible.***

Figure 5.3 Present Scenario of Bally STP Location

Embedded Control Measure: Measure stated in Construction and Demolition plan shared with ERM are:

- Vehicle, equipment and machinery used for would conform to applicable emission norms(PUC certificate);
- Designated storage area for generated waste with provision of covering.
- Water sprinklers to control fugitive dust emissions.

Anticipated impact scenarios mentioned above will be short-term and will exist during construction activities only. As a result they pose medium risk and they are reversible in nature. The potential impact on air quality is assessed to be Minor.

Mitigation Measures:

The proposed mitigation measures are as follows:

- The construction materials waste will not be stored in the direction of prevailing wind. Further efforts will be made to maintain the stockpile against a wall or obstruction so that it works as a windbreak and fugitive emissions during strong winds can be avoided;
- Hazardous or Non-hazardous waste generated from construction activities at the site will not be burned;
- All loading and unloading activities to be carried out as close as possible to the storage facilities;
- Proper handling of materials to ensure minimal emission of dust. Trucks used for transportation of material during site preparation will be provided with impervious sheeting;
- Stacks heights for DG sets should be by the formula H = h + 0.2 *capacity of DG (in KVA) where H is total height of stack and h is height of building in meters where the generator is installed.

Impact Significance	Air Quality Impact during Construction phase			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Negligible**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as ***Negligible.***

Operational Phase

Embedded Control Measure: The Project embedded control measures are as follows:

- Inbuilt Bio-gas Scrubber to remove sulphates;

Impact Assessment

Sources of impact during operation phase firstly, emergency bio-gas flaring on non-operational condition of bio-gas engine during STP operation. Biogas generated in sludge digester will be cleaned in bio-gas scrubber and then sent to Bio-gas holder. Depending upon the operating pressure gas will either be flared through the stacks or sent to bio-gas engine and the flue gas will be vented out affecting the ambient air quality. To estimate the spread of air emissions from bio-gas flaring modelling study has been conducted. The composition of the biogas is 50-70% of methane, with the remaining gases comprising of Nitrogen, Carbon Dioxide and traces of Hydrogen Sulphide. On combustion, the gas emitted largely comprises of Carbon Monoxide, Total Volatile Organic Carbon (VOC) and Oxides of Nitrogen. The Solid Waste Management Rules, 2016 has provided standards for emissions from incinerators/thermal technologies from solid waste treatment/disposal facility. The Standard is not applicable on emissions from flaring (direct thermal application) and power production (through ignition engines). Hence, standards for emissions recommended from ignition engines and flare stacks in Guidance Note on Landfill Flare and Engine Management and Monitoring, 2012[32] by Environmental Protection Agency, Ireland has been considered in the study. Since the design of flare stack has not been shared, it is assumed that the flare will operate with 99% efficiency and accordingly stack and emission parameters have been considered[33].

The table below shows the estimated emissions from flue gas and bio-gas flaring:

[32] https://www.epa.ie/pubs/advice/air/emissions/Guidance%20Note%20on%20Landfill%20Flare%20and%20Engine%20Management%20and%20Monitoring%20(AG7).pdf

[33] file:///C:/Users/Indrani.Ghosh/Downloads/flare-efficiency-estimator.pdf

Table 5.5: Flue Gas Emission Standards from the Proposed Plant

Source of stack	No. of stack	Stack Height (m)	Stack Internal Diameter (m)	Flue gas exit velocity (m/s)	Flue gas temperature (degree Centigrade)	Normal Volumetric Flow rate (Nm^3/hour)	Emission Concentration (mg/Nm^3)			Emission Rate (g/s)		
							NO_x	CO	VOC	NO_x	CO	VOC
Biogas Engine	1	10	0.6	18	450	989	500	1400	1000	0.17	0.48	0.34
Flaring	1	10	0.6	5	800	795	150	50	10	0.033	0.011	0.002

Impacts due to the operation of the plant were assessed by modelling projected emission rates using the AMS/EPA Regulatory Model (AERMOD). AERMOD is a modelling system consisting of three separate modules: AERMET, AERMAP and AERMOD. AERMET is a meteorological pre-processor and uses hourly surface observations, cloud cover, and upper air parameters from twice-daily vertical sampling of the atmosphere to create two output files consisting of surface and vertical profile data, respectively. The terrain pre-processor AERMAP uses DEM maps as well as user generated receptor grids. AERMAP's output file consists of the x, y locations of each receptor, mean sea level (MSL) elevation and hill profile parameters. The hill profile parameter is used in determining plume flow around elevated terrain.

Model Options: The AERMOD model was run with the following regulatory default options in this assessment:

- Stack-tip downwash;
- Elevated terrain effects;
- Use of calms processing routine;
- Use of missing data processing routine; and
- No exponential decay

Meteorological Data: The input meteorological data for the AERMOD was generated using the MM5 model, which was downscaled to fine grid data suitable for modelling. The data used in the study was site specific and was collected during study period.

Terrain Data: Terrain data for the AERMAP model were taken from the 30 m SRTM database, while land cover data was sourced from satellite imagery of the Project site and its surroundings.

Receptors: The receptor grid or network, defined the locations of predicted ground level concentrations (GLCs) used to assess compliance with the relevant standards or guidelines. The following comprehensive fine and coarse receptor network was used for this analysis:

- 100 m spaced receptors from the source up to 10 km.

Modelling Results

Predicted maximum ground level concentrations within the Project AOI with biogas as fuel are presented in **Table.5.6.** Isopleths of ground level concentration for different averaging periods of the pollutants (NOx, CO and VOC) with biogas as fuel are presented in **Figure 5.6 to Figure 5.13**.

It is evident from the predictive results outlined under **Table 5.6** that, the maximum ground level concentration (maximum baseline concentration + predicted maximum concentration) in the Project AOI with natural gas as fuel will be well within the applicable standards for air quality. The additional pollution load of PM_{10} and NOx from proposed expansion project to the baseline condition (**refer 4.2.7**) may not cause major changes in the existing baseline conditions or exceed the NAAQS. The emissions from the plant will however be long term, i.e. will occur for entire life of the plant. The potential impact on air quality due to emissions from the plant is assessed to be **moderate**.

Table 5.6: Summary of Maximum Incremental Ground Level Concentration Values

Pollutants	24 Hourly Maximum GLC	Distance from Source(m)	Direction
Source – emission from stack attached to Biogas Engine			
NOx	1.92	392	South-West
CO	5.20	398	South-West
VOC	3.69	394	South-West
Source – emission from flare stack			
NOx	1.81	157	South-West
CO	0.60	156	South-West
VOC	0.11	156	South-West

Overall incremental impact on the ambient air quality due to the STP operation, taking into account existing air quality and neighbourhood sources causing air pollution, can be considered of ***Minor*** significance.

Figure 5.4 NOx Isopleths of stack connected to Engine

(24 Hourly Maximum Ground Level Concentrations)

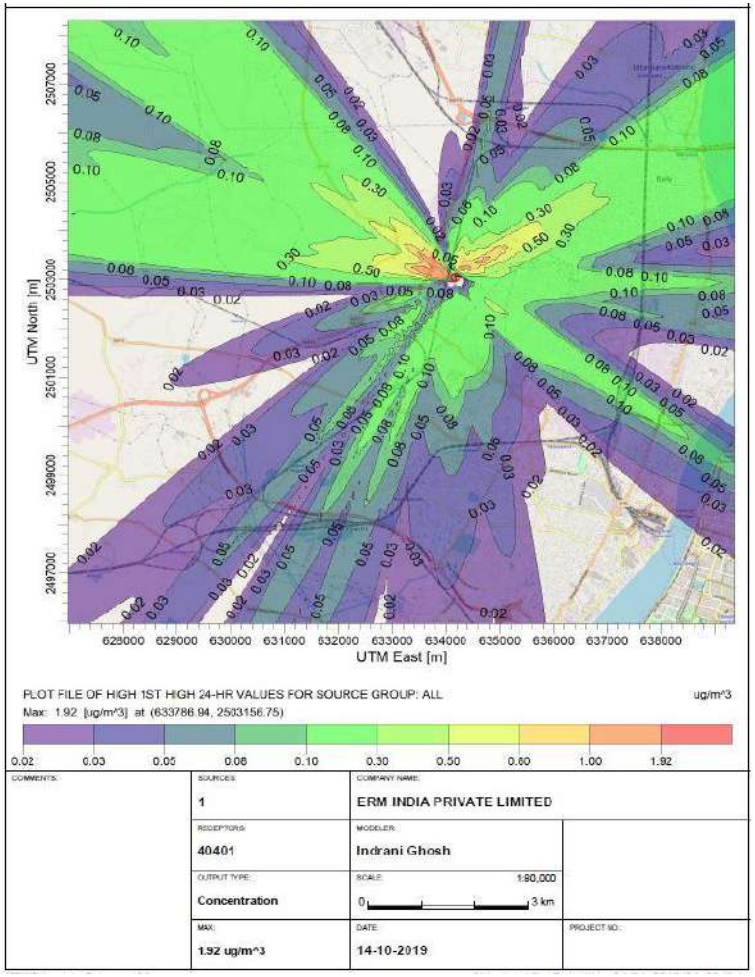


Figure 5.5 CO Isopleths of stack connected to Engine

(24 Hourly Maximum Ground Level Concentrations)

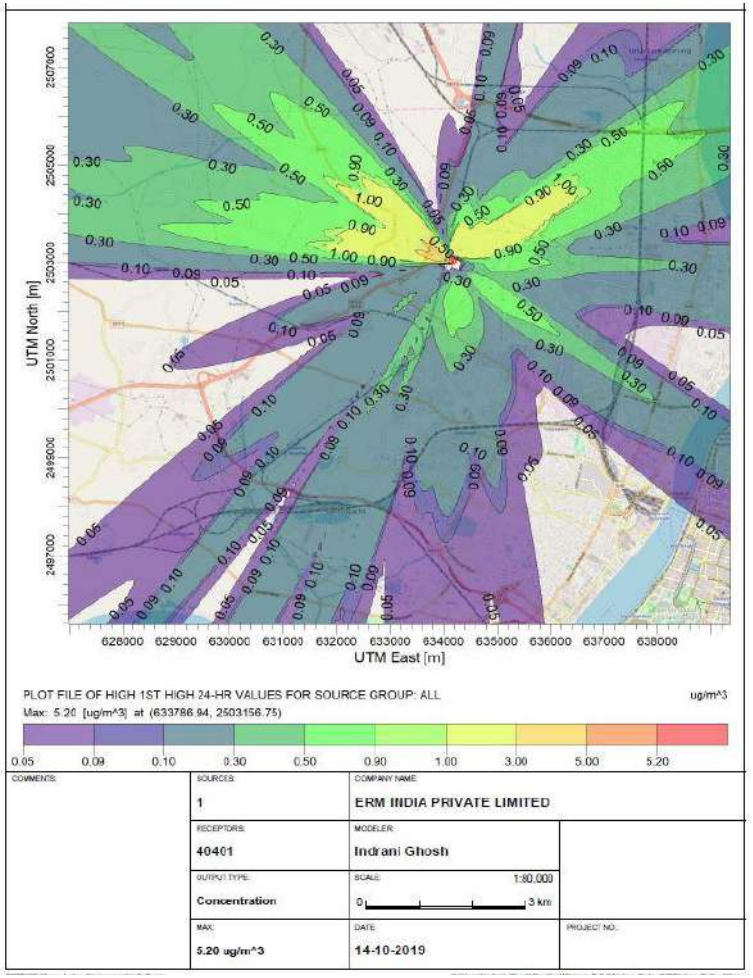


Figure 5.6 VOC Isopleths of stack connected to Engine
(24 Hourly Maximum Ground Level Concentrations)

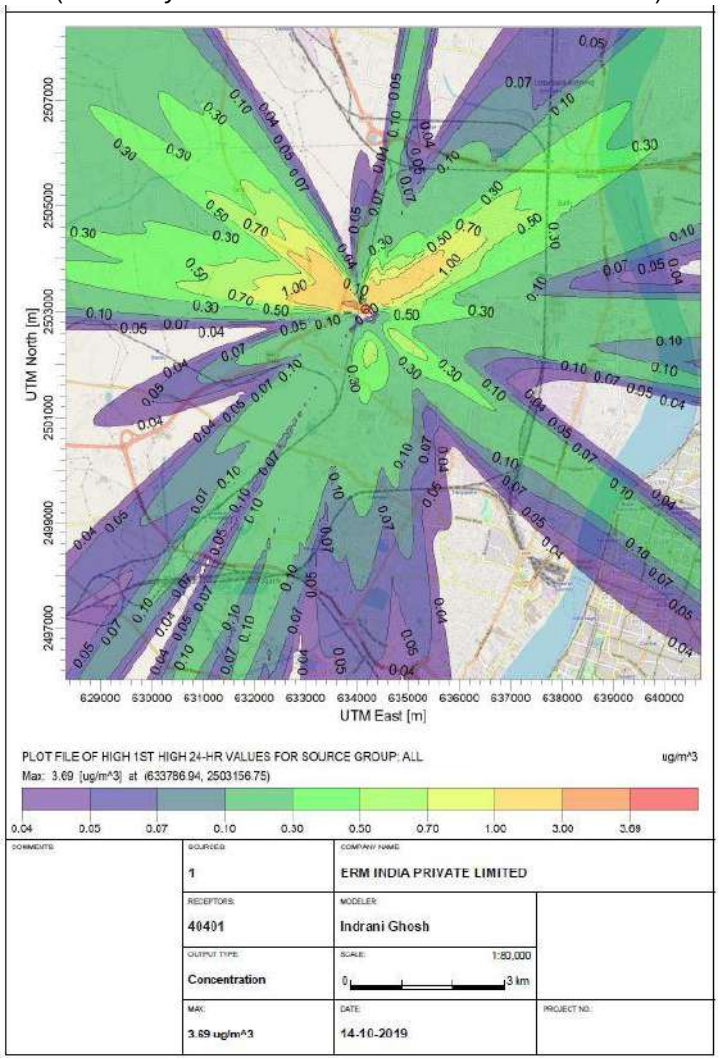


Figure 5.7 NOx Isopleths of flare stack-
(24 Hourly Maximum Ground Level Concentrations)

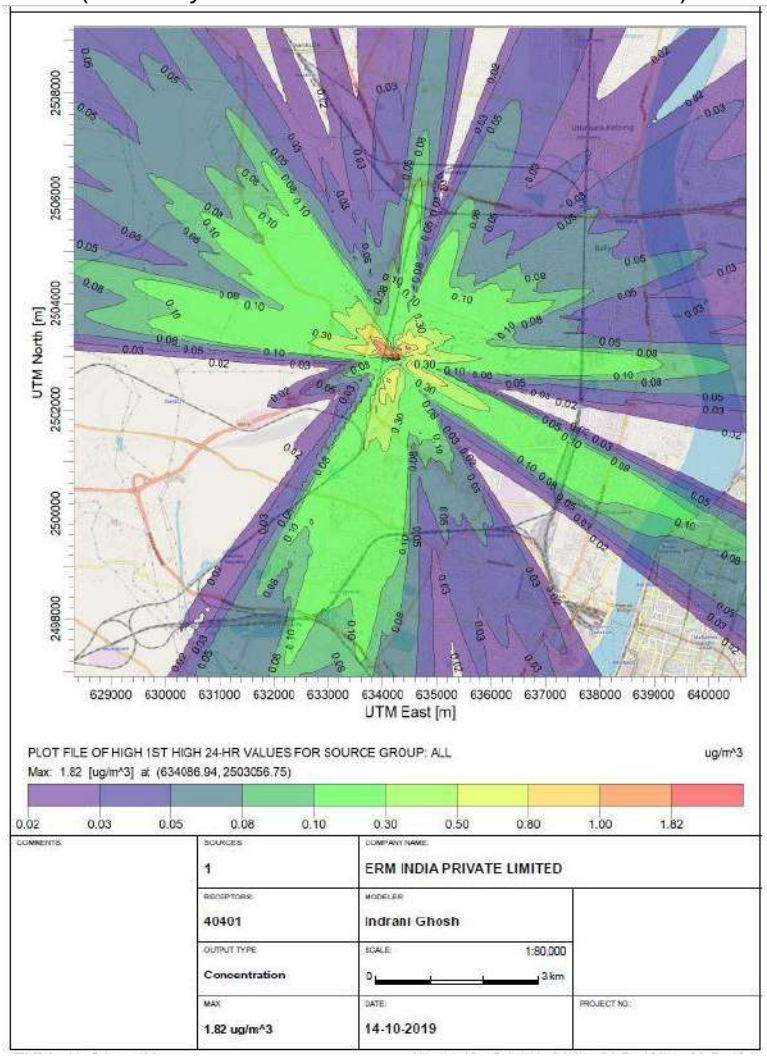


Figure 5.8 CO Isopleths of stack connected to Engine

(24 Hourly Maximum Ground Level Concentrations)

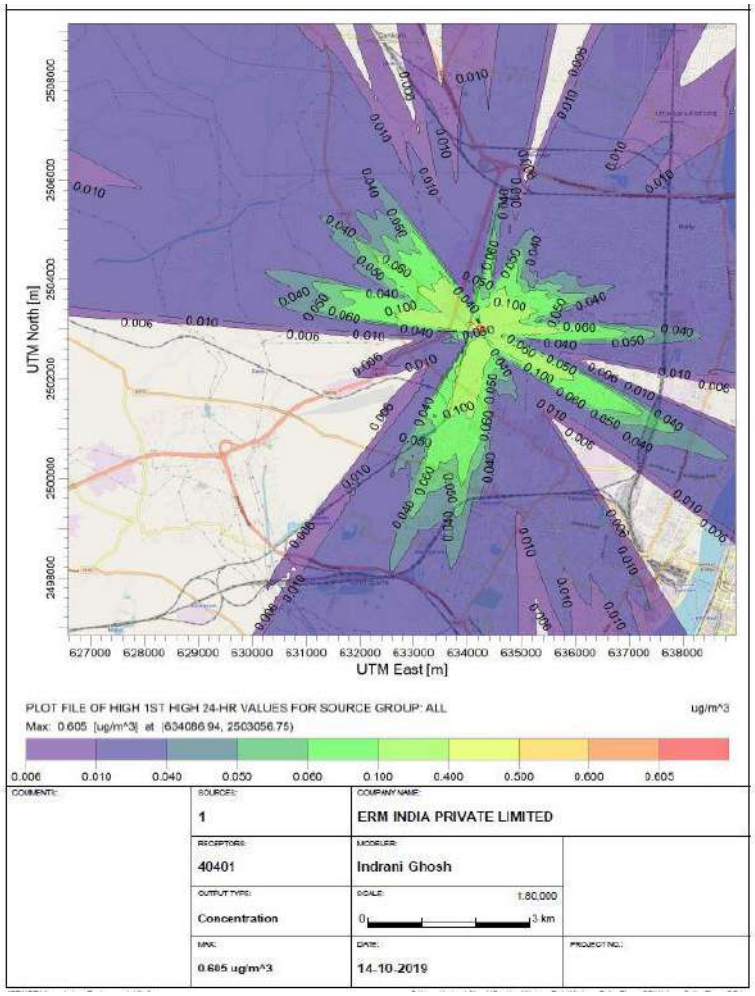
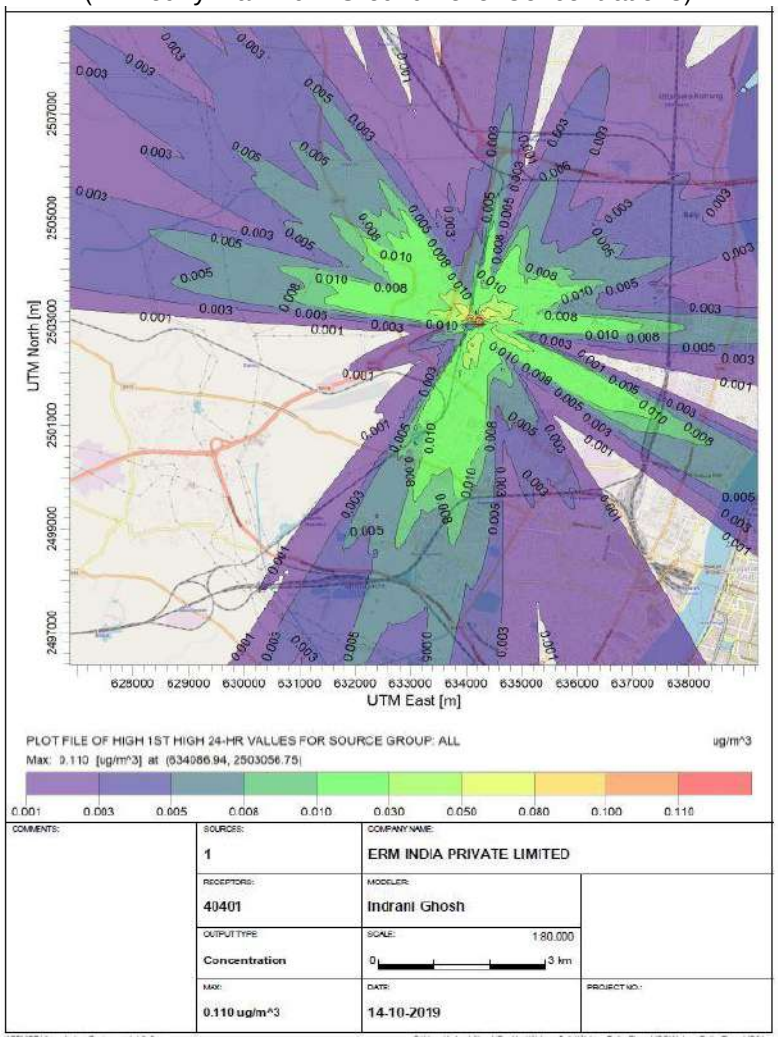


Figure 5.9 VOC Isopleths of flare stack

(24 Hourly Maximum Ground Level Concentrations)



Odour Impacts

Nuisance odour generated from sewage and wastewater treatment plants impairs ambient air quality and represents a growing social and public health issue that is increasingly a cause for public discomfort and complaints. Biological treatment and stabilization processes which are widely applied for sewage treatment reduce the nutrient concentration in waste water, thus minimizing environmental impact. However, when anaerobic conditions are reached during microbial decomposition of organic matter present in sewage (food, animal scums, organic compounds, etc.), unpleasant odours are generated. From the chemical nature point of view, the main contributor of such odour are gases like Hydrogen Sulphide as well Volatile Organic Compounds (VOCs) resulting from anaerobic decomposition of organic matter with sulphur and nitrogen content. Other by-products of such decomposition process may comprise of highly odorous compounds like mercaptans, organic sulphur substances and amines.

As per standard STP operation, key emission sources of odour substances from the proposed STP are as follows:

- Potential sources of odour due to mass transfer and organic reaction leading to formation of odorous substances are, aerated grit separator, activated sludge treatment section. As per GSPPL these structures of proposed STP are closed, odour generated within them will not spread outside, hence these have not been considered while estimating odour impacts.
- While, sources where new odorants form, i.e., primary/secondary sedimentation, thickening tanks are considered major sources of odour and hence they are considered for odour impact estimation.
- In addition, other sources will include underground conduit lines, and existing I&D structures. In order to assess an incremental increase of odour levels consequent adverse impacts in the immediate neighbourhood of the STP site, a dispersion modelling approach has been adopted. It needs to be noted here that there is no ambient odour level standard that are specified by regulations in India – regulatory guidance though mentions that odour levels from discharges /wastes should be managed such that it is not objectionable to receptors. The step-wise methodology adopted for carrying out the prediction exercise is discussed below:
- Considering multiple uncharacterized odorant gases to be the potential source of Odour, standard Odour emission rates/factors, based on review of order of magnitude estimates from specific components of biological water treatment plants (sedimentation tanks, aeration tanks, sludge thickeners, etc.), available in literature has been used (in terms of Odour emission rate in ou per m^2) to estimate source wise contributions/Odour flow rates from the STP, as per **Table 5.7** below.

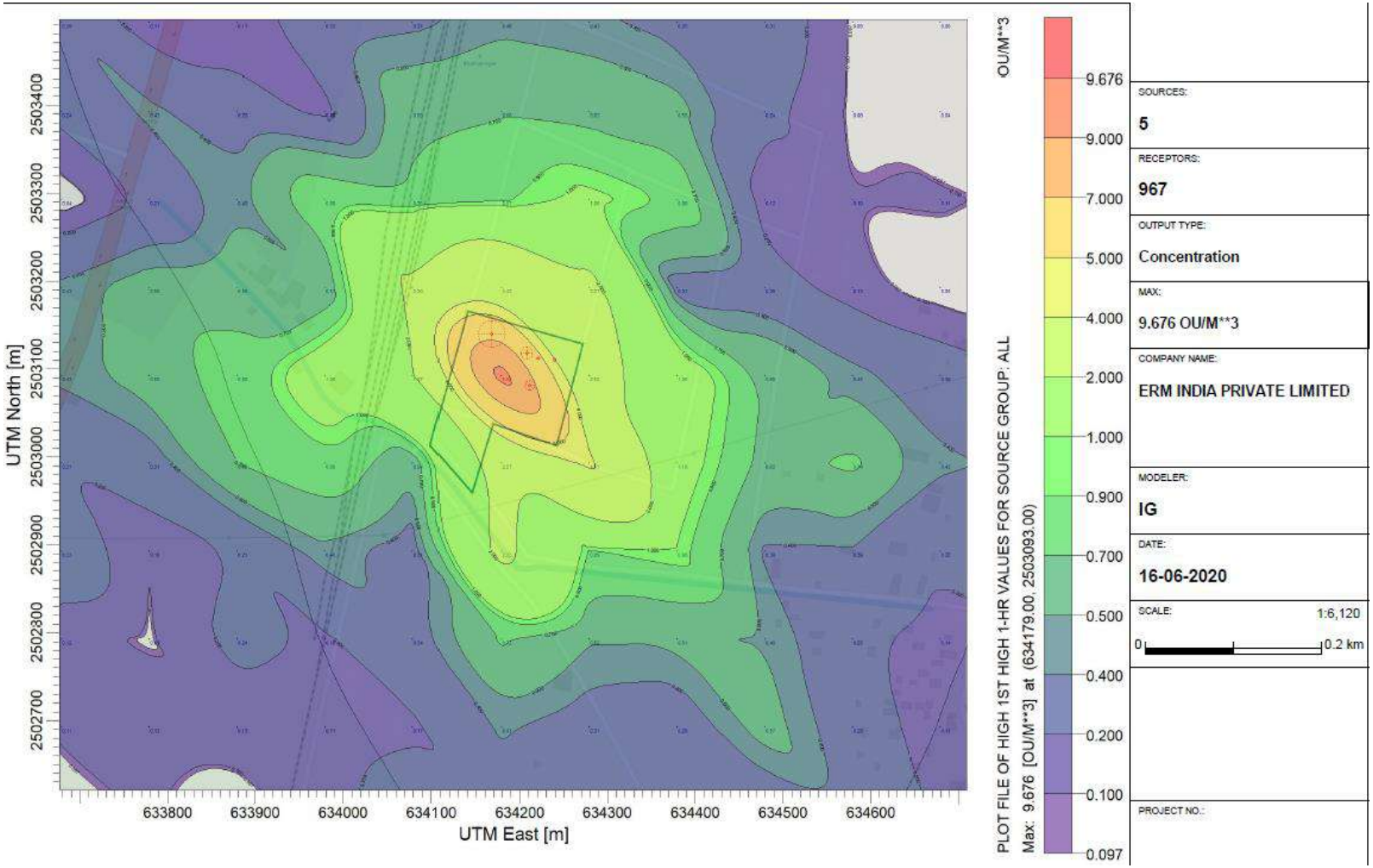
Table 5.7: Source wise Contributions/Odour Flow Rates from the STP

Source	Area (m^2)	OU/m^2h	OU/m^2s	OU/s
Primary Clarifier	147.34	5000	1.39	204.63
Secondary Clarifier	730.25	500	0.14	101.42
Aeration Grit Chamber	86.54	20000	5.56	480.81
Digester Feed Sump	8.03	35000	9.72	78.15
Digested Sludge Sump	11.33	16000	4.44	50.38

- One season's meteorological data has been complied based on near site secondary data available and used for the use in the predictive modelling exercise. Given that the terrain is flat, and the proposed buildings and structures are not very high, no terrain data or building wake effects have been considered in the model run.

- Odour dispersion has been predicted using AERMOD steady-state plume model in area source mode resulting in estimation of ground level Odour concentrations (GLC) as Odour units / m3 at specific receptor locations and as contours of specified Odour levels within 1 km radius around plant. **Figure 5.10** provides the Odour concentration contours around the source of emissions.

Figure 5.10 Odour Concentration Contours around the Source of Emissions



The dispersion of odour concentrations based on emissions from source of origin shows that the highest concentrations 9.676 OU/m^3 at a point located within 100 m from the source. As per guidance available in the UK, it is generally accepted that odour concentrations of 5 – 10 OU/m^3 give rise to a faint odour which may just exceed the annoyance threshold of human receptors and distinct odour which can give rise to a nuisance results from a concentration of > 10 OU/m^3. It is also anticipated that the odour from the STP will be masked sufficiently by the existing ill managed municipal solid waste storage locations beside the STP boundary. Hence, an incremental adverse odour impacts will be caused by the operation of the STP for the residents of Bhattanagar. As these residential houses are within ~50 m from STP western boundary. Moreover, there is a potential for some odour nuisance to be generated along the sewer lines which may impact residents neighbouring the alignment, shops and markets (**refer section 2.5)** and due to temporary storage of de-silted material/solid waste during de-siltation along the sewer network. Duration of temporary storage may be upto 8 hrs maximum post which these will be collected by collection trucks and disposed to KMDA assigned landfill, which is comparatively short, hence the impact may be considered to be of minor significance.

Impact	**Air quality and Odour impact during Operational Phase**			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Short Term	Medium Term	Long Term	
Impact Extent	Local	Regional	National	
Impact Scale	Low	Medium	High	
Impact Magnitude	Positive	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Moderate**			

Mitigation Measures:

- Developing a ambient monitoring plan and stack monitoring schedule
- Using low sulphur content diesel for DG sets.
- Keeping the storage areas under moist conditions to prevent dust formation.
- To ensure compliance with the air emission criteria for flue gas stacks, the following measures will be implemented during operations:
  - The use of continuous emission monitoring (CEM) equipment for the measurement of air emission levels in the exhaust stack of HRSG. CEM will be undertaken for PM_{10}, NO_x, SO_2, CO and O_2;
  - $PM_{2.5}$ and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the bio gas.
  - The stack will be provided with safe access to sampling points for CEM.

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as ***Minor.***

5.4.3 Noise Quality

Construction Phase

Impact Source: The potential impact on noise quality may arise out of the following:

- Machineries and Equipment;
- Vehicular traffic;
- Back-up DG set.

Impact Assessment: The proposed project site and linked facilities are located near residential settlements having micro and mini scale of industrial activities undertaken in the vicinity of the site apart from vehicular traffic on Kona Expressway and south-eastern railway line (Howrah-Kharagpur) **(refer section 4.2.13)**. Current noise sources at the site of the project are due to natural sources and homebased or micro scale industrial operation i.e. grinding machine, lathe machines, stamping mills etc. Manmade sources include DG set operation, traffic noise, which was negligible in the project site due to low traffic volumes on nearby roads apart of Kona Expressway which is at an aerial distance of 500 m. The construction of STP will produce significant noise. The cumulative level of noise generated during this phase will be ~70-80 dB(A).This intensity of noise is higher than the standard set by central pollution control board i.e. 55 dB for residential area during day time and 45dB for night time. Minimum distance of receptors from the STP site is ~10 m, the intensity of noise from sources i.e. backhoe, Front loader, Generator, tractors, dozers and concrete vibrators is envisaged to exceed 55 dB by the time it reaches to the receptors. This may cause discomfort for the construction workers and nearby receptors (**refer section 2.4**). The base condition (**refer 4.2.8**) state that the existing environment is stressed due to homebased and micro scale industry operation, noise generated during this phase will add up to this high sensitivity of receptors condition. Since the activities are for shorter duration hence the magnitude of impact is Moderate in nature.

Mitigation Measures: Effective noise management protocols would be implemented wherever applicable during construction and operating phases of the life of this project. Besides this protocol measures, construction work will be limited to day time periods, thus avoiding the night time which is the most noise sensitive. The following measures should be treated as a part of the project proposal which include:

- Switching off unnecessary or idle equipments;
- Fitting of noise mufflers to mobile equipments; and
- Preventive maintenance of equipment to minimize noise emissions.

Operational Phase

During daily operations of STP, noise will generated from pumps and air compressor having noise range of 60-90dB or DG set operation for providing back up for administrative building and noise generated from it with enclosure is within range of 60-70dB. As per Site setting **(refer 2.4)** distance of nearest receptor is ~10 m and noise generated from either source will be above 45-55 dB and have moderate effect on the already stressed baseline **(refer 4.2.8)**.

Mitigation Measures:

- High-quality pump installations will be arranged within the territory of the treatment plant. Much less, noise is generated from pumps, which are made of stainless steel or cast iron. Low-cost pumps, which are made of thin steel sheets produce more noise;
- During the installation of pumps, noise-insulating material such as foam plastic can be used as far as possible;
- Pumps will be arranged on vibration isolation platforms, for which thick rubber sheets can be used;
- If necessary, equip personnel with proper protective equipment;
- Frequent change of personnel that are employed for noisy works;

As discussed in the baseline section and above, the area in the vicinity of the site already has high day and night time noise levels prevailing because of existing noise emitting sources like vehicular and railway traffic and also operation of earth movers and heavy machinery exceeding ambient noise level standards for residential area. In the following section, an attempt has been made to assess incremental noise pressure levels that may be caused by construction and operational activities related to the STP project.

A noise modelling exercise has been undertaken based on sound pressure level propagation equations to predict noise levels generated during construction and operation phase from the proposed site near receptors. The predicted results will help in ascertaining if the sound propagated due to the proposed activities at receptor level will be in compliance with stipulated ambient noise levels and if any receptors in the immediate vicinity of the sites would be adversely impacted and plan for appropriate mitigation measures.

As per principle of sound pressure level propagation, in a free field condition, the sound pressure level decreases in inverse as the distance from the source increases, and the following equation holds:

$SPL_{(R2)} = SPL_{(R1)} - 20 \log R2/R1$;

Where, $SPL_{(R2)}$ = Sound Pressure Level at distance R2; and
$SPL_{(R1)}$ = Sound Pressure Level at distance R1.

In addition, the sound pressure level reduces during propagation due to atmospheric attenuation (frictional loss of sound energy for moving through air medium) and due to absorption with solid obstacles such as concrete walls, berms, vegetation, etc, interaction with ground and several other factors as outlined above.

Hence, the refined equation for sound propagation around a noise source has been used for modelling:

$SPL_{(R2)} = SPL_{(R1)} - 20 \log R2/R1 - Ae - Aabs$;

Where, Aabs = Atmospheric attenuation of sound energy that varies with frequency of sound level, temperature and relative humidity;
Ae = Excess attenuation is a combination of all effects:

$$Ae = A_{weather} + A_{ground} + A_{turbulence} + A_{barrier} + A_{vegetation}$$

For application to the specific noise sources that would contribute to ambient noise levels, it has been assumed that:

- At any given point of time, all the equipment and vehicle listed in **Table 5.8** and a DG set with SPL of 75 dBA are being operated together;
- All the equipment are operating within a radius of 50 m and equivalent noise level from each equipment is cumulatively considered to be a single point source;
- The frequency of noise generated from each equipment is 500 Hz;
- At operation phase, a 800 KW Biogas plant and 800 KVA DG set will operate;
- Meteorological parameters such as wind speed and wind direction were not taken into consideration.

Table 5.8: Equivalent Sound Level (Leq) for Equipment and Vehicles

Equipment/vehicle	Leq (dB)	Equipment/vehicle	Leq (dB)
i. Construction Phase			
Wheeled loader	80	Concrete Mixer	84
Tracked loader	82	Batching Plant	78
Dozer	81	Pneumatic Drill	95
Excavator	85	Compressor	70
Dumper	89	Diesel Generator set	75
Grader	83	Hand-held pneumatic rock drill	90
Pneumatic breaker	86	Water pump	77
Compressor	87	Hand-held electric circular saw	82
Pneumatic spade	87	Club Hammer	79
Road roller	80		
Auger	90		
ii. Operation Phase			
Hydraulic pump	81	Mixing Pit Pump	81
Digester Loading Pump	81	Air Blower	80
Biogas engine	90	DG Set	75

It is to be noted that the land use of 600 m around source has been considered for this noise dispersion modelling exercise. The total area has been divided into three quadrants based on the land use. The three quadrants have been described below.

- South-west to north-west (Q1) – There is a railway corridor of 15 m that is 1 m higher than the adjoining land and runs from North to South. There is a 50 m wide National Highway – 6 (NH-6), located between 500 and 600 m from the source. There are residential areas located beyond the NH-6. At the center of the quadrant, there are parking areas for vehicles and a motor vehicle garage;

- North-west to north-east (Q2)–There are open water treatment tanks, fallow land and railway corridor. At the north-west corner, between 500 m and 600 m there is a manufacturing unit of Britannia Industries Limited;
- North-east to south-east (Q3) – There are open water treatment tanks up to 300 m and residential houses between 300 m and 600 m;
- South-east to south west (Q4) – There are open fallow land, waterbodies, canals up to 500 m. There are residential houses between 500 m and 600 m.

The results of the noise modelling exercise from the source both during construction and operation phase has been shown in **Figure 5.11** and **Figure 5.12** below.

In construction phase, the Equivalent Sound Pressure Level (Leq) from different equipment and vehicle operation was calculated to be 100.2 dB. In operation phase, the Leq from 800 KW Biogas plant and 800 KVA DG set is calculated to be 90.14 DB. The baseline noise, predicted sound pressure level and cumulative noise at monitoring locations during construction and operation phase is provided below:

Table 5.9: Total Noise Levels at Receptor Locations

Receptor Location	Baseline Noise Level (dBA)	Predicted Sound Pressure Level (dB)	Cumulative Noise Level (dB)	Daytime Noise Standard (dBA)
Construction Phase				
N1	57.9	76.5	76.6	55
N2	58.4	52.1	59.3	55
N3	56.6	50.5	57.6	55
N4	59.5	66.1	66.9	55
Operation Phase				
N1	57.9	68.1	68.5	55
N2	58.4	43.6	58.5	55
N3	56.6	42.0	56.7	55
N4	59.5	57.6	61.7	55

Currently, the existing ambient noise level at monitoring locations is above the daytime stipulated standard of 55 dBA. As shown in **Table 5.9** above the cumulative sound pressure level will not increase the existing noise level at the residential areas of Bhattanagar N2 and N3 during construction and operation phase.
The monitoring location of N4 is located within 100 m of the Site. The monitoring location of N1 is within 300m of the Site. There are no residential area at this location. Hence, the cumulative increase in noise will not create impact since there are no receptors.
The cumulative noise level at the proposed construction site is more than 85 dB, as best practise the workers must be provided with personal protective equipment such as ear muffs to reduce exposure to high noise level.

Figure 5.11 Predicted Incremental Noise Pressure Levels during Construction Phase

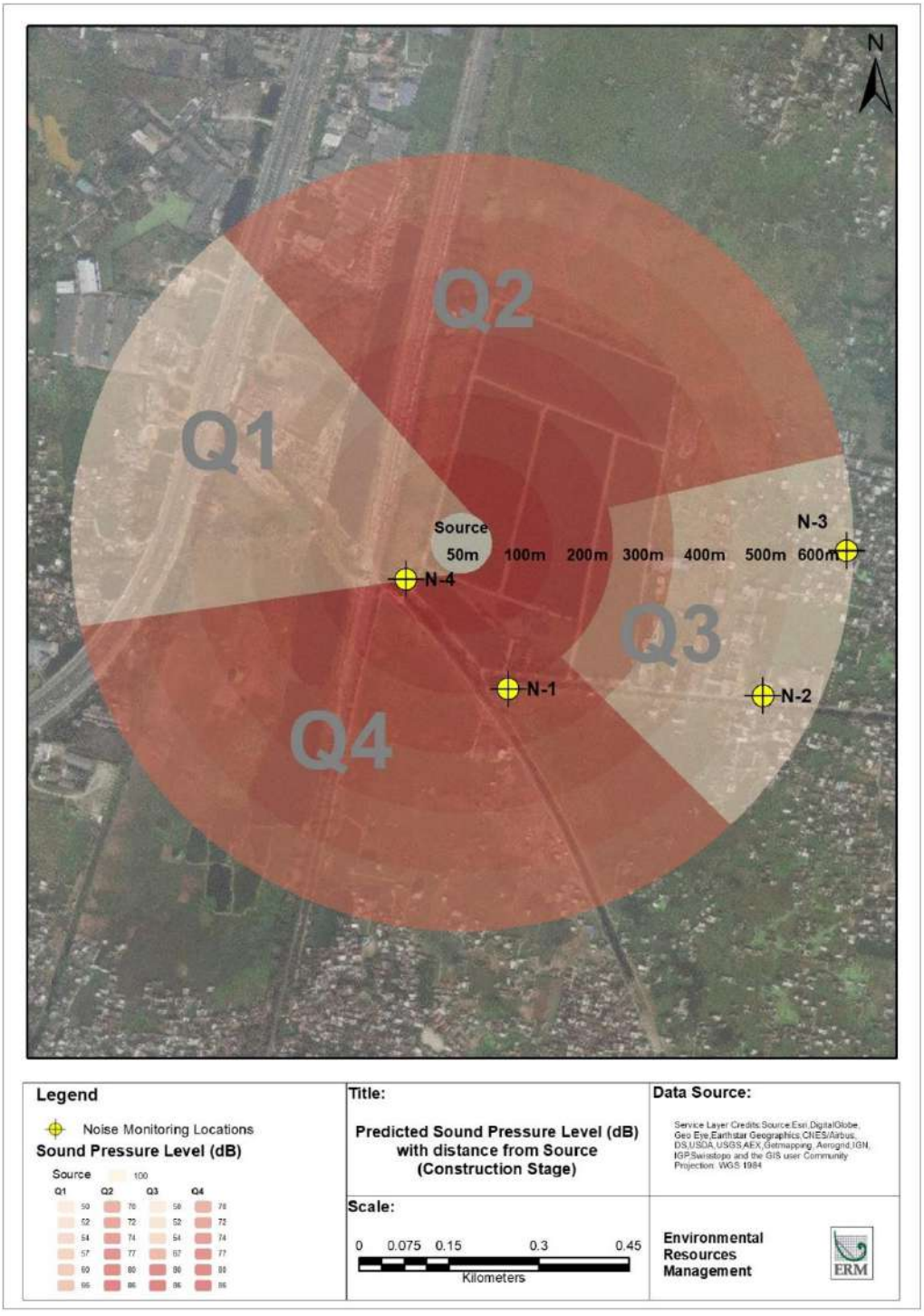
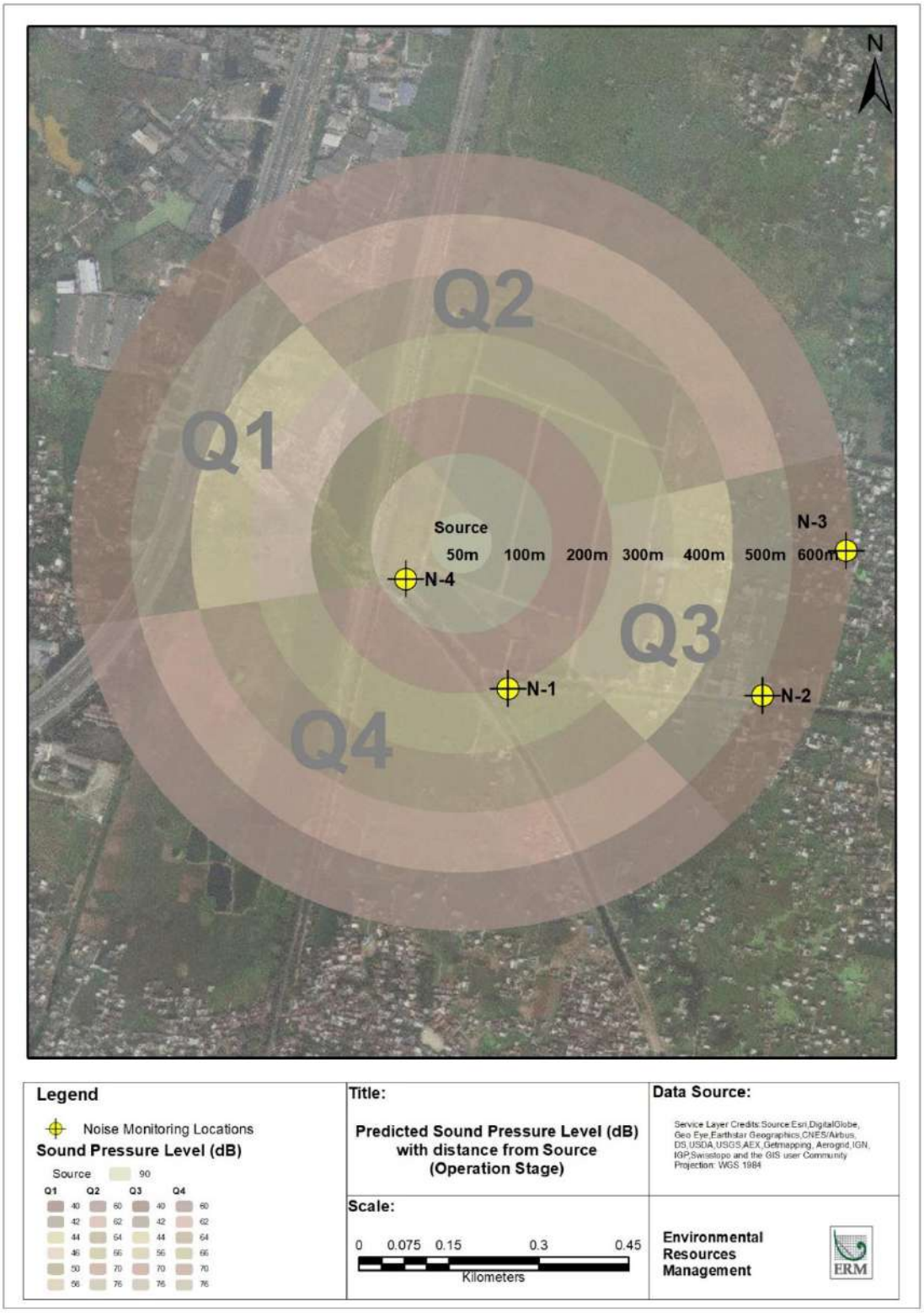


Figure 5.12 Predicted incremental Noise Pressure Levels during Operations Phase



Impact Significance	Impact due noise generation during operational phase			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered ***Moderate***			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Medium.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as ***Medium***

5.4.4 Drainage Impacts

During project life-cycle potential scenarios impacting the surrounding drainage system are, firstly, storm water from surrounding low marshy lands entering into the proposed STP complex, secondly, flood scenario developed due to heavy rainfall. Lastly, daily operation of STP resulting in discharge of treated wastewater. Under all scenarios discussed above, discharge will happen into Howrah drainage channel through pacha khal **(refer section 4.2.9)**. As discussed in baseline (**refer section 4.2.9**) the carrying capacity of Howrah drainage channel is 7968 MLD. Hence we infer that excess load of 62 MLD from STP operation will not have any impact on the drainage of the surrounding. The potential impact scenarios as discussed above will also have negligible impact on the drainage due to buffer carrying capacity of ~7000 MLD.

Mitigation Measure:

- *Site can develop a storm water drainage system as best management practice.*

Impact Significance	Impact on Drainage			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Negligible**			

Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as ***Negligible***

5.4.5 Surface Water Quality

Construction Phase

No adverse impact on surface water quality is envisaged as no discharge into surface water is proposed during construction phase and all proposed phase activities will happen within the STP complex as result the there is no interaction with surface water resource also.

Impact Source: Contamination of surface water bodies during the construction phase is possible in the following cases:

- Oil spill in case of violating the rules of their storage or the rules of construction equipment and vehicles maintenance;
- In case of contaminated water discharge during the earth works;
- In case of discharging vehicles or equipment, wash down water;
- In case of improper management of construction waste;
- In case of improper management of sludge and storm waters, etc.

Mitigation Measures:

- Providing spill kits near oil and grease storage
- Using a secondary container during transfer of oils, grease etc.
- The drainage system at site is to be provided with sedimentation tank and oily-water separator to prevent contaminants, especially oil and grease, from being carried off by surface runoff.

Operational Phase

The objective of the proposed project activity is aimed at creating environmental improvement in terms of reducing pollution load to receiving water stream of Pacha Khal and subsequently Howrah Drainage Channel by installation and operation of STP and linked sewerage infrastructure. The functioning of the STP is ultimately intended to reduce the load of untreated sewage generated in the area to the river Hooghly. The Howrah Drainage Channel, the surface water stream that would receive the discharge is already significantly polluted by untreated sewage and waste water load from upstream areas in it catchment and the downstream Howrah Drainage system has also been observed to be having similar conditions with the average observed BOD concentration in the range of 50 – 60 mg/l. So the treated effluent discharge which is to be having BOD levels (design) of 20 mg/l is unlikely to cause any incremental adverse impact to the receiving surface water environment.

The facility has a flat topography **(Refer Section 4.2.1)**, the only impact during operation phase on surface water would be improper operation or malfunctioning of STP equipment or in case of flood situation resulting to draining of storm water during heavy rains or monsoon season causing local level spill over in the Pacha Khal and Howrah Drainage Channel, in the immediate vicinity of the STP facility **(Refer Section 4.2.9).**

Quantitative Rationale

As discussed earlier in this section discharge from STP during construction and operation phase has no adverse impact and improves the quality of water in drainage channel. We have come across in baseline section that BOD of drainage canal (Pacha Khal) in vicinity to STP discharge point is 52 mg/l or 52 X 10-3 kg/m^3, and as per STP design parameters the highest BOD load in STP treated water is 20 X 10^{-3} kg/m^3.

Data

A.	Drainage Cannel peak flow (m^3/Hr)	:10032.3
B.	STP discharge Peak Flow (m^3/Hr)	:2583.33
C.	Highest BOD load in drainage Channel (kg/m^3)	:52 X 10^{-3}
D.	Highest BOD load in STP treated water discharge (kg/m^3)	:20 X 10^{-3}

Formulae used for Total BOD in drainage channel and STP Treated water

Total BOD (Kg/Hr) = **BOD Concentration (Kg/m^3)** X **Flow Rate (m^3/Hr)**

E.	Total BOD load in Drainage Channel (Kg/Hr)	:521.68
F.	Total BOD load in STP treated water discharge (Kg/Hr)	:51.67

Formulae used for calculating Cumulative BOD load from STP on drainage Channel

$$\text{Cumulative BOD Load (mg/L)} = \frac{E+F}{A+B}$$

Result

As per formulae stated above the cumulative BOD load on the adjacent drainage canal due the peak BOD load discharge from STP operation is 45.45 mg/L. Hence, there is an improvement in water quality of drainage canal in vicinity to STP discharge point, as the there is an estimated reduction of 6.55 mg/L in BOD concentration in drainage channel due to discharge of STP. Above mentioned assessment is based on following assumptions:

1. BOD load is uniformly distributed in the drainage channel water at the upstream from the STP discharge point; irrespective to changing season and time;
2. STP discharge is uniform throughout its operation;
3. No influx of fresh water or wastewater into the drainage channel from surrounding environment.

Note:

Due to upstream and downstream discharge scenario present in the drainage channel, it is not possible to predict with uncertainty the impact of STP treated water discharge in the ultimate receiving body i.e. Hooghly river, as GSPPL and KMDA has no control over the upstream and downstream from the drainage basin into Pacha Khal and Howrah Drainage Channel.

Mitigation Measures:

- Provide emergency measures for potential sewage overflows from sewer systems, including intervention troughs along the affected main surface drains that are likely to receive overflowing sewage. Similar collection trough could also be provided downstream the treatment plants,
- Draw up a monitoring schedule for the treated sewage quality. This should actually constitute an important component of the sewage treatment disposal (sampling at pre-designated locations of the treatment plants and submitting to the laboratory for analysis. Key water pollutants would include organic matter, settable solids and nutrient residuals.

Note:

- The immediate sewage water canals has been considered as the receiving water body and not the rivers further downstream (Hooghly). Since there are several other sewage water outlet sources both upstream and downstream to the proposed STP discharge points from the surrounding urban/sub-urban areas;

- With the above rationale, assessing ecological sensitivity of the downstream river and relevant biodiversity of lower Gangetic Delta will not be reasonable to qualify or interpret any impact due to the proposed project, considering the treated water discharge from the proposed project STPs will be of better quality than those receiving sewage water canals which are finally discharge into the downstream river.

5.4.6 Ground Water Quality

There will be no groundwater extraction during project life-cycle, as per site observation, there exist a borewell near the entrance gate along the eastern boundary or west of existing MPS within the STP complex, which is used for drinking and domestic purpose presently. All water during construction and will be sourced through water tankers and during operation phase water will sourced from municipal supply with daily withdrawal rate of 0.5 m^3/day as mentioned in Consent to Established (CTE) applied by Wabag. Hence there will no impact on ground water resource. Potential sources of impact for ground water contamination are minor oil and grease spillage, during maintenance of construction machinery, repair of pumps and compressors during operational phase.

5.4.7 Soil Quality

Construction Phase

Impact scenario envisaged for the project phase are firstly wastewater generated during suppression of fugitive emission during this phase and secondly, chances of oil spills and oil/grease mixed cotton waste not properly disposed after maintenance/repairing activities of construction equipment, during this phase **(refer section 2.8).**

Construction waste may contain hazardous as well as non-hazardous waste.These waste must be segregated at source or else any leakages or spills viz. grease and lube oil from motors and gearboxes, heavy metals from circuit boards and electrical panels etc. will contaminate the soil within the facility as well as at the disposal ground.However, these impacts are temporary, limited only to STP Site and reversible in nature.

Fuels, lubricant, paints, etc., would be stored at designated paved areas. Thus the contamination of soil can happen only due to accidental spillage of fuel, lubricants and paints from storage areas and during transfer of fuels and chemicals. However, in case of a spill, the restoration of top soil is usually difficult and a time taking activity.

In context of quantification of storage, handling and disposal of Construction & Demolition (C&D) wastes as well as liquid wastes (lubricants/hydraulic oils etc) that are envisaged to be generated from the proposed project, GSPPL will develop and implement a detailed Waste Management Plan. The said Waste Management plan will be developed after a detailed quantification study of structures that is envisaged to be demolished and constructed.

The primary monitoring results of soil quality results shows that soil inside and near the STP is highly porous in nature, having heavy metals i.e. Copper, Lead and Zinc but these are not alarming in nature **(Refer Section 4.2.4).** Any impacts from above mentioned activity will be reversible in nature and will deteriorate the baseline condition. The above mentioned soil quality impacts will be localized within the project site or in the immediate vicinity. The significance of potential impact, without mitigation measures in place, on soil quality is assessed as ***Minor***.

Mitigation Measures:

- Manage spills of contaminants on soil using standard engineering practices;
- Impervious storage area, especially for fuel & lubricant, chemical, hazardous waste etc.
- Municipal solid waste generated from the labour camp and construction site will be transferred to the disposal site in consultation with the local municipality;
- Fuel, chemical and lubricant will be stored in paved storage areas.

Impact Significance	**Impact on Soil Quality during Construction Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Minor.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of impact on soil quality is assessed as ***Minor.***

Operational Phase

Potential impact on soil quality can arise due to activity i.e. accidental spillage of fuel (from DG set or used for initial ignition of gas engine) maintenance activity & lubricant (for gears, motors and air compressor unit) from storage facility or from transport vehicles; which will get absorbed by soil and impact the quality of soil within the STP Site, chances of spreading of contaminated soil to receptor surrounding is negligible as all operational phase activity will take place within the STP Site. Secondly activity of improper storage and disposal of STP sludge and biogas scrubber sludge, which have high organic content will have positive impact by increasing the fertility of the soil as dried sludge are mostly used as bio fertilizers. The only case that will heavily impact the soil quality of the STP and surrounding is overflow of STP equipment due to malfunctioning or flood situation.

Occurrence of such events is very rare, though these situations are detailed in control measures **(refer section 2.8)**.Overall impact for this phase is estimated to be negligible has the impact scale is low, sensitivity of receptor is low resulting in magnitude of impact to be as negligible.

Mitigation Measures: The following mitigation measures will be implemented:

- Ensure proper spill control and management at site;
- Monitor and detect any contamination on soil & ground water;
- Good housekeeping to prevent spillage and runoff from site;
- Ensure the disposal of waste into designated storage and disposal area.

Impact Significance	**Potential Impact on Soil Quality during Operational Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Negligible**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, significance of impact on soil quality during operation phase of the Project is assessed as ***Negligible.***

5.4.8 Road Traffic

As per **section 2.3** site has only one access road which is used by residents for daily activities.The STP site is connected through one major route i.e. Bhattanagar Road .To understand the baseline condition and traffic influx, baseline monitoring was undertaken on Bhattanagar Road, which would be predominantly used during the construction phase for trucks, tippers, and other heavy machinery that will be mobilized.

From the proposed project approximately, additional 10-15 PUC/day carrying construction material, disposal of construction waste and transportation of plant machineries and raw materials will be using the Bhattanagar Road. Based on the baseline traffic survey conducted (**Refer Section 4.2.13**). The average peak hourly traffic on this route was 3.92 PCU/Hr (up) and 3.77 PCU/hr (down) number of vehicles per hour and maximum traffic load was 10.5 PCU/Hr (up) and 11 PCU/Hr (down). The site access road has the carrying capacity of 35 tons vehicles. Movement of heavy vehicles along the road has a potential to cause accidents or hazards due to increase in traffic during construction phase, may cause perceptible changes in the existing scenario as this road is mostly by local resident for day to day activities. This additional load of 10-15 PCU/day of traffic load for the site access road may cause major changes. Receptors on northern and eastern boundaries will be affected. During the Site visit it was observed that wide of the access road was ~12ft, this is serious concern for movement of heavy vehicles during the construction phase specially.Use of vehicles

more than 35-ton capacity may damage the road and since the duration of construction phase is short term, the potential impact on road and traffic due to operational traffic is assessed to be ***Minor***. As major movement of traffic will happen only during this phase.

Work along the MPS will be planned so that traffic movement is not disrupted. And work along sewer lines will be conducted over short stretches of 25 m in order to cause minimum traffic disruption.

Mitigation Measures:

- Trucks are not loaded beyond their load carrying capacity.
- Impose speed limit for vehicles moving in and out of STP complex by put display signs and hazards linked with rash driving.

Impact Significance	**Impact on Road Traffic**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Small.**			

Residual impact:

Considering the implementation of above mentioned mitigation measures, the residual impact disturbance/ discomfort to local people due to increase of traffic is assessed to be ***Small.***

5.4.9 Community, Health and Safety

Experience shows that because of its nature and scale, project like Bally STP can be expected to have a limited interface with the local community and as a result will have minimal impact on the safety and health of local communities. During the construction stage of the project, there will be an influx of workmen and labours, with some of them being from different socio-cultural settings as compared to the residential settlement around site. In the case that hygienic conditions are not maintained at the project site, there may be a vector borne and other ailments in the immediate vicinity. Unless proper sensitisation of neighbouring communities is undertaken and appropriate safeguards are adopted, there is a possibility for increase in sexually transmitted diseases, though the possibility appears quite remote.

The site clearing activities and construction activities (involving fill materials, brick and concreting work) would result in emissions of dust and noise, discharge of sanitary wastewater and potential littering from labour camps during a short phase and has a potential to contribute to additional nuisance levels for the community and households located immediately adjacent to site. However, with very few people living near the site, no significant health related impacts are expected to the communities in the area. The increase in vehicular movements as a result of plying of construction

vehicles on the adjoining roads and the site access road would add to the risk of accidents in which local residents may be involved. Although there is a public concern over the potential health effects linked with the exposure to noise, odour and fugitive emissions, empirical data is insufficient to demonstrate adverse health impacts from typical STP projects. Considering good construction practices and planned embedded measures for mitigating these impacts, the overall significance of community health and safety impacts can be rated to be **minor.**

5.4.10 Spread of Infectious Diseases

5.4.10.1 Construction and Operation Phase

The influx of workers may impact public health as it may lead to an increase in the prevalence of diseases. The influx of migrant labour during the construction phase may lead to their mixing with the local population, which can have adverse impacts on the public health of the neighbourhood, as potential communicable diseases such as HIV/AIDs can be spread.

Mitigation Measures

- Health screening of workers,
- Undertaking health awareness among the local community,
- Training programs on HIV/AIDS and other communicable diseases, etc.
- providing the local community of an understanding of the project activities and the possible health and safety risks linked with the same;
- Implementation of on-site vector control measures.

5.4.11 Occupational Health and Safety

Construction Phase

Impact Source:

- Waste handling and storage;
- Material handling and storage;
- Welding and gas cutting activities;
- Use of earth moving equipment;
- Installation of electrical equipment;
- Installation of chlorination unit;

Embedded Control Measure:

- Health and Safety policy and procedures
- Project specific Health and Safety committee;
- SOPs' for different activities (work to permit, work at height, hot work, confined space entry etc.)

Impact Assessment:

- All the impact sources listed above are hazard prone and involve a significant amount of risk for the people working.If these risks and hazards are not monitored or controlled then they may lead to fatal incidents which will have a negative impact.The receptors are mainly construction workers and people residing near by **(refer section 2.4).**They are get directly affected by these activities, the impact scale is low and for short duration.
- During construction phase, Personal Protective Equipments (PPE) such as Protective footwear and protective goggles, Welder's protective eye-shields shall be provided to workers who are

engaged in welding works, earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.Workers deployed for renovation of brick sewer line will work in confined space, with low oxygen availability is another aspect which cannot be neglected.The overall impact with considering the embedded control systems is ***Minor.***

Mitigation Measures:

- Setting up a H&S committee for the site;
- Designated H&S personal for daily activities;
- Following all SOPs listed in WABAG H&S policy and procedures;
- Conduct HIRA and HAZOP study for the project activities.
- The workers will also be provided all necessary safety appliances such as helmets, safety belts, life lines, earplugs, mask, respiratory apparatus etc.
- A well maintained first aid kit including an adequate supply of sterilized dressing materials and appliances will be made available.
- Only the working staff and authorised personnel will only be allowed inside the STP premises.
- Drinking water facility will be made available. Also, adequate ablutions and change facilities to promote appropriate occupational health and safety (OHS) will be provided.
- The O&M and EPC contractor for the project i.e. M/s. VA Tech WABAG has a formalised Occupational Health, Safety and Environmental Policy endorsed by the Managing Director and Group CEO Mr. Rajiv Mittal. This policy will be applicable throughout the concession period. A copy of the Occupational Health, Safety and Environmental Policy is attached as an Appendix A.

Impact Significance	**Impacts on Occupational, Health and Safety during Construction Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Negligible**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as ***Negligible.***

Operational Phase

During operational a number activity i.e. regular maintenance of STP equipment resulting in discharge of lube oils and grease, change over chlorine tonners , sample collection for quality analysis, planned shutdown of STP for cleaning purpose, handling and storage of sludge from sludge digester etc. All of these activity pose potential health and safety risk for employees involved during these activities as well as to the environment.

For hazardous and non-hazardous waste generated during maintenance, waste generated during activity may contaminate the soil due presence of harmful chemicals. Waste from cleaning activity may contain pathogen in them which pose risk to health of employees and receptors within the vicinity of STP causing vector bore disease. Due to embedded control measures (**refer section 2**.8) impact from above mentioned activities is estimated to be minor. Impact from chlorine tonner is separately assessed and has been attached in **Appendix D.**

Mitigation measure:

- Appointment of Site specific health and Safety officer;
- Formation of Health and Safety committee for developing and implementing plans and procedure.
- Manuals regrading Operations and maintenance procedures will be developed and maintained to ensure optimum environmental management of the activity will be produced.
- The workers involved in O& M will be adequately trained to operate the plant and also trained in environmental management requirements of the plant.

Impact Significance	**Impact on Occupational Health and Safety Operational Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Minor.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as ***Negligible.***

5.5 Social Impacts

5.5.1 Access Disruption

Construction Phase

Source of Impact:

Sewer Pipelines

The proposed project will entail temporary access disruption during excavation work for the removal of debris and piling up of mud earth along the roadside for laying of new sewer pipelines along congested locations. Using large construction machinery such as cranes etc and vehicular movement for transportation of construction materials for carrying out construction materials etc. will likely cause access disruption.

Impact Assessment:

The proposed project will entail heavy access disruption during the laying of new gravity sewer lines, dismantling, replacement or laying of existing raising mains, and during desilting work. As observed during site visit, the alignment of the existing sewer line traverses through the congested market and residential areas. Therefore these proposed activities will cause access disruption for commercial and residential structures located near the RoW of the existing sewer alignment. The laying of the new sewer pipelines will involve an open-cut method, where reportedly, a trench of 2 to 2.5 metres in width, 30 metres in length and 1.5 metres depth, will be excavated.

The replacement of the existing pipeline will be carried out along the existing alignment, where a trench will be excavated from the existing manhole, to the nearest manhole. Reportedly, the depth of the trench will be 1.5 metres. The entire process for replacement of a 30-metre sewer pipeline, which includes excavation, replacement and backfilling activities, will take approximately three days.

The processes for laying and replacement of sewer pipelines will thus cause access disruption in heavy traffic areas where the proposed work will take place. Moreover, it has been observed during the site assessment that the following locations will be impacted by temporary access disruption and congestion through the laying of rising mains and gravity sewer pipelines:

- BOC Ground Road which is located near Outfall 3 and where a 250 mm dia gravity sewer pipeline of 260 m length will be laid, therefore causing access disruption to the area.

- Temple Road/ Mahendra Bagchi Road (Rashbari Ghat and Mandir) which is located near Outfall 5 and where a 300 mm dia and 430 m length gravity sewer pipeline will be laid. There are approximately 5 kiosks situated on the left side of the road and 6 kiosks situated on the right side of the road. Additionally, the location has a temple i.e. the Rashbari Mandir, therefore there could potentially be temporary access disruption to this location.
- At Panchanantala, the location for Lifting Station 4, a 200 mm dia and 10 m length gravity sewer pipeline will be laid and there is a temple i.e. Jagganath temple, which is situated a few meters ahead of the Lifting Station 4. In addition, a 300 mm dia, 900 meter rising main will also be laid which will potentially cause access disruption to a daily market along the path of the proposed activities. Approximately 34 shops, which include vegetable and fruit vendors as well as kiosks, are situated along this path.
- Jaya Bibi Road is located near Outfall where a new gravity sewer pipeline of 300 mm dia and 900m length will be laid. It was observed that there is a cattle shed present in the area.

- Golabari is located near Lifting Station 6, where a new rising main of 350 mm dia and 160 m length is proposed to be laid, along the center of the road. The location has a school and ferry transportation in the vicinity.
- At Ram Lochan Shaire Street, there are approximately 16 kiosks, therefore there is potential for traffic disruption, including on the movement of trucks.
- Along Salkia School Road, starting from Salt Gola Lifting Station 5 area to Golabari Lifting Station 6 area, a 600m dia and 657 m gravity sewer pipeline will be laid along the center of the road. This road is congested, therefore the proposed work will potentially cause temporary access and traffic disruption.

Table 5.10: Access disruption Road Details

	Proposed Activity	Location of Impact	Road Width Approx.	Receptor	Photos
1.	Laying of 250 mm dia 260 m length gravity sewer pipeline	BOC Ground Road near Outfall 3 location	12-14 ft	Local Inhabitants	 BOC Ground  Outfall 3 near BOC Ground
2.	Laying of 300 mm dia, 430 m length gravity sewer pipeline	Temple Road (Mahendra Bagchi Road) near Rashbari Ghat/Mandir Outfall 5	14 ft	5 kiosks are situated on the left side of the road and 6 kiosks situated on the right side of the road	 Rashbari Ghat-Outfall 5  Kiosks near Rashbari Ghat-Outfall 5

	Proposed Activity	Location of Impact	Road Width Approx.	Receptor	Photos
3.	Laying of 300mm dia, 600 m length gravity sewer pipeline	Lalababu Shaire Street near Outfall 6	8-10 ft	Local Inhabitants	 Outfall 6 Location  Road Leading to Outfall 6
4.	Laying of 300mm dia, 750 m gravity sewer pipeline	Ram Lochan Shaire Street near Outfall 7	10 ft	16 Kiosks	 Ram Lochan Shaire Street, near Outfall 7
5.	Laying of 300 mm dia, 900 m rising main Laying of 200 mm dia, 10 m length gravity sewer pipeline	Panchanantala area near Lifting Station 4	12-15 ft	34 shops, which include vegetable and fruit vendors and kiosks,	 Vegetable and Fruit Vendors in Panchanantala Area

	Proposed Activity	Location of Impact	Road Width Approx.	Receptor	Photos
6.	Laying of 300 mm dia and 900m length gravity sewer pipeline	Jaya Bibi Road near Outfall 2	15-18 ft	Factory and local inhabitants	 Cattle Shed above Outfall 2  Temple Near Outfall 2
7.	Laying of 350 mm dia and 160 metre length rising main	Golabari area near Lifting Station 6	15-16 ft	School, Ferry Transportation	 Road along Golabari LS 6  School near Golabari LS 6  Ferry Transportation near Golabari LS 6

	Proposed Activity	Location of Impact	Road Width Approx.	Receptor	Photos
8.	Laying of 600m dia and 657 gravity sewer pipeline	Salkia School Road	20-22 ft	School and local inhabitants	 Road along LS 5 Salt Gola

Source: Observation during Joint Site Visit Dated 13th August, 2019

Embedded Measures:

The Concessionaire has put in place the following measures to minimise impacts and access disruption during the laying of the pipelines:

- For minimizing the duration and extent of the impacts, the concessionaire will carry out the excavation work utilising machines such as the backhoe excavator. Additionally, during the excavation work, safety measures will be put in place such as usage of danger lighting, sight rails, safety barricades, signage of retro-reflective sheet of high intensity grade, to prevent any mishaps to the commuters and pedestrians.
- In locations such as narrow streets and crowded market places where the usage of machines is not feasible, the work will be carry out manually. The concessionaire will put in place necessary precautions such as bracing / shoring for the excavated trenches.
- The concessionaire will carry out replacement of sewer lines in stretches.On each day, the maximum stretch at one location for the construction work which includes trench excavation, replacement and backfilling will be 25-25 m. Therefore the total duration of all stages which include excavation, laying & back-filling, for one day will be 10-12 working hours. The construction work will be carried out during off-business hours from 1:00 pm to next morning 6:00 am.
- A Traffic Safety Management Plan will be developed for the contractors to comply during construction, where they will carry out work on the road in a manner where there is minimum disruption to the traffic flow while executing the work satisfactorily. Some of the measures to ease traffic congestion includes the following
  - Where construction activities are taking place at multiple sites along the same or on parallel routes, construction activity and the movement of road users is co-ordinated to ensure that the total delay along the route or on signed alternative routes is within acceptable limits;
  - In the urban environment, works requiring partial road closures, alternative routes will be provided.
- The traffic arrangement during construction shall be so as to ensure that.
  - Road users are accommodated through and around the construction zones safely with minimum delay;
  - Where construction activities are taking place at multiple sites along the same or on parallel routes, construction activity and the movement of road users is co-ordinated to ensure that the total delay along the route or on signed alternative routes is within acceptable limits;

- In the urban environment, works requiring partial road closures on alternative routes should be phased, where possible, so that they are not undertaken at the same time. As such, no issues related to traffic congestion and disruption to shop vendors in this day to day work is envisaged.

Additional Mitigation Measures:

The Concessionaire should also build in the following clauses in the contract agreement of the works Contractor and ensure the following:

- The contractor should inform all the stakeholders well in advance)at least two months(before the start of the construction work to enable shop owners to stock up and remain unaffected if goods vehicles are unable to reach them during construction;
- If necessary, a temporary site alternative/arrangement to be provided for temporary parking space for the cycle stand and e-rickshaw stand in consultation with the local administrative authorities;
- The contractor should provide proper barricading and signage or notices to indicate the ongoing work. In case by-lanes towards the residential areas/shops are located from the replacement stretches, contractor to provide proper barricading and temporary alternate route for people to access their houses/shops.
- Alternative access route to be provided for the community to access their residential places and in case of any medical emergency.
- The above measures will be part of the contract agreement for the work Contractor Agency and will be implemented through it, with careful monitoring by the Concessionaire.

Impact	Access Disruption to the road side entities.			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Within the RoW of the existing government roads within which the sewer pipelines will be laid.			
Frequency	During the construction phase			
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Moderate**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations)	Significance of impact is considered **Minor**			

Residual impact:

Considering the implementation of above mentioned mitigation measures, the residual impact disturbance/ discomfort to local people due to increase of traffic is assessed to be minor.

5.5.2 Structure Loss[34]

5.5.2.1 Construction Phase

Source:

a. Laying of 300 mm dia and 900 metre length gravity sewer pipeline at Jayabibi Road

Impact Assessment:

The proposed project may potentially affect few structures partially. These structures are basically those located within the project footprint, they have encroached on the public roads RoW. During excavation work these structure may potentially be affected.

As per the SIA survey, the laying of 300 mm dia and 900m length gravity sewer pipeline at Jaya Bibi Road near Outfall 2. Road width of approximately 15-18ft was assessed to have an impact on one structure -a cattle shed located near the Outfall 2 location.

Consultations with the cattle shed owner and the authority of one temple located adjacent to the impacted structure reveal that land where the cattle shed stands, belongs to the Land Port Authority of India. The shed is being utilised by two members, who are earning approximately Rs. 400 to 500 per day and they operate from 5 am to 7 pm. Furthermore, during the consultations, the cattle shed owners indicated that during the proposed upgradation works, they are willing to relocate the cattle to another section of the premises.
The screening of the affected structure has been carried out based on the information shared by the project concessionaire regarding the project components and the proposed work. Due to absence of project design and DMS, it cannot be ascertained whether there will be an impact to the cattle shed structure. Therefore, at present it cannot be ascertained whether there will be impact to the structure.The project concessionaire reported that appropriate mitigation measures will be taken to ensure that no damage to structure occur during the construction work cattle shed structure, however, the extend of loss and impact will be ascertained during the detailed measurement survey.

Box 5.1 Impacted Structure in Jayabibi Road


Mitigation Measures:

- A detailed assessment will be carried out during the detail measurement survey to determine the extent of impact, structure type and usage

[34] This impact category have been included in case the project activities will causes any structural losses. Hence, the impact and the entitlement for this category has been accounted for. Though at present only one structure have been identified, however, in the absence of a detailed design and measurement survey it could not be positively ascertained whether on the exact natue of the impact.

- Compensation will be provided to the affected as per replacement value as per the basic schedule of rates
- In case of partial structural damage, the project will restore the affected structure to its original condition.
- In the case tenant/leaseholder, the affected person will be assisted in identifying alternative location

Impact Significance	**Impact on Structure**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Moderate**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Small**			

5.5.3 Temporary Loss of Income

5.5.3.1 Construction Phase

Source of Impact:

Road side vendors and shops who are operating their businesses as squatters within the RoW of existing government roads; the trunk sewer pipelines will be laid within the RoW of existing roads.

a. Laying of a 300 mm dia, 900 mètre raising main at Panchanantala.

The excavation work may potentially lead to road blockage and access disruption, and as a result the commercial establishments and vendors located near the RoW of the project footprint (sewer line) will face some disturbance in operating their businesses on daily basis. On the basis of screening and site visits along the road stretches through which sewer lines are likely to be laid/replaced reveal that there will be temporary disruption to on-going commercial and vending activities thus leading to temporary income loss during the period of construction period (which is assessed to be around 3 days).

The proposed work includes the laying of a 300 mm dia, 900 metre rising main at B.K Pal Temple Road, Panchanantala, near a daily market. In this location, there are approximately 34 shops which include vegetable and fruit vendors, as well as kiosks. It was reported that they approximately earn

between INR 200 to INR 500 per day, and a survey of a shop owner indicated a monthly income of INR 6000. The laying of the rising main will thus not only cause traffic disruption to the daily market area but could potentially lead to the temporary closure of those 15 shops**.** Table 5.11 below presents the impacts identified during the laying of the rising main, who will experience temporary loss of income.

Table 5.11: Number of Affected Entities

Sl. No.	Sewer Pipeline Location	Tentative No. of Affected Entities	Photos
3	Laying of 300 mm dia, 900 m rising main Laying of 200 mm dia, 10 m length gravity sewer pipeline at Panchanantala area near Lifting Station 4. Road width is approximately 12-15 ft.	15 shops (vegetable and fruit vendors and kiosks)	 shops along Panchanantala

Embedded Control Measures:

- For minimizing the duration and extent of the impacts, the concessionaire will carry out the excavation work utilising machines such as the backhoe excavator. Additionally, during the excavation work, safety measures will be put in place such as usage of danger lighting, sight rails, safety barricades, signage of retro-reflective sheet of high intensity grade, to prevent any mishaps to the commuters and pedestrians.
- In locations such as narrow streets and crowded market places where the usage of machines is not feasible, the work will be carry out manually. The concessionaire will put in place necessary precautions such as bracing / shoring for the excavated trenches.
- The concessionaire will carry out replacement of sewer lines in stretches.On each day, the maximum stretch at one location for the construction work which includes trench excavation, replacement and backfilling will be 25-25 m. Therefore the total duration of all stages which include excavation, laying & back-filling, for one day will be 10-12 working hours. The construction work will be carried out during off-business hours from 1:00 pm to next morning 6:00 am.

Mitigation Measures

- A one-time compensation will be paid to the affected persons for the temporary loss of income (for the period of disruption) as per the entitlements detailed out in the Livelihood Restoration Framework;
- The Concessionaire will ensure that compensation for the income loss is paid to the affected persons before the start of any physical work;
- The Concessionaire has to establish an effective grievance redress mechanism, which should be properly communicated to all the affected persons and stakeholders; this will be a platform to raise their concerns and complaints;
- The contractor should ensure that the construction work takes place during lean business hours and during the night to avoid major disruption;

- The contractor should inform all the stakeholders well in advance (at least 30 days) before the start of the construction work, to enable shop owners to stock up and remain unaffected if vehicles delivering goods are unable to reach them during construction;
- Contractor during construction should ensure that structure near the RoW are not affected and excavation should be carried out to the possible extent to avoid any damages to residential and commercial structures.

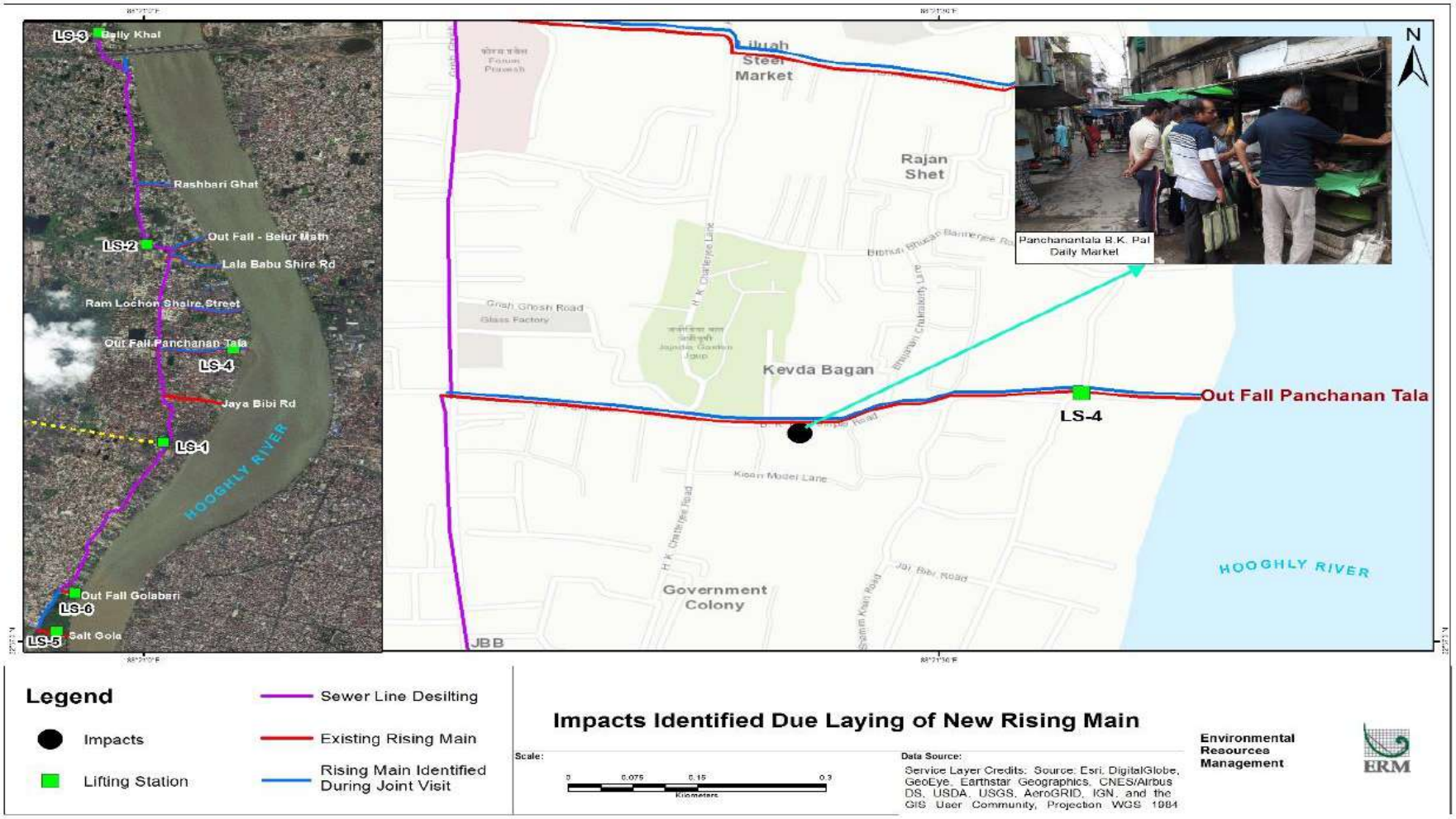
In case any approach or access built by the residents over drains is disturbed, then the approach will be rebuilt, if needed, at the end of construction in that location. Until that time, a temporary approach may be provided, if feasible.

Impact	Temporary Loss of Income for Shops, Road Side Vendors and Kiosks.			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Within the RoW of the existing government roads within which the sewer pipelines will be laid.			
Frequency	During the construction phase			
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Moderate**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations)	Significance of impact is considered **Minor**			

Residual impact:

Considering the implementation of above mentioned mitigation measures, the residual impact disturbance/ discomfort to impacted shops due to temporary income loss for access disruption is assessed to be minor.

Figure 5.13 Impacts Identified Due Laying of New Rising



5.5.4 Permanent Livelihood Loss for Fishermen Groups at Bally Waste Stabilisation Pond

Construction of Sewage Treatment Plan (40 MLD STP and 22 MLD WSP) in the reclaimed area from the esisting WSP at Kona.

Impact Assessment:

The proposed Bally Sewage Treatment Plant is to be constructed in the reclaimed area from the existing WSP at Kona utilising part of the Facultative and Anaerobic ponds. During screening and scoping visit it has been found that the WSP where STP is proposed to be constructed and the remaining part of the WSP is being used by fishermen cooperative groups.

As reported by GSPPL, the Concessionaire for the proposed 62 MLD sewage treatment facility (40 MLD STP and 22 MLD WSP), has the strict mandate to ensure the treated discharge water quality from both 40 MLD STP and 22 MLD WSP, complying the standard stipulated under the Concession Agreement with KMDA in place. The treated discharge quality per Concession Agreement has to meet the presently enforced effluent discharge standards for Sewage Treatment Plants as outlined under Environment (Protection) Amendment Rules, 2017. GSPPL is of the opinion that continuing fish farming activity in the WSP ponds will increase and impact the organic loading in the WSP through application of fish feed and other chemicals in form of disinfectant or growth medicines which will ultimately impact the mandate of the treated discharge quality from the WSP against the stipulated standard. Therefore, GSPPL has decided on not allowing any fish farming activity in the Bally WSP area from the date of official handover of the Site by KMDA to the Concessionaire. This will trigger livelihood loss for all 46 fishermen from 4 fishing cooperative groups (approximately).

The construction of the STP at the Kona WSP will thus cause permanent income loss to all the members of the fisheries groups. As mentioned that fishing is the primary occupation of the affected fishermen, the proposed project will causes economic displacement for all the 46 members. Besides loss of income the fishermen will also incur investment lost incurred in the existing WSP pond. This includes pond development and other input cost.

The livelihood loss for the fishermen will also causes income loss for the approximately18 fish farm workers who has been engaged by the fishing groups for carrying out aquaculture activities (breeding, feeding fish, application of medicines, cleaning ponds, harvest fish when ready for sale, assist in loading the harvested fish stocks for transporting to market etc.) in the WSP. Out of the total, 10 are workers and 4 are security guards. The income received by the fish farm workers for such work ranges from INR 6000 to INR 10000 per month. These workers are engaged on a monthly basis.

Mitigation Measures:

- Provision of 60 days' notice period to the fishermen cooperatives prior to emptying the waste water from the WSP for construction;
- The fishermen to be allowed to fish out the remaining catch from the pond before start of work;
- Compensation for loss of livelihood and other investment loss for the affected households will be assessed and determined in the Livelihood Restoration Plan (LRP);
- As per the consultation meetings held under Chairmanship of the District Magistrate, Howrah involving representation from WBSPMG, KMDA, VA Tech WABAG and NMCG on 28th July and 4th August 2020, the fishing cooperatives have no tenable legal claim on the WSP ponds or to create any legal encumbrance of any nature on the government. Nevertheless, GSPPL on it's

own account will implement the Livelihood Restoration Plan (LRP) in alignment with the LRF in compliance with to meet the safeguard requirements of IFC Performance Standard 5 on Involuntary Resettlement and the ESMF of NMCG (guided by World Bank Operational Policy 4.12 on Involuntary Resettlement) as also to create a positive environment and community goodwill in the project area.

- In case the affected person is not satisfied with the compensation, he/she has the right to express concern through formal application to the grievance process.

Impact	Impact on Permanent Livlihood Loss			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Major**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Small**			

Residual impact:

- Considering the implementation of livelihood restoration measures, above mentioned mitigation measures, the residual impact disturbance/ discomfort to impacted is assessed to be small.

5.5.5 Influx of Labour and Conflict with Local people

Construction Phase

During the construction period, labour will be required for construction work for STP, and for laying and excavation work. Reportedly, the man power requirement for the construction phase is approximately 100-150 workers, who will be mobilized for the construction and civil work. These include unskilled, semi-skilled and skilled workers. Reportedly, 80% of the labour is expected to be sourced from outside the district and only 20% will be sourced locally.

The intra state migration of labour may affect the project area in terms of additional burden on public infrastructure such as water supply, electricity, and other social dynamics, which may potentially have an impact on local communities.

Moreover, there is a possibility of conflict with local people residing near the project footprint. The influx of labour may potentially lead to conflict with local people residing near the project footprint due to cultural differences. The conflict can also arise with shop owners and business entities operating their businesses near the project footprint due to access disruption, in case no proper mitigation measure is put in place. This can take place especially during the excavation and replacement work

of the pipelines. The construction of the STP will be within closed premises and the labour camp will also be situated within the site.

As this impact is restricted to the construction phase, measures such as proper orientation to workers on gender and cultural sensitivity and prior information dissemination before construction starts is evaluated to be of ***Minor*** significance.

Mitigation Measures:

- Communication to local community, shops and vendors prior to the start of the construction;
- Labours would be provided training on local culture and traditions through daily tool box talk;
- Local community to be made aware of the grievance mechanism and provide access to the local community and labourers to the grievance redressal mechanism for the project;
- The contractor are responsible for providing adequate accommodation facilities for the labourers;
- Local community to be made aware of the grievance mechanism and provide access to the local community and labourers to the grievance redressal mechanism for the project;
- The contractor would be required to develop labour management procedures and mitigation measures before the start of works and monitor and update the Labour Management Plan (LMP), as necessary during the course of the project.

5.5.6 Labour Accommodation

Construction Phase

Approximate 100-150 workers will be employed during the construction phase of the project. The demand for workers will keep on changing depending on the requirement of the work to be undertaken. It has been reported by the GSPPL site representative that 80% of the workers during the construction phase, will be non-locals[35]. As a result, a labour camp will be required during the different construction periods. Mobile camps will also be required to be set up at every location during the construction work. As observed during the site visit, the alignment of the existing sewer line for the proposed work passes through congested areas, thus haphazard establishment of the camp will aggravate the congestion. Improper sanitation facilities in the construction labour camps can also trigger vector borne diseases and impact the health and safety of the workers and the nearby community. Measures such as proper collection, storage and disposal of wastes, Proper sanitation facilities to prevent contamination of water resources from sanitary effluents generated from labour camps will be implemented. Taking these measures into account, the impact to public health and safety is evaluated to be of ***Minor*** significance.

Mitigation Measures:

- The proximity of the camp should be located away from the congested, market and densely residential areas.
- The community are to be made aware of the camps and local community. Movement of migrant labourer with in the villages should be restricted and local residents /villagers should be restricted from the labour Camp;
- In the labour camp, minimum space should be allocated for each person. Separate accommodation for men and women. The labour camp (including mobile camp) to be set up should meet the requirement of IFC and EBRD;

35 Non-local in this context is defined as an intra state migrants who are non-residents of Howrah Municipal Corporation (HMC), but are residents of West Bengal belonging to other districts.

- Provision of safe drinking water, adequate sewage and garbage disposal systems;
- The camp should be appropriate to protect the workers against heat, cold, damp, noise, fire, and disease-carrying animals, and, in particular, insects ;
- Camps should be equipped with adequate lighting, sanitary and washing facilities for both men and women;
- Waste and Waste water generated from labour camp should not dump with in the villages;
- Nearby Pond/Surface water should not be polluted;
- For dismantling of the mobile camps after completion of construction work, the contractor should ensure that all residual materials are collected to avoid any unnecessary lasting impacts of the accommodations on the communities (garbage, equipment etc.).
- Grievance Redressal Mechanism should be made aware and accessible to the local people in case of any complaints and issues. The mechanism should also be made available to the workers to register their grievances.

5.5.7 Gender Empowerment Impacts

The project in Bally will directly impact the livelihood (temporary) of which one female headed PAH in Bally who engaged as a fruit/vegetable vendor, situated at BK Pal road and is earning an average income of approximately Rs. 9000 per month. The project will also trigger permanent livelihood loss for four women engaged in fishing activities inside the fishing ponds earning an average income of Rs. 25000 per month to Rs. 30000 per month. The permanent loss of livelihood will have an impact on the women to gain access to other employment activities elsewhere considering their lack of alternative skills and educational qualification.

An analysis of the workforce participation of the surveyed population indicates that majority of the women are not participating in the workforce and the consultations also revealed that majority of the women are engaged in unpaid domestic work. Female workforce among the surveyed population accounted for 17% (as per SIA survey). Reason such as limited employment opportunities, women busy in household works and movement restrictions are some of the reason for low female workforce in the area.

Review of the workforce participation at the existing Bally WSP and linked facilities reveal that all the workers are male workers. Therefore women are almost entirely unrepresented in the workforce. As a result, there is need to promote gender equality in all aspects of economic development. Women's roles in construction are mainly confined to supply of unskilled labour and vending of foodstuffs to the construction workers. As civil construction work will take place at Bally WSP, including at the linked facilities during the construction phase, the participation of women in the construction workforce should be ensured to reduce gender disparity and enhance gender mainstreaming. Accordingly, detailed methods of engagement for women in the project area are presented in the Gender Action Plan (GAP) developed for the Project.

Embedded control measure

- The Project Concessionaire has put in place a policy for Prevention of Sexual Harassment (POSH)
- The project concessionaire has a HR Policies which mandated equal employment opportunity for both genders

Mitigation Measure:

- Ensure rehabilitation measures such as compensation of women project affected persons who will face temporary livelihood loss due to the laying of sewer pipelines, through identifying opportunities for them.

- Gender based livelihood restoration measures for women facing permanent livelihood loss. Such initiatives should include trainings on entrepreneurship as well as technical and vocational skills for self-employment. This will be implemented as per the LRP.
- GSPPL can also develop CSR Projects which include initiatives around the following aspects:Improving the health conditions of women in the project area, such as improving water supply, health and sanitation; Improving access to education for girls in the project area through school donations and provision of scholarships;
- Ensure the implementation of the Gender Action Plan (GAP) for the project.
- Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work.
- GSPPL to ensure that the company level policy on Prevention of Sexual Harassment (POSH) in the Workplace is also extended to the project level. HR Policy should have provisions on anti-gender based violence.
- Trainings on anti-sexual harassment, anti-gender based violence and social protection benefits to be imparted to all employees.
- Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment.
- Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements.
- GSPPL can also develop CSR programmes and trainings focussed on improving the health conditions of women and well as access to education for girls.
- Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise 50% of women members

5.5.8 Loss of Employment of Existing Workers

At present there are thirty-two (32) contractual workers employed at the Bally facilities under Associated Cooperative Labour Contractor and Construction Society Ltd and Ganga Action Plan Contract Workers Co-operative Society Ltd

Post the construction, the project will be operated and maintained by the new O&M entity engaged by the Concessionaire, therefore, there is a potentiality of retrenchment scenario of the existing contracted workers, which may lead to a loss of livelihood for these workers. Consultation with the existing workers during site visit revealed that some of the workers have been employed for over 25 years. Thus, the project will impact the employment and livelihood of the existing contractual workers who may get laid off during the new O&M contract regime.

Based on the review of existing contracting arrangement between KMDA and the respective man-power supply contracting agencies, it is observed that KMDA has assigned the compliance liability against all applicable labour regulations (viz. Employees State Insurance Act, 1948; Employees Provident Fund and Miscellaneous Provisions Act, 1952; *Wages Act, 1936; Minimum Wages Act, 1948; Employee Liability Act, 1938; Industrial Dispute Act, 1947 and Contract Labour (Regulation and Abolition) Act, 1970* or the modifications thereof or any other Laws relating thereto and the Rules made thereunder from time to time.) fully on the respective contractor agencies as the part of the contract agreement. As well as the condition on contractor shall indemnify KMDA against payment to be made under and the observance of the laws aforesaid and the CPWD Contractor's Labour Regulations having application within the State of West Bengal without prejudice to his right to claim indemnity from his sub-contractors.

It was also noted that as per Clause 18B of the said contract agreement, in every case in which by virtue of the provisions of Section 12, Sub-section (1) of the Workmen's Compensation Act, 1923 (i.e

principal employer's liability to pay compensation in case of bodily injury and disablement caused or death of any contracted worker in the execution of the work) KMDA is obliged to pay compensation to a workmen employed by the contractor, in execution of the work. However KMDA will recover such amount of compensation so paid from the contractor as per the legal provision under Section 12, Sub-section (1) of the Workmen's Compensation Act, 1923.

Moreover, as per *Industrial Dispute Act, 1947* the term "retrenchment" is defined as "….*termination by the employer of the service of a workman for any reason whatsoever, otherwise than as a punishment inflicted by way of disciplinary action, but does not include: termination of the service of the workman as a result of the non-renewal of the contract of employment between the employer and the workman concerned on its expiry or of such contract being terminated under a stipulation in that behalf contained therein*…."

In absence of actual agreement in place between the O&M Agencies and KMDA, the date of expiry of the contract between them could not be ascertained.

The concern related to the contractual workers had been in discussion between the NMCG, KMDA and the Concessionaire. In the second Review Meeting of the progress of achievement of conditions precedent by the stakeholders of Howrah, Bally and Baranagar and Kamarhati STP Projects under HAM held on 22nd October 2019 under the chairmanship of Director General, NMCG, the employability of the workers deployed by KMDA for the operating facilities were discussed. It was decided that a consultative meeting would be conducted by KMDA and the Concessionaire with the existing workers and a necessary action plan would be submitted to the lender (IFC).

Based on the second review meeting held on 22nd October, 2019, the Concessionaire held a meeting with the Chief Executive Officer, KMDA on 27th November, 2019, following which the Concessionaire (VA Tech Wabag) submitted a letter number KMDA-NMCG/Proj/016/19-20 dated 27th November, 2019. Issues related to the existing workers were discussed and the letter mentions that, Wabag shall facilitate re-engagement of around 25 numbers of existing workers and that KMDA to identify alternate sites for rest of them from the list of workers provided by KMDA. KMDA was requested to kindly advice the concerned workers to provide age/ identify proof for the chosen ones. The documents are appended as **Appendix L** and **Appendix M**.

Additionally, a meeting was held on 10th February, 2020 between KMDA and GSPPL and subsequently on 14th February, 2020, regarding the re-engagement of the existing contractual workers. As a mitigation measure, it was decided by KMDA they will re-deploy the existing contractual workers from Arupara and Baranagar facilities to other facilities of KMDA, while GSPPL will be responsible for re-engaging 32 existing contractual workers from Bally MPS and the linked facilities.

Mitigation Measures:

- As per IFC PS 2 guidelines, viable alternatives to retrenchment should be analysed.
- If retrenchment is necessary, to reduce the adverse impacts of retrenchment on the workers, a Retrenchment Plan should be developed, meeting the following IFC PS 2 provisions on retrenchment
- As per the IFC Performance Standards 2, the retrenchment plan should be based on the principle of non-discrimination and should reflect the client's consultation with workers, their organizations, and, where appropriate, the government, and comply with collective bargaining agreements if they exist.
- The client should comply with all legal and contractual requirements related to notification of public authorities, and provision of information to, and consultation with workers and their organizations.

- The client should ensure that all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner.
- All outstanding payments and social security benefits and pension contributions and benefits should be paid:
  - on or before termination of the working relationship to the workers,
  - where appropriate, for the benefit of the workers, or
  - Payment will be made in accordance with a timeline agreed through a collective agreement.
  - Where payments are made for the benefit of workers, workers will be provided with evidence of such payments.
- The abovementioned mitigations have been presented in a Labour Management Framework (LMF).
- The Retrenchment Plan is required to be prepared prior to the closure of the contract of the workers, which has to be conducted in consultation with the affected parties and the Concessionaire.
- It should be noted that if the existing workers are redeployed into other alternate sites of KMDA and by the Concessionaire, then the impact would be reduced. Failing to which the Labour Management Plan would be effective.
- A monitoring plan should be put in place to monitor the redeployment of labour to other facilities. The monitoring plan will be effective from the date of financial closure and handover of the project to GSPPL. A third party audit should be conducted to monitor the redeployment of workers to other facility.
- It may be considered to provide the retrenchment compensation as mandated by the following provision under Industrial Disputes Act, 1947.
  - The Conditions precedent to retrenchment of workmen outlined as per Industrial Dispute Act, 1947 Section 25F as “No workman employed in any industry who has been in continuous service for not less than one year under an employer shall be retrenched by that employer until (a) the workman has been given one month's notice in writing indicating the reasons for retrenchment and the period of notice has expired, or the workman has been paid in lieu of such notice, wages for the period of the notice; (b) the workman has been paid, at the time of retrenchment, compensation which shall be equivalent to fifteen days' average pay for every completed year of continuous service or any part thereof in excess of six months; and (c) notice in the prescribed manner is served on the appropriate Government or such authority as may be specified by the appropriate Government by notification in the Official Gazette.”
  - The existing workers (if they wish to continue work) may be accommodated or deputed into other such facilities (if there is such scope available) run by KMDA.
  - Alternatively, these workers may be considered or given priority by the then O&M Agency, based on their selection and recruitment criteria, during the O&M phase

6. ALTERNATIVE ANALYSIS

Analysis of alternatives involves a thorough study of the possible future conditions in the project study area of the possible future conditions in the project area in response to a set of alternatives without the project or status quo condition.

6.1 Project Rationale

The proposed project involves involve construction of a new STP of 40 MLD capacity will be built on the reclaimed area after partial filling up of two ponds and renovation of linked intersection and diversion sewerage network. As part of the project bidding process under NMCG programme, the Concessionaire GSPPL is entrusted to implement and operate, the project within the pre-existing premises and piece of land, therefore no alternate sites were considered. Limited environmental impacts are expected during construction. Little air, water and noise pollution is expected from the proposed construction activities; however these are localized impacts and can be minimized with proper construction schedule and precautionary approach. Since the project is in an existing piece of land, no alternate sites were considered. Moreover, he proposed plant site is in accordance with MoEFCC guidelines:

- There are no National Parks/Sanctuaries within 10 km radius;
- There are no Historical places/places of tourist importance within 10 km radius.

6.2 Alternative Treatment Plant Technology

Comparative statement of different STP technology and corresponding environmental and social impacts are highlighted below:

Table 6.1: Comparison between Treatment Plant Technologies

Technology	Merits	Demerits
Conventional Activated Sludge Process (ASP)	■ Land requirement is less compared to others ■ Reduced flies and odour nuisance ■ Better control possible	■ High Capital cost ■ High Power requirements ■ Skilled labour is required for O & M.
Extended Aeration (EA)	■ High quality effluent ■ Lesser complicated design ■ and operation ■ Capable of treating shock loads ■ Well stabilized sludge	■ Higher power requirements for aeration ■ Relatively larger tanks ■ Mainly used for smaller plants
Sequencing Batch Reactor (SBR)	■ Simplified process ■ Final clarifiers and Return ■ Sludge pumping not required. ■ Compact ■ Operation is flexible; nutrient ■ removal possible ■ Better SS settling and high effluent quality ■ Batch system eliminates peak surges ■ Automatic control of MLSS and SRT through sludge wasting.	■ High Peak flows can disrupt operation ■ Skilled labour required ■ Batch discharge may require equalization prior to disinfection ■ Frequent sludge disposal ■ Higher specific energy consumption
Cyclic Activated Sludge (CAS)	■ External clarifiers, sludge scrappers, recycle pumps not required.	■ Extensive piping and valves/gates required. ■ Higher maintenance skill required

Technology	Merits	Demerits
	■ Well settleable sludge flocks. ■ Control in time enables flexibility by adapting times for nitrification, Denitrification, ■ Biological phosphorous removal, sedimentation, depending on influent characteristics. ■ Easy & compact construction. ■ No moving mechanical parts ■ Less head loss	
Membrane Bio Reactor (MBR)	■ High quality nitrified effluent Compact ■ Plant expansion is simple ■ Capable of absorbing hydraulic and organic shock loads. ■ No secondary clarifier required	■ High capital & O&M cost ■ Extensive piping and valves ■ Higher maintenance skill required
Trickling filter	■ Capacity to handle shock loads ■ Dependable performance ■ Minimum supervision. ■ Lesser land requirement in comparison with other conventional systems.	■ Capital costs and power requirements are high. ■ Mosquito and odour nuisance is high. ■ Equipment is prone to heavy corrosion

Sewage treatment plant based on sequential batch reactor (SBR) is a proven technology and has some specific advantages compared to other conventional technology.

6.3 Alternative Alignment for Sewer lines and Rising Main

The proposed work for replacement of sewer line and laying of rising main will be carried out in the existing RoW; hence, no alignment route will be required. As a result, the scope for analysing the alternative alignment/site for sewer line is very limited. However as reported by the site representative of the Project Concessionaire, the following alternatives will be adopted.

Alternative A: in case the stretches for carrying out the proposed work is found to have any sort of displacement (physical or economical), the alignment of the sewer line, will be adjusted either shifting the alignment of the existing sewer line from the flank of the roads towards the centre of the road or likewise to avoid physical displacement.

Alternative B: In case the stretches for undertaken the work were found to have any severe impact such as displacement (physical or economical), the proposed work will be revisited to avoid major impacts.

Moreover, for impacts that are unavoidable, including temporary impacts, consultations will be undertake and mitigation measures will be adopted meeting the safeguard requirements of IFC.

6.4 No Project

By doing nothing, it may mean that the City of Kolkata remains at the worrying sewer coverage status, while the large part of the sewage generated flows into River Hooghly. This shows that doing nothing will not only continue worsening the local sanitation challenges but also regional environmental problems as pollution loading into River Hooghly increases.

Establishment of new STP at will have positive environmental impacts. It is unlikely that it will pollute the air, the soil, or contaminate the aquifers in the area. However, if the proposed STP is not established, the wastewater of many area of Bally region from the septic tanks and the sewerage collection system will continue discharging raw sewage into the nature and this will exert negative

effects on the local environment and continue to create health problems. The No Action Alternative would see the continued release of untreated sewage into nearby available area, exacerbating the deterioration of soil and water quality. This is due to the acceleration load of organic and inorganic substances, which are streaming to the river and groundwater with the increasing wastewater flow. The existing living environmental problems will become more sever and may inhibit economic and social development of the area in the medium and long term:

- Degradation of the environment and reverse negative developments;
- Depletion of the aquifer;
- Dramatic decrease of both quantity and quality of the groundwater;
- Degradation of the river water bathing quality and biodiversity; and
- Degradation of health situation and increase of water related diseases due to poor sanitation system.

7. STAKEHOLDER ENGAGEMENT

7.1 Introduction

A stakeholder is defined as “an individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project”. Stakeholder Analysis is the process of categorising identified stakeholder groups according to their impact on the project and the impact the project will have on them. This information is then used to assess the manner in which the interests of the stakeholders or the project’s impact on them should be addressed in the project development plan or its operation.

The importance of stakeholder analysis lies in the assessment and understanding of the socio-political environment surrounding the project. It allows for:

- Identification of the interests, concerns and societal risks surrounding the stakeholders, as well as conflicts of interests (if any);
- Identification of relations between stakeholders that may enable “coalitions” of project sponsorship, ownership and co-operation as well as the mechanisms which may influence other stakeholders;
- Key groups/ individuals to be identified who need to be informed about the project during the execution phase;
- Identifying stakeholders (those who might have an adverse impact on the project) and taking appropriate measures to mitigate their influence; and;
- Development of a framework for participatory planning and implementation of various project activities including interventions for community development.

The identification of stakeholders and their inclusion in the decision-making process is thus essential in the process of prioritizing, analysing and addressing issues; and in creating management systems and strategies to address the concerns/ expectations of various stakeholders.

The following sub-sections thus provide a profile for the various stakeholders in the project as well as their concerns and relative influence with regard to the project.

7.1.1 Identification of Stakeholders

The stakeholders who would directly impact or are directly impacted by the project are known as Primary Stakeholders and those who have an indirect impact or are indirectly impacted are known as Secondary Stakeholders. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the table below.

The significance of a stakeholder group is categorized considering the magnitude of impact of the Project on the stakeholder or degree of influence (power, proximity) of a stakeholder group on the Project functioning. The significance of the stakeholder group importance for the Project and the requirement for engaging with them is identified as an interaction of the impact and influence. The list of key stakeholders is presented in **Table 7.1**.

Table 7.1: List of Key Stakeholders

Sl. No.	Stakeholder Group	Description
Primary Stakeholders		
1.	Project Affected Persons (PAPs) which includes Fishermen, Commercial and Residential Structures	■ This stakeholder group comprises of the affected fishermen carry out fishing in the WSP ponds and will be potentially impacted due to the construction of the new STP facility. ■ This stakeholder group comprises of the Project Affected Persons (PAPs) residing and operating their businesses along the Right of Way (RoW) of the project area and may be potentially impacted by the laying and/or replacement of the sewer pipelines.
2.	Local Community in Project Area	■ This stakeholder group comprises of the community residing in the project area. ■ This group is not expected to be directly impacted by the Project activities but may be indirectly impacted.
3.	Religious Institutions	■ This stakeholder group includes a temple located in the RoW and/or in proximity to the Project area.
4.	Project Workforce	■ This stakeholder group refer to the existing workers who are currently engaged for the STP and its linked facilities. ■ This stakeholder group refers to the direct workers (payroll staff) and indirect workers (third-party or contractual workers) who will be engaged in the Project.
5.	M/s Ganga STP Projects Private Ltd. (GSPPL) and sub-contractors	■ This stakeholder group i.e. GSPPL, is the Special Purpose Vehicle (SPV) that has been incorporated for the Project. ■ GSPPL will be subcontracting the Designing, Building, as well as Operations and Maintenance (O&M) scope for the project to M/s VA Tech Wabag Limited (Wabag)
6.	Kolkata Metropolitan Development Authority (KMDA)	■ KMDA is the Project Executing Agency. Moreover, in this project context, KMDA is the client of the concessionaire and will be the owner of all assets after the end of the concessionaire period of 15 years.
Secondary Stakeholders		
7.	National Mission for Clean Ganga (NMCG) &	■ NMCG is the governing authority for the Project on behalf of the Government of India.
8.	Project Financing Agencies/Institutions	■ This stakeholder group includes International Finance Corporation (IFC) is evaluating a potential investment opportunity into the Project.

Sl. No.	Stakeholder Group	Description
9.	Regulatory Authorities	■ This stakeholder group comprises of regulatory authorities at the district, state and national level that are responsible for various permits and licenses pertaining to the Project.
10.	Urban Local Bodies/ Municipality	■ This stakeholder group refers to the jurisdiction under which the STP and its linked facilities are located in i.e. Howrah Municipal Corporation. ■ This group is responsible for the development of their respective urban areas.

7.1.2 Stakeholder Mapping

Stakeholder Mapping is a process of examining the relative influence that different individuals and groups have over a project as well as the influence of the project over them. The purpose of a stakeholder mapping is to;

- Study the profile of the stakeholders identified and the nature of the stakes;
- Understand each group's specific issues, concerns as well as expectations from the project that each group retains;
- Gauge their influence on the project.

On the basis of such an understanding, the stakeholders are categorized into High Influence/ Priority, Medium Influence/ Priority and Low Influence/ Priority. The stakeholders who are categorized as high influence are those who have a high influence over the project or are likely to be heavily impacted by the project activities, and are thus high up on the project proponent's priority list for engagement and consultation.
Similarly, the stakeholders categorized as medium influence are those who have a moderate influence over the project or even though they are to be impacted by the project, it is unlikely to be substantial and these stakeholders are thus neither high nor low in the project proponent's list for engagement. On the other hand, the stakeholders with low influences are those who have a minimal influence on the decision-making process or are to be minimally impacted by the project and are thus low in the project proponent's engagement list.

The significance of a stakeholder group is categorized considering the magnitude of impact (type, extent, duration, scale, frequency) or degree of influence (power, proximity) of a stakeholder group and urgency/likelihood of the impact/influence associated with the particular stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed taking the power/responsibility and proximity of the stakeholder group and is categorized as negligible, small, medium and large. The Urgency or likelihood of the impact on/influence by the stakeholder is assessed in a scale of low, medium and high. The overall significance of the stakeholder group is assessed as per the matrix provided in Table 7.2.

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Table 7.2: Stakeholder Impact Matrix

		Sensitivity /Vulnerability / Important Resource / Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The following section provides brief profiles of the various stakeholders in the project as discussed in the previous sub section along with their degree of influence. The details are provided in **Table 7.3** below.

Table 7.3: Stakeholder Profiles and Influence Mapping

Stakeholder Group	Stakeholder Profile	Impact/Influence of the Project on this Stakeholder Group (Negligible, Small, Medium, Large)		Urgency/Likelihood of Influence of Stakeholder Group on Project (Low, Medium, High)		Level of Influence of Stakeholder
Project Affected Persons (PAPs) which includes Fishermen, Commercial and Residential establishment. The commercial establishment includes roadside vendors and kiosk	■ This stakeholder group comprises of the Project Affected Persons (PAPs) residing and operating their businesses along the Right of Way (RoW) of the project area and may be potentially impacted by the laying and/or replacement of the sewer pipelines. This group mainly consists of commercial and residential structures. ■ This Stakeholder group comprises of the affected fishermen undertaking fishing inside the WSP ponds which have been considered for the construction of the new STP facility.	■ This group constitutes as one the most important stakeholder groups as it will be impacted due to the construction of the new STP facility. Thus the fishermen groups will faced permanent income loss for the fishermen undertaking fishing in the affected WSP ponds. ■ This groups will also be affected temporarily by the laying and/or replacement of the sewer pipelines. ■ The entire process for the laying/replacement of a sewer pipeline will take approximately 3 days therefore causing temporary traffic congestion and access disruption to these commercial and residential structures situated along congested areas of the project RoW. ■ The commercial structures which include kiosks and vendors may be impacted by temporary income loss due to	Large	■ This stakeholder group will play an important role in allowing for smooth functioning of the Project, as well as shaping public opinion towards the Project. ■ The Project impacts on this stakeholder group are however temporary and can be mitigated through proper traffic management, road signage, barricading and undertaking work during off-peak hours. ■ In addition, the Project Affected Persons (PAPs) may potentially be engaged as local resources during the construction phase of the project, in the form of construction labourers, mason workers and drivers, etc. ■ This stakeholder group can also provide goods and services required for the construction of the Project in	High	Major

Stakeholder Group	Stakeholder Profile	Impact/Influence of the Project on this Stakeholder Group (Negligible, Small, Medium, Large)		Urgency/Likelihood of Influence of Stakeholder Group on Project (Low, Medium, High)		Level of Influence of Stakeholder
		potential closure of their shops during the proposed work.		the form of truck services and construction material suppliers etc.		
Local Community in Project Area	■ This stakeholder group comprises of the community residing in the project area. ■ This group is not expected to be directly impacted by the Project activities but may be indirectly impacted. ■	■ The laying and replacement of the pipelines may potentially affect the local community residing in the project area, but are not expected to be directly impacted by the Project activities. ■ As mentioned above, the entire process for the laying/replacement of a sewer pipeline will take approximately 30 days therefore this stakeholder group may temporarily and indirectly be affected by congestion and access disruption, caused by the Project activities. ■	Small	■ The project impacts on this stakeholder group are indirect, temporary and can be mitigated through proper traffic management, road signage as well as barricading. ■ Similarly, this stakeholder group may potentially be engaged as local resources during the construction phase of the project, in the form of construction labourers, mason workers and drivers, etc. ■ This stakeholder group can also provide goods and services required for the construction of the Project in the form of truck services and construction material suppliers etc.	Medium	Minor
Kolkata Metropolitan Development Authority (KMDA)	■ KMDA is the Project Proponent Moreover, in this project context, KMDA is the client of the concessionaire and will be the owner of all assets after the end of the concessionaire period of 15 years.	■ KMDA is the Project Proponent under the Project governing authority i.e. National Mission for Clean Ganga (NMCG).	Large	■ Being the Project proponent who will own all assets after the end of the concessionaire period, this stakeholder group is important for the smooth functioning and implementation of the Project. ■ This stakeholder group is also responsible for acquiring the licenses and permits for the Project as well as for the	High	Major

Stakeholder Group	Stakeholder Profile	Impact/Influence of the Project on this Stakeholder Group (Negligible, Small, Medium, Large)		Urgency/Likelihood of Influence of Stakeholder Group on Project (Low, Medium, High)		Level of Influence of Stakeholder
				implementation of the Livelihood Restoration Plan (LRP) ■ This group may also play an important role in the formation of public opinion towards the Project.		
Project Workforce	■ This stakeholder group refer to the existing workers who are currently engaged for the STP and its linked facilities. ■ This stakeholder group refers to the direct workers (payroll staff) and indirect workers (third-party or contractual workers) who will be engaged in the Project.	■ A total of 32 workers are currently engaged for the STP and its linked facilities. The project will thus cause loss of unemployment/retrenchment of the existing workers at the Bally and its linked facilities ■ The Project will engage manpower for the civil construction work during the construction phase comprising of approximately 100-150 workers, therefore providing employment opportunities. ■ This group will include unskilled, semi-skilled and skilled workers. ■ Reportedly, 80% of the workforce will be from outside the district and 20% will be local workers. ■ The project may pose health and safety concerns if proper safety measures are not adopted by the workers.	Medium	■ This stakeholder group is important for the smooth functioning and timely implementation of the Project which can be considered through Labour Management Framework (LMF). ■ This stakeholder group is important for the smooth functioning and timely implementation of the Project, which can be ensured through a Labour Management Plan (LMP). ■ The group has an important role in formation of public opinion and in case their labour requirement and health and safety are not complied, this group may pose the risk of conflict and protest which may affect the image of the concessionaire.	Low	Minor

Stakeholder Group	Stakeholder Profile	Impact/Influence of the Project on this Stakeholder Group (Negligible, Small, Medium, Large)		Urgency/Likelihood of Influence of Stakeholder Group on Project (Low, Medium, High)		Level of Influence of Stakeholder
M/s Ganga STP Projects Private Ltd. (GSPPL) and sub-contractors	■ This stakeholder group i.e. GSPPL, is the Special Purpose Vehicle (SPV) that has been incorporated for the Project. ■ GSPPL will be subcontracting the Designing, Building, as well as Operations and Maintenance (O&M) scope for the project to M/s VA Tech Wabag Limited (Wabag)	■ As this stakeholder is the SPV for the Project, the Project is providing it with a sustained business opportunity.	Large	■ This stakeholder group is critical for the smooth functioning and timely implementation of the management plans formulated for the Project. ■ The manner of functioning of this group will influence the opinions of the local stakeholders about the Project.	High	Major
National Mission for Clean Ganga (NMCG) &	■ NMCG is the governing authority for the Project.	■ NMCG is the governing authority for the Project.	Large	■ As the governing authority, this stakeholder group is important for the smooth functioning and implementation of the Project. This includes being responsible for overall escrow mechanism and payments to the Concessionaire.	High	Major
Project Financing Agencies/Institutions	■ This stakeholder group includes International Finance Corporation (IFC) is evaluating a potential investment opportunity into the Project. ■	■ The influence of the Project on the stakeholder group will primarily relate to the impact that the Project's performance will have on public opinion on the financing agency, locally, nationally and internationally.	Large	■ This stakeholder group's influence on the Project will primarily relate to the determination of the Project's financial feasibility. ■ In addition to the national rules and regulations, the project is required to comply with the applicable standards and guidelines of these financing institutions.	High	Major

Stakeholder Group	Stakeholder Profile	Impact/Influence of the Project on this Stakeholder Group (Negligible, Small, Medium, Large)		Urgency/Likelihood of Influence of Stakeholder Group on Project (Low, Medium, High)		Level of Influence of Stakeholder
Regulatory Authorities	■ This stakeholder group comprises of regulatory authorities at the district, state and national level that are responsible for various permits and licenses pertaining to the Project.	■ The impact of the Project on this stakeholder group is negligible as it is one of many projects being implemented in the state and the country.	Small	■ This stakeholder group's influence on the Project is high as this group provides the licenses and permits essential for the functioning of the Project. ■ This stakeholder group can enable Project shut down, temporary stoppage, or levy of penalties and fines, in the event of non-compliance.	High	Moderate
Urban Local Bodies/ Municipality	■ This stakeholder group refers to the jurisdiction under which the STP and its linked facilities are located in i.e. Howrah Municipal Corporation. ■ This group is responsible for the development of their respective urban areas.	■ The impact of the project on this stakeholder group will be in the case of potential for social disruption between the local inhabitants and the workforce. ■ There can be impacts on the environment such as noise, air and water pollution during the construction and operations stages.	Small	■ The impact of the stakeholder group on this Project is high as their cooperation in required especially during the mitigation of potential social impacts cause by Project activities such as addressing traffic congestion and access disruption. ■ Additionally, the cooperation of the respective municipalities are required during the identification of the Project Affected Persons (PAP).	High	**Moderate**

7.1.3 Stakeholder Consultation

7.1.4 Public Consultation Meeting on NGRBA ESMF

On December 2010, a public consultation was conducted at Unnayan Bhawan, Kolkata with the presence of the Urban Development Department, representatives of the municipalities and educational institutes. The objective of the meeting was to brief on the objectives of the Environment and Social Management Framework (ESMF) of the National Ganga River Basin Authority (NGRBA), including the future activities planned as part of the project. The structure of the NGRBA as well as matters related to land acquisition, entitlements, resettlement and rehabilitation were also discussed. It was also highlighted that the improvement of the sewerage system through the project, will improve public health as a whole, thereby having a positive impact.

The participants from Panihati Municipality shared their thoughts about the status of the structures constructed under the Ganga Action Plan Phase 1 and Phase 2, and highlighted that some of them are not functioning properly due to various reasons. Participants from Mahestala, Bhatpara and Gayeshpur Municipalities highlighted that there is a lot pollution being caused by both small scale and large-scale industries. Representatives from Chandan Nagar also indicated that untreated sewage from the municipality is also being discharged into the river.

7.1.5 Stakeholder Consultation during ESIA Process

Consultations have been conducted with stakeholders of the Bally STP project which include the existing contractual workers at the STP and linked facilities, as well as those stakeholders who are situated in congested locations within the project area. The details are presented in **Table 7.4** below. The minutes of the stakeholder consultations along with participants list are provided in **Appendix F**.

Table 7.4: Details of Stakeholder Consultation

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
1.	**Existing Pump Operators Contractual Workers** *Location:* Belur Lifting Station (LS) *Date:* 21st June 2019	■ The consultations with the existing contractual workers at the lifting station reveal that 3 operators are working in the LS. The workers have three shifts, which include morning shift, day shift and night shift. ■ The workers in the Lifting station are being employed by Associated Co-operative .Society, a contracting agency engaged by KMDA for the operation of the STP and its linked facilities. ■ The LS in Belur receives water intake from Lal Baba College and Belur area. The outlet point is located at Belur Math Ghat behind Belur Math Temple, Lala Babu Shire Road, and Ramlochan Shire Street. The current capacity from the station is reported to be 25 Hp ■ The area in and around the Belur Math is being maintained by the Belur Math Authorities. ■ The pump operators reported to have an idea about the proposed work but they don't have any clear idea about the scope of work to be done.	■ The workers expressed concern about irregular salary disbursement by the respective contractor. ■ Moreover, the workers expressed that in the lifting station premises, there is no toilet and drinking water facilities. Moreover, no health checkups and safety protection was given to the staffs as part of the health and safety concern for undertaken the task. ■ The workers further expressed that the work to be undertaken such as the replacement of the pipelines will improve the services and functioning of the LS.

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
		■ No leakages, water logging and blockages in the sewer line were reported in the area.	
2.	**Existing Contractual Worker at Ghusuri Lifting Station and Golabari** *Location***:** *Ghusuri Howrah Municipal Corporation* *Date***:** *21st June, 2019*	■ In Ghusuri lifting station, there are a total of 6 contractual workers who are currently working in LS and 4 workers working in Golabari LS. These contractual workers are working under the contractor, Associated Cooperative Society. ■ The workers reported to have no knowledge and awareness about the proposed project. ■ The workers reported that there is water logging near the Lifting Station. However, the condition of the pump building is poor as well as the capacity of machine.	■ According to the pump operators in Ghusuri, they expressed concern that in case of any construction work to take place, the area around Naskar Para Road, and Kali Majumder Road are very congested, hence proper traffic arrangements and safety measures should be put in place. ■ In Golabari, the area near to the LS is highly congested and accordingly a Golabari Ghat is located near to the LS. Therefore, safe access for passengers should be provided during the construction period. ■ According to the pump operators in both the LS, water logging takes place in front of the LS.
3	**Existing Contractual Worker at Bally Khal Lifting Station** *Location*: N.K. Pal lane, Howrah *Date:* 21st June 2019	■ The Lifting Station has a total of four workers working under the Associated Cooperative Society. They operate in shifts: 1st Shift from 6pm to 2 pm, 2nd Shift from 2 to 10 pm and 3rd shift from 10-6 am. ■ The Pump operator reported to be unaware of the proposed project. ■ The area in and around Chaital Para near Bally Jute and N.K.Pal Lane manhole besides the meat shop are facing water logging.	
4	**Existing Contractual Worker at Salt Gola Lifting Station** *Location*: *Salt Gola, Howrah* *Date*: *5th July, 2019*	■ The operation in Salt Gola Lifting Station is being manned by four workers. These contractual workers are working under the contractor, Associated Cooperative Society. ■ All of the five machines in the Lifting Station are out of order therefore the Lifting Station in non-functioning. ■ A discussion with the workers reveal that the workers are not aware about the proposed work. Their expectation is replacement and repair of the sewer pipeline. ■ No water logged is reported near to the Lifting Station	■ According to the pump operators, there is a Railway Godown in Salt Gola area therefore any construction work may lead to further congestion in the area. ■ Therefore, proper measures need to be kept in place during construction to avoid congestion and inconvenience to the local community.
6.	**Consultation with Committee Members of the Jaganath Temple**	■ According to the members present during the consultation, The Temple is newly renovated by KMDA since the temple was partially impacted due to the GAP project. ■ The Members reported that the intake water is released from the outfall without	■ The temple members reported that in the event there is any damage done to the structure either partially/fully during the construction phase, the concerned authority/agency will

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
	Location: Belur Panchanan Tala Jagannath temple Date: 17th July, 2019	properly treatment thus polluting the river Ganges. ■ The committee members extended their support during the construction and replacement work. ■	have to reconstruct/ repair the affected portion of the Temple. ■ The construction shouldn't affect the existing water pipeline facility located near the Jaganath Temple. ■ The people from in an around the area are accessing the temple for praying, hence during the construction the contractor should provide safe access for worshippers as the temple is located in a congested area.
7.	**Consultation with Local Community residing near the Kona WSP** *Location: Ananda Nagar and Bhatta Nagar Date: 22nd June 2019*	■ The history of the WSP area once belong to Bhatta Jamindar The land back then was used by 108 families who undertake farming in the existing waste treatment plant in Kona. As the land was required by the government for the WSP, the affected farmers were rehabilitated and were given 2 katha land each. Hence form those who are still residing in the area around WSP have shifted their livelihood from farming to fishing. ■ The WSP pond was leased out on a yearly basis for fishing. A co-operative of fishing community was formed in the year 2014 who undertake fishing inside the WSP pond. ■ Every year as part of the lease agreement issued by the office of Block Development Office, token money is paid by the fishermen to the Gram Panchayat to undertake fishing inside the WSP. ■ Discussion with the local community revealed that they are not aware about the project and the work to be undertaken.	■ The local community expressed that the Project will provide long-term benefits to the fishermen community. ■ As the pumping station has stopped functioning, no water is currently being pumped into the ponds. As a result the water level, the *Bheri* is currently insufficient for pisciculture.
8.	**Consultation with Local Market Users** *Location: Belur Date:27th August 2019*	■ The morning market is located in B.K Pal road of Belur Panchanantala. ■ On a daily basis there are local vendors who sit from morning 6.AM to 9 AM, regularly for selling of vegetables, fish and meat. ■ The roadside vendors are from the surrounding areas of Belur and they reported that most of them belong to the low income groups. The average income of the roadside vendors per day ranges from INR 200 to INR 500. ■ The vendors operate their business throughout the year, however they reported that they are facing difficulties during the rainy season as they operate their business in the open space without shade.	■ The vendors expressed their willingness to cooperate during the implementation (construction) of the project. ■ They expressed that the impacts should be reduced to a minimum, if possible. Furthermore, they requested that after the excavation and construction works are completed, the road should be repaired accordingly.

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
9.	**Consultation with Committee Members of the Temple** *Location: Bimal Ghat, Jay Bibi Road* *Date: 24th August, 2019*	■ The Temple was established in the year 1969 by one of Sri. Gopal Singh. The temple priest is Shyam Chandra Jha. The temple is also called as Shib Temple. ■ Inside the Property of the Temple, there is a main temple and three other rooms which is rented out. ■ Near to the proposed outfall in Jay Bibi road there is one cattle shed located above the over the Out fall. The Pujari reported that the Cattle shed was given to be set up on a rented basis. ■ The temple committee members are not aware about the proposed project. However, they expressed their cooperation for the project as they expected the project would protect the river Ganga from getting more polluted.	
11.	**Consultation with Block Development officer of Bally Jagacha Block** *Location: Block Development Office, Madhya Para, Ghosipara, Bally* *Date: 28th August 2019*	■ The WSP ponds fall under the Chakpara Anandanagar Gram Panchayat. The land of the WSP falls under KMDA but it has been handed over to Block Development Office under the order of the Ministry for promotion of pisciculture activity in the ponds. However under the administrative order, in future in case of any development/infrastructure work, the land will be handover back to KMDA by BDO. ■ In all the 6 ponds (2 Anaerobic, 2 facultative and 2 Maturation), fishing activity is allowed only in 4 ponds (maturation and facultative). Reportedly, no fishing activity is permitted inside the Anaerobic ponds due to the high content of BOD & COD thus the product is not safe for public consumption. ■ ■ In the WSP ponds, fishing in the WSP had been carried out for the last 20 years by the local from nearby the WSP location on a lease basis issued by the BDO. The WSP ponds have been lease out for fishing activity on a yearly basis. The lease was last renewed on the 31st March 2018 and since then the lease has not been renewed. Currently, the WSP pond is vacant and no fishing activity is undertaken inside the 6 WSP ponds. As a result, there will be no person to be affected on account of the proposed project. ■ ■ Fishing is reported to be carried out by the local as secondary livelihood activity and mainly for self-consumption. The fishermen are not dependent on the	

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
		ponds for their day-to-day earnings. Reportedly, as of the last lease record (document evidence will be shared by KMDA to ERM), the WSP has been leased out to 8-9 people to carry out fishing in the WSP ponds. ■ ■ KMDA officials reported that lease has not been renewed and evident for the same will be provided as proof so that the project execution agency does not face any issues/problems in the future.	
12	**Consultation with Fishermen Groups at WSP Kona** *Location: Kona Waste Stabilization Pond, North Howrah, Bally* *Date: 9th September, 2019*	■ The fishing activity in the WSP pond has been carried out for the last 20 years under the approval of the Chakpara Anandanagar Gram Panchayat. Recently in the last three years, the WSP pond is overseen by the Block Development Officer (BDO). ■ The BDO has issued a 3 years lease agreement to four (4) cooperative society. The agreement was last issued by the BDO since September 2017 and this is the running third year. The lease was reported to be a verbal agreement and there is no written form of agreement. The fishermen reported that every year they are to pay the tender amount to the BDO for carrying out fishing for the year 2019-2020. ■ The yearly payment was made through demand draft in the name of Bally Jagacha Panchayat Samitee. As reported by the fishermen, the last lease payment made by the Ma Ganga Cooperative society to the BDO was INR 3,30,000 ■ The cooperative societies - Jeven Jevika Mahotsa Goshti comprises if 14 members and Ma Ganga Fishery of 12 members. None of the representatives from the other two cooperative societies were present during the meeting. ■ ■ The four Cooperative society were assigned each pond for carrying out the fishing. ■ ■ When trying to ascertain the dependency of the fishermen on the WSP pond, it has been reported that from only 5 members from Ma Ganga and 7-8 member from Jeevan Jevika are dependent on the WSP ponds for fishing as their primary occupation. For the remaining members, they are engaged in services and job-related activity as their primary occupation	■ The fishermen reported that though currently, they are not harvesting any fish from the WSP, however there are still remaining fish in the ponds. The fishermen expressed that they should be given the right to salvage the remaining fish before the work starts. ■ In the case of any decision regarding infrastructural development and to be taken place in the WSP, the Panchayat Samiti and all the fishermen should be communication and informed immediately. ■

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
		■ The major fish cultivated are Rohu, Katla, Prawn (Chingri),Lalentika, Maitikal, Kalgosh, Japanese Puti, and Vietnamese Koi and Kol Chingri. ■ The Fishermen reported that the harvest is done once in 3 months and the last harvest was in December 2018. ■ The average yearly production is 7 to 8 ton, and the last production was reported to be 500 kg and the Gross income is INR 65000. The profit earned after procuring all the input supplies and payment of fees are shared among the members equally. ■ The representative from Jeevan Jevika Cooperative Society reported that during the first year of the contract, an investment of INR 15,00,000 was spent, out of which the fishermen faced a loss of INR 6,70,000. The major reason for the loss was the insufficient flow of water from the MPS towards the ponds. Secondly, the presence of huge chemical in the WSP ponds led to the sudden death of fishes. This was reported mainly in the case of fishing is undertaken in the Anaerobic pond ■ When trying to ascertain the awareness of the project, the fishermen reported that none of them are aware of the proposed project, but have expressed their willingness and cooperation required for the project.	
13	**Consultation with Fishermen Groups at WSP Kona** *Location: Kona Waste Stabilization Pond, North Howrah, Bally* *Date: 14th September, 2019*	■ The WSP falls under the Chakpara Anandanagar Gram Panchayat. The WSP land was previously being overseen by the Block Development Office (BDO), Bally Jagacha and it was revealed that the tender for fishing activities at the WSP was floated by the Panchayat Samiti, under Bally Jagacha Block. ■ As per discussion with Maa Ganga Fisheries group has made an initial investment of Rs. 2 Lakhs each. This group utilizes Pond 1 (Maturation Pond) and they indicated that they harvest 4 times a year, with approximately 500 kgs for the first 3 cycles. They indicated that they yield 7-8 tones during the last cycle and that they sell their produce to the local market. They also indicated that they made the full payment of 3 lakhs during the first cycle i.e. the 2016-2017 cycle. During the second cycle, i.e. the 2017-2018 cycle, they made a payment in two installments i.e. 60% and then 40%. During the present cycle i.e 2019-2020, they have already made	■ They indicated that they have been facing a loss in the previous cycles and that they have also been utilizing their own funds for the cleaning of the chemicals present in the ponds. These chemicals were used by the previous group utilizing the ponds, to increase the fish yield. ■ Taking into consideration their already incurred losses, the groups thus shared their concerns about the current cycle, and particularly about not having received any intimation from either the Block Development Office or the Gram Panchayat authorities about the jurisdiction of the ponds being handed over to KMDA, and about the project as a whole. They therefore requested for immediate communication from the respective authorities about this new development.

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
		40% of the payment i.e. Rs. 1, 20,000 in cash, for which a receipt was also produced. ■ As per discussion with Jivan Jeevika Fishing representative, Mr. Sanjoy Mondal, the group has 12 members and they have been functioning since 2017. They utilize pond 6 (Anaerobic Pond) and Pond 2 (Facultative Pond). ■ As per discussion with Maa Kali Fishing representative Mr. Amit Roy, the group has 14 members and utilize Pond 4 (Maturation Pond) and Pond 5 (Anaerobic Pond). They mostly cultivate small fish. Reportedly, they have already made 40% payment for the 2019-2020 cycle. They also indicated the fish cultivated at pond 5, which is the anaerobic pond, is mostly affected in terms of yield. ■ As per discussion with Maa Tara Fishing representative, Mr. Amit Mondal and Mr. Babusona Patip, the group has 10 members and they utilize Pond 3 Facultative Pond. For the cycles, 2017-2018 and 2018-2019, they have made the full payment of 3 lakhs each cycle, to the Gram Panchayat but have not yet made the payment for the present cycle 2019-2020. It may be noted that since the group leader for Maa Tara fisheries, Mr. Babusona Patip was not able to physically attend the meeting, the ERM team was able to discuss with him over the phone. In addition, a representative was present on his behalf i.e. Mr. Amit Mondal.	
14	**Consultation with Workers at Bally WSP and Associated Facilities**	■ The discussion revealed that the contractors at these facilities are engaged by three different O&M agencies i.e. M/s. Associated Cooperative Labour Contractor and Construction Society Ltd; M/s. M.C.E Construction, and M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd since 2009, 2008 and 2006 respectively. ■ The workers of M/s. Associated Cooperative Labour Contractor and Construction Society Ltd and M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd. present during the consultation indicated that they have been receiving their salary, ESI, PF, Bonuses as well as some increase in their salary proportionate to Dearness Allowance (DA) increase, during the	■ The workers shared that they strongly expressed their apprehension of losing their jobs due to the onset of this project. They also requested the authorities for their reasonable consideration to protect their livelihood and current earnings.

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
		government pay scale change. However, the workers under M/s. M.C.E Construction do not avail this D.A benefit. ■ As reported by the workers engaged at Arupara STP, the STP was commissioned in 1970 and has not been functioning since March 2019. ■ It is understood from the consultation that O&M agency Associated Cooperative Labour Contractor and Construction Society Ltd is formed as a consortium of existing workers, out of which some workers are holding designated posts.	
15	**Consultation with Local Community at Panchanantala** *Location: Panchanantala, Bally* *Date: 13th February, 2020*	■ A consultation was conducted with the local community residing at Panchnantala Road. ■ This road stretch will require replacement of sewer lines. The ERM team was accompanied by the Wabag team and the purpose of the consultation was to provide an awareness about the proposed upgradation works, the implementation timeline and as well as to gather their suggestions and inputs. The team gave a detailed briefing about the duration of work, which will be approximately three days, as well as the nature of disruption. ■ The name of the locality is B.K Pal Road comprising of 4 wards with 2000 households. The community reported that about 80% of the households belong to BPL community. ■ The major occupation of the community is daily wages. Majority of the resident are from West Bengal followed by migrants from Bihar and Jharkhand. ■ The areas around the BK Pal road faces frequent flooding especially during the rainy season. The major reason is the clogged drain connecting to the high drain. As a result the water from the low drain overflows and causes waterlogged in the areas. The community reported that as a result of this, many of the local resident were suffering from Dengue. ■ The road stretches along the BK Pal road is very busy and heavy vehicle coming from Ghusuri more are passing through this road stretches. The road stretches is busy from 7 am to 1 pm and from 4 pm to 10 pm.	■ The community perceived that the proposed project will improve the drainage system in the area and hopeful the issues of water logging will be resolved. They expressed cooperation for the project during construction period. ■ The community, however raised their concern that in the earlier construction work have causes damage to public utilities such as the drinking water pipelines. Therefore they urge that during replacement work, measure should be taken to avoid damage to public utilities. ■ The local community were told of the grievance mechanism and a toll numbers was shared with the community members in case of any grievances.
16	**Consultation with Local Community at Jayabibi Road**	■ A consultation was conducted with the local community residing at Jayabibi Road. This road stretch will require replacement of sewer lines. The ERM	■ The community requested for advance notice prior to construction since they are

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
	Location: Jayabib Road, Bally *Date: 13th February, 2020*	team was accompanied by the Wabag team and the purpose of the consultation was to provide an awareness about the proposed upgradation works, the implementation timeline and as well as to gather their suggestions and inputs. The team gave a detailed briefing about the duration of work, which will be approximately three days, as well as the nature of disruption. ■ The name of the locality is 38/39 Jayabibi Road. In this road stretches about 11 households are residing along the road stretches. They are mainly engaged in daily labour. Women are also engaged in labour work and their monthly income is between 2000-2500 per month. ■ The areas around the Jayabibi road comprises of small narrow lane with small scale industry some of which are metal and engineering works. ■ Heavy vehicles of approximately 10-6 tyres are frequently using the road stretches. ■ The community reported no water logged issues in the areas. ■ The community perceived that the proposed project will improve the drainage system in the area and hopeful the issues of water logging will be resolved. They expressed cooperation for the project during construction period. ■ There is no time limit for carryout construction, however requested that during construction, they should be given a safe access path to access their homes. ■ The local community were told of the grievance mechanism and a toll numbers was shared with the community members in case of any grievances.	utilizing a portion of the road for keeping their scrap items. ■ They however agreed to extend their support for the project and that during the construction phase, they will accommodate their belongings/scrap items to a nearby location.
17	**Consultation with Local Community at Paschim Ghughupara** *Location: Kona Waste Stabilization Pond, North Howrah, Bally* *Date: 13th February, 2020*	■ A consultation was conducted with the local community residing at Paschim Ghughupara. This locality is located just outside the WSP ponds. The ERM team was accompanied by the Wabag team and the purpose of the consultation was to provide an awareness about the proposed upgradation works, the implementation timeline and as well as to gather their suggestions and inputs. The team gave a detailed briefing about the duration of work, which will be approximately three days, as well as the nature of disruption.	■ The community reported no objection for the proposed project and willing to cooperate during the entire period. ■ However they requested that in case of any damage to the existing road stretches, the project concessionaire should repair the road in order to avoid any inconvenience to the local community.

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
		■ The name of the locality is Paschim Ghughupara under Bally Jagacha Block. The locality has approximately 1000 HHs. ■ The locality has 4 schools comprises of English, Hindi and Bengali medium. These schools operate between 8 AM to 3 PM in the afternoon. ■ Though no impacts is identified along this area, however the road for transporting construction materials during construction period will passes through this locality. Therefore the community were made aware of the vehicular movement during the construction period. ■ No issues of water logging is reported in the areas. ■ The local community were told of the grievance mechanism and a toll numbers was shared with the community members in case of any grievances.	
18	**Meeting with Fishing Group Members with District Administration Through 'Google Meet', online video conferencing platform** *Location: Fishing group members were present at BDO Office, Bally-Jagacha* *Date: 28th July, 2020*	■ Informal fishing groups were using the WSP ponds at Kona based on commercial lease agreement. ■ BDO, Bally-Jagacha stated that the WSP ponds were being utilized for fish farming with the permission of earstwhile Kolkata Metropolitan Water and Sanitation Authority (KMWSA) based on annual lease agreement between the fishermen and Bally-Jagacha Panchayat Samity. After Octobe 2018, the lease agreement was discontinued and was handed over to KMWSA in September 2019. ■ District Magistrate, Howrah intimated the fishermen group about the proposed project, which was welcomed by the fishermen group members. ■ The fishermen group members mentioned that they have engaged themselves in other different profession.	■ A further meeting with fishermen group was proposed to discuss and close the issue and that the meeting will be duly intimated to the group members.
19	**Meeting with Fishing Group Members with District Administration Through 'Google Meet', online video conferencing platform**	■ The fishermen group were mostly informal group bearing no legal status; the groups were engaged into fish farming in the WSP ponds for two yearsthrough annual lease agreement with Bally-Jagacha Panchayat Samity during 2017-2018. ■ The agreement was discointinued in the year 2018 and the WSP ponds were handed over to KMDA in 2019. ■ The fishermen were earlier engaged in different other profession for livelihood and will return to other or earlier occupation.	■ No concerns were raised by the fishermen group members in this regard.

Sl. No	Stakeholder Group	Details of Consultation	Concern and Expectation
	Location: Fishing group members were present at BDO Office, Bally-Jagacha *Date: 4th August, 2020*	■ In the meeting it was mentioned that any future claim regarding livelihood restoration arising out of this project would be scrutinized as per the parameters and conditions laid down by donor agencies in this regard after due verification of the claims and if found justified, it would be sent to the Urban Development Department, Govt. of West Bengal and KMDA for necessary action as per the law.	

Figure 7.1 Local Stakeholder Consultation Sessions Conducted

Jaganath Temple, Panchanantala

Consultation with workers at Bally MPS and Lifting Stations

Consultation at Kona MPS

Consultation with Workers at LS 1 Ghusri

Consultation with Vendors at Morning Market

Consultation with Fishermen Groups at Kona WSP

Consultation with local community at Panchanantala

Consultation with Local Community at Jaya Bibi Road

7.2 Stakeholder Engagement Plan

GSSPL will establish a stakeholder engagement program for all three project sites which includes a comprehensive suite of stakeholder's consultation, disclosure activities and engagement exercises and media interactions. The objective of the communication plan includes:

- Identification and analysis of the stakeholder groups and their profiles, interests, issues/impacts and concerns relevant to the Project;
- Ensure the inclusion of women and vulnerable groups in all phases of stakeholder engagement;
- Identification of specific measures to allow meaningful engagement with the different stakeholder groups in a manner that is transparent and accessible using culturally appropriate communication methods with a specific focus on vulnerable groups;
- Allow for a relationship to be built with the various stakeholders of the Project based on mutual respect and trust;
- Facilitate adequate and timely dissemination of information to the stakeholder groups in a culturally appropriate manner;
- Provide systems for prior disclosure/dissemination of information and consultation, including seeking inputs from affected persons, incorporation of inputs, as applicable, and Principles of Stakeholder and Engagement
- Providing feedback to affected persons/groups on whether and how the input has been incorporated;
- Providing mechanisms for feedback and dispute resolution;
- To enable proof of resolution of all grievances;
- Provide a mechanism for documentation of the activities undertaken and the reporting and monitoring of the same.

A detailed Stakeholder Engagement Plan (SEP) has been prepared for all three sites.

7.2.1 Resource and Responsibility

GSPPL has overall responsibility for the implementation of the Stakeholder Engagement Plan (SEP). GSPPL's CSR department will also be engaged in implementing the SEP. However, KMDA will also be involved with regard to the disclosure and implementation of activities related to the Livelihood Restoration Plan (LRP) GSPPL's main activities include:

- Responding to the concerns and issues expressed during public consultations.
- Allocating sufficient funds to implement a viable Stakeholder Engagement Plan.
- Ensuring that all public consultation and information disclosed is documented.

The detailed activities to be undertaken are included in the detailed SEP.

7.2.2 Methods for Stakeholder Engagement

The methods of engagement incorporate individual profiles, concerns, and expectations of the groups. The need for different modes of engagement is primarily because the utilization of a common modus operandi for all the stakeholders and that too for the whole project duration may result in the failure of the engagement process to achieving its goals.

- *Public Meetings:* These meetings and consultations not only form a part of certain regulatory requirements (such as public hearing) but also serve as useful tools for gathering information from larger groups. These meetings and consultations typically involve a notification (to publicize

the matter to be consoled upon) and a consultation (a two way flow of information) at a larger community level; such as at the ward or municipality level.

- *Focus Group Discussions:* An FGD refers to a discussion carried out amongst a group of people (6 to 8) from a similar background/profile on a specific topic while being guided by a moderator. The primary purpose of such discussions is to gather insight into the thought process of the group in regards to a particular issue. Apart from FGDs, general discussions with either the community or individual representatives are also part of the engagement process. This method allows for the collective opinion of these groups to be captured and assessed.
- *One on One Meeting:* This form of engagement is typically a structured or semi-structured interview/discussion with one or few stakeholder representatives. These allow for an in-depth qualitative issue with stakeholder groups that are likely to be knowledgeable.

7.3 Information Disclosure

This section provides an understanding of the information disclosure and consultation plan put in place for the project. This plan shall guide the engagement with the external stakeholders through the life of the project. Ongoing public consultation, meeting minutes and records will be kept in record. A summary report of all public consultation issues, grievances and redressal will be prepared at project level.

The information disclosure will be undertaken primarily through two means; preparation and dissemination of briefing material and organization of community consultations or group meetings. The primary purpose of the disclosure process will be to make information accessible and available to all in a simple and easy to understand manner. The briefing material shall be in the local language i.e Bengali. Following communication tools shall be designed for effective dissemination of relevant information (**Table 7.5**) below.

Table 7.5: Information Disclosure Plan

Topic	Documents to be Disclosed	How & Where	Frequency
Disclosure of the Proposed projects	Project related information	The project will developed an ESIA which will detail out the project impacts and the proposed mitigation measure of the proposed. The information will be shared with the community during consultation. ■ Municipality Office ■ Site Office of the EPC	At the time of preparing the ESIA
Disclosure of the draft ESIA	Draft ESIA	The project will prepare an ESIA and made available to affected persons and local NGOs in the local language; Bengali in the following offices: ■ Project Website ■ DC's Office ■ Local Gram Panchayat office ■ Site Office of the EPC Contractor	At the time of finalizing of the ESIA

Topic	Documents to be Disclosed	How & Where	Frequency
Resettlement Entitlements	Livelihood Restoration Plan (LRP).	The project will make the LRP available to affected persons and local NGOs in the local language; Bengali in the following offices: ■ Project Website ■ DC's Office ■ District Libraries ■ Local Gram Panchayat office ■ Site Office of the EPC Contractor	At time of finalization of LRP
Livelihood Restoration Framework	Information regarding impacted people and their entitlements in local language	■ Soft copy in Web-site ■ Letter to each local ULBswebsite of project	At the time of Within 20 days of Draft LRF Report is submitted
Grievance Redressal	SEP and GRM	■ Local Gram Panchayat office ■ Site Office of the EPC Contractor	Prior to start of construction
Environmental & Social Management Plan	Construction schedule including transportation and movement of heavy machinery	■ Project Website ■ Hard copies in Bengali in the following offices: ■ Local gram panchayat office ■ Office of the contractor	Prior to start of construction.
Regular Disclosure	Meetings with the stakeholders to provide them an update on the status of the project, the next steps and the possible impacts on the stakeholders	■ Local village gram panchayat office	As per demand or request from specific stakeholders

7.3.1 Information Disclosure with ULBs

KMDA had informed all the concerned ULBs for the 'Pollution Abatement (Interception & Diversion with STP) Works for River Ganga at Howrah, Bally and Baranagar-Kamarhati Municipal Town in West Bengal including 15 years of Operation and Maintenance under Hybrid Annuity Based PPP Mode' and that execution of the work may temporarily cause inconvenience in certain stretches and impacts are being assessed by ERM.

A disclosure meeting was conducted on the 12th of November, 2019 between the officials of Howrah Municipality and ERM, to disclose about the KMDA project on the upgradation of the STP and sewerage system at Howrah Municipality. The following are the main points discussed:

- The ERM team apprised the ULB officials about the purpose of the meeting including the potential environmental and social impacts, which include impacts on air quality as well as community health and safety during the construction phase. Other potential social impacts include temporary livelihood loss and access disruption, during the construction of the STP facility and laying and replacement of the sewer pipelines.
- The ERM team also informed about the potential short-term disturbance in the neighbourhood of the STP, during construction phase. However, it was highlighted that these impacts are temporary and will be addressed through proper mitigation measures that is discussed in the environment and social management plan (ESMP).
- The Municipal Chairperson and the municipal ward members present indicated that they understand the purpose and value of the project and mentioned that since it is in the public interest of the community, they have agreed to offer their full cooperation during the project implementation phase.
- It was informed to them that it is assessed, during the construction phase some road side vendors, kiosks may potentially be impacted due to rehabilitation and relaying of the sewer pipelines; this is assessed to be temporary income loss. Moreover, during construction, the fishermen undertaking fishing inside the WSP ponds will be impacted. Survey would be conducted to identify the potentially affected persons. The information on the affected persons will be further updated on finalisation of the design and detail measurement survey. If any person/s is assessed to be impacted, he/she will be compensated for the loss as per the framework document.
- The participants requested for information before the commencement of project activities and also demanded that once the excavation works are completed, the roads should be repaired to its original state. They also requested that the STP project design as well as the timeline of the project to be shared with them before commencement of the construction work.
- After the discussion, the Executive Engineer of HMC; Executive Engineer of PWD and Councillor of Ward 39, conducted a joint visit to the project area, to understand the potential areas for disruption were deployed for a joint visit to the project area, to understand the potential areas for disruption. The minutes of the meetings are provided in the **Appendix K.**

7.3.2 Disclosure with Community

A disclosure meeting was conducted on the 7th of November, 2019 between communities and ERM representatives, to disclose about the KMDA project and where the sewer pipeline replacement work would be undertaken.

The following are the main points discussed:

- The ERM team explained to the community residing in Panchanantala about the purpose of the disclosure meeting and explained about the proposed upgradation works.
- The team further disclosed on the work to be undertaken to improve the existing sewerage line Bally and surrounding area.
- The community were informed of the traffic disruption during the construction and replacement work to be carried out along the road stretches.
- The team further highlighted that there will be potential temporary impacts particularly related to access disruption and temporary livelihood loss during the laying or replacement of the sewer pipelines.

- The community were also informed that compensation is being considered, for the impact caused by the project. The compensation amount for the affected shops will be based on their daily income.
- The community members have expressed their support for the project as they view it as beneficial to the community. They however requested that they be informed in advance when the work starts and suggested that construction work should be carried out during the night to avoid and minimise the disruption to the local community and commercial establishments/vendors.
- Some members also suggested that once the road work has completed, the roads should be repaired accordingly. The indicated that in the past, certain upgradation works which involved excavation work were not completely repaired, which therefore caused some inconvenience.
- The members mentioned that since the project is in the public interest, they support the project activities. The minutes of the meetings are provided in the **Appendix K.**

A disclosure meeting was conducted on the 12th of November, 2019 between affected fishermen and ERM representatives, to disclose about the KMDA project and work would be undertaken.

The following are the main points discussed:

- The team informed the affected cooperative societies that 2 ponds will be affected on account of the construction of the STP facility. About 30% of each of the affected ponds will be talked for the proposed work.
- The groups' members informed to have carried out fishing inside the WSP ponds from 2017 and that yearly payment for leasing out the pond is paid to the respective BDO. The group members are aware about the project.They further expressed that the work to be undertaken for the improvement of these Ponds and also the modification of MPS is in the interest of the community
- The team further disclose that there will be impact on the fishing activity carried out inside the WSP, particularly in two ponds where the proposed STP facility will be constructed. The team further highlighted that there will be potential temporary impacts particularly related to access disruption and temporary livelihood loss during the laying or replacement of the sewer pipelines.
- The community were also informed that a compensation is being considered, for the impact caused by the project. The compensation amount for the affected fishermen will be considered based on their income from the fishing activity etc.
- The community members have expressed their support for the project as they view it as beneficial to the community. They however requested that they be informed in advance when the work starts.

The members mentioned that since the project is in the public interest, they support the project activities. The minutes of the meetings are provided in the **Appendix K**.

7.3.3 Reporting and Monitoring

It is recommended that during the construction phase of the project, the performance of the SEP be reviewed on a bi-annual basis. For the purpose of the review, the Environmental and Social Specialists for the Project, will prepare reports on public consultation issues, grievances and redressal, to be submitted to the project management, on a quarterly basis. During the operations phase, the reports will be submitted on an annual basis. Subsequently, a Stakeholder Engagement Report and Monitoring Report should be prepared and disclosed annually on the IFC website. This report will include a summary of the issues raised by the stakeholders, the numbers of grievances, a

summary of key actions taken to address the grievances, an analysis of trends, as well as plans for further engagement.

7.4 Livelihood Restoration Plan (LRP)

Though the proposed project does not involve any land acquisition, business and shops will be temporarily affected on account of the rehabilitation of the sewer pipelines. The affected businesses are thus entitled to compensation for their loss of income, for each day of disturbance on fully closed roads. Therefore, a Livelihood Restoration Plan (LRP) is required to be prepared for compensating the identified affected persons. The LRP will be based on the Livelihood Restoration Framework (LRF) that has been developed based on international safeguard (IFC) for resettlement and rehabilitation.

The Livelihood Restoration Plan (LRP) will be prepared comprising the database of all the affected persons, prior to the start of the construction work. The LRP will include the types of loss, entitlement to restore the losses, the implementation mechanism, the grievance mechanism as well as schedule for implementation and budget. The approved LRP will be disclosed with the concerned stakeholders.

A socio economic survey of the businesses and structures present along the relevant sections, will be conducted. All businesses identified in the project-impacted areas (sections ready for construction) before the cut-off date will be entitled to compensation for loss of income. For shops such as hawkers, and street vendors, the actual income earned in the project area will be considered. Additionally, all fishermen carry out fishing inside the WSP ponds where the STP facility will be constructed will be considered. Compensation in the case of loss of structure will be calculated based on the replacement cost

The compensation for loss of business/income for titleholders will be determined based on the income tax declaration to be provided during the census survey. For non-titleholders and squatters, the daily income sales will be considered for determining the compensation.

8. GRIEVANCE REDRESS MECHANISM

8.1 Introduction

The implementation of a project is a complex time and labour intensive process involving multitude of lifecycle phases and processes. Over the duration of the project, it encounters numerous instances of conflicts, allegation and dissatisfaction within the working and associated human capital and their interactions. Some of these issues could be related to

- compensation payment,
- improper estimation of affected assets,
- failure to fulfil commitments,
- poor management of construction activities,
- accidents due to inappropriate planning of vehicle movement, and
- Cultural conflicts between migrant workers and local communities etc.

Most of the conflicts and allegations may not appear to be of serious nature but if not managed appropriately from the beginning may snowball into a bigger issue. In order to manage these risks, an internal mechanism is required to be in place where the aggrieved party(s) can lodge their complaints and get it amicably settled prior to approaching the formal mode of solution available to them i.e. access to legal system through courts. In order to provide a formal forum to the aggrieved party(s) i.e. deal with issues arising out of project, it is proposed that a joint grievance redress mechanism be instituted for both environmental and social related issues.

8.2 Objectives of the Grievance Redressal Mechanism

The basic objective of the GRM shall be to provide an accessible mechanism for addressing both internal and external grievances. Internal grievances include grievances from both direct and indirect employees such as local workers and migrant workers, through contractors. External grievances include complaints from affected people, community or any stakeholder(s) having a stake in the project. The GRM thus aims to resolve any social (including labour, contractor, and community amongst others) and environmental related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of project related work activities. The other important objective is to democratize the development process at the local level and to establish accountability towards the stakeholders.

The Grievance Redress Mechanism will also cover grievances/concern of the existing workers to in relation to the potential loss of employment. All existing workers have the right to initiate the procedures as laid down in the following section. Moreover, the GRM does not prevent the complainant from bringing his/her concerns to the courts or other relevant government bodies.

8.3 Process of Grievance Redressal Mechanism

A project Grievance Redressal Mechanism (GRM) will be established to receive, evaluate and facilitate the resolution of the affected and displaced persons concerns, complaints and grievances. The grievance mechanism will aim to provide a time bound and transparent mechanism to voice and resolve concerns linked to the project.

A Grievance Redress Cell will be established by the concessionaire for reporting and addressing grievances of the affected communities and workers. The Grievance will comprised of key members

from GSPPL, District Magistrate (if required) KMDA, Local Authority, Local NGOs and key members of the local Municipal ward. Involvement of at least 2 female members in the GRC is mandatory.

During the project preparation, as part of the public consultation process, information regarding the GRM will be disclosed to the affected persons. Grievances related compensation will be acknowledge, evaluated and responded through the GRM. The GRM will continue to function, for the benefit of the affected person and the community, during the entire life of the project including the maintenance period.

For ensuring the effective implementation of GRM, GSPPL shall designate one of its staff dedicated for the grievance redress process as social safeguard officer (SSO) who will have the overall responsibility for timely grievance redress on environmental and social safeguards issues, including keeping and maintaining the complaint and redress records.

A three tier mechanism have been proposed for addressing grievances:-

Tier 1: The first level and immediate contact for of resolution grievances will be the GSPPL Site Supervisor or E&S Manager. A Toll Free number 03340055688/689 is put in place for receiving complaint and grievances. The complaints /grievances may be received either verbally or through written applications. Prior to construction of any works, the E&S team under the supervision of the Environment & Social Manager should notify the workers and the local residents and community of the projects and the potential impacts and temporary disturbance of the project. In case the aggrieved person/workers has any complaint with he/she can lodge a complaint to the site supervisor which will then be passed on to the E&S Manager. For addressing the complaints, the E&S Manager, if required, can take the assistance of the urban local bodies/municipality. . Grievance can also be registered anonymously in written form to the onsite Supervisor/E&S Manager. A grievance register will be kept at each project facility, Lifting station, Main Pumping Station and STP. At the 1st Level the Project Manager, Resident Engineer and on site E&S Manager will make efforts to resolve the grievance/ complaint within a period of 10 days from the date of receipt of the complaint. In case the aggrieved is not satisfied with the solution provided during Tier 1, he may escalate it to Tier 2.

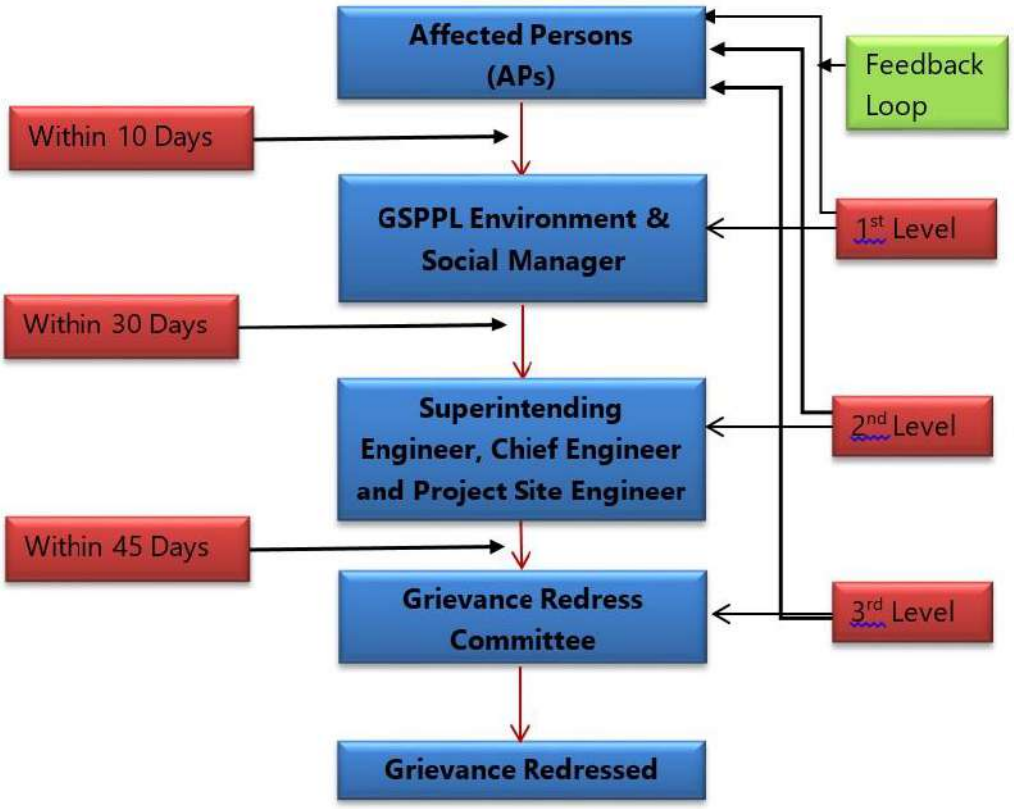
Tier2: Complaints and grievances which remain unresolved, will be escalated to the next tier comprising of the Superintending Engineer, Chief Engineer and Project Site Engineer. Representatives from urban local bodies comprising of both men and women, if required will also be included as members of the committee. Such cases should be resolved within 30 days from the day the escalation of the issue take place. In case the complainants are not satisfied with the decision of the committee, the issue can be escalated to the next Tier.

Tier 3: Should the issues remain unresolved, the complaints can be escalated to the third level the Grievances Redress Committee (GRC). Such cases should be resolved within 45 days from the day the escalation of the issue take place. The GRC comprises of the District Magistrate as under ‘Namami Gange’ program. Other members comprise of the following:

1. District Magistrate Chair Person
2. Superintending of Police
3. Executive Officer of the Municipal Corporation Member
4. Mayor of the Municipal Corporation Elected Member
5. Representatives from NGO
6. Sub Divisional Officer
7. Executive Engineer, PWD and PHED

The GRC will resolve the matter within a time period of 60 days. **Figure** 8.1 presents the three tier grievance redressal mechanism for addressing external grievances.

Figure 8.1 Grievance Redressal Mechanism for External Stakeholders



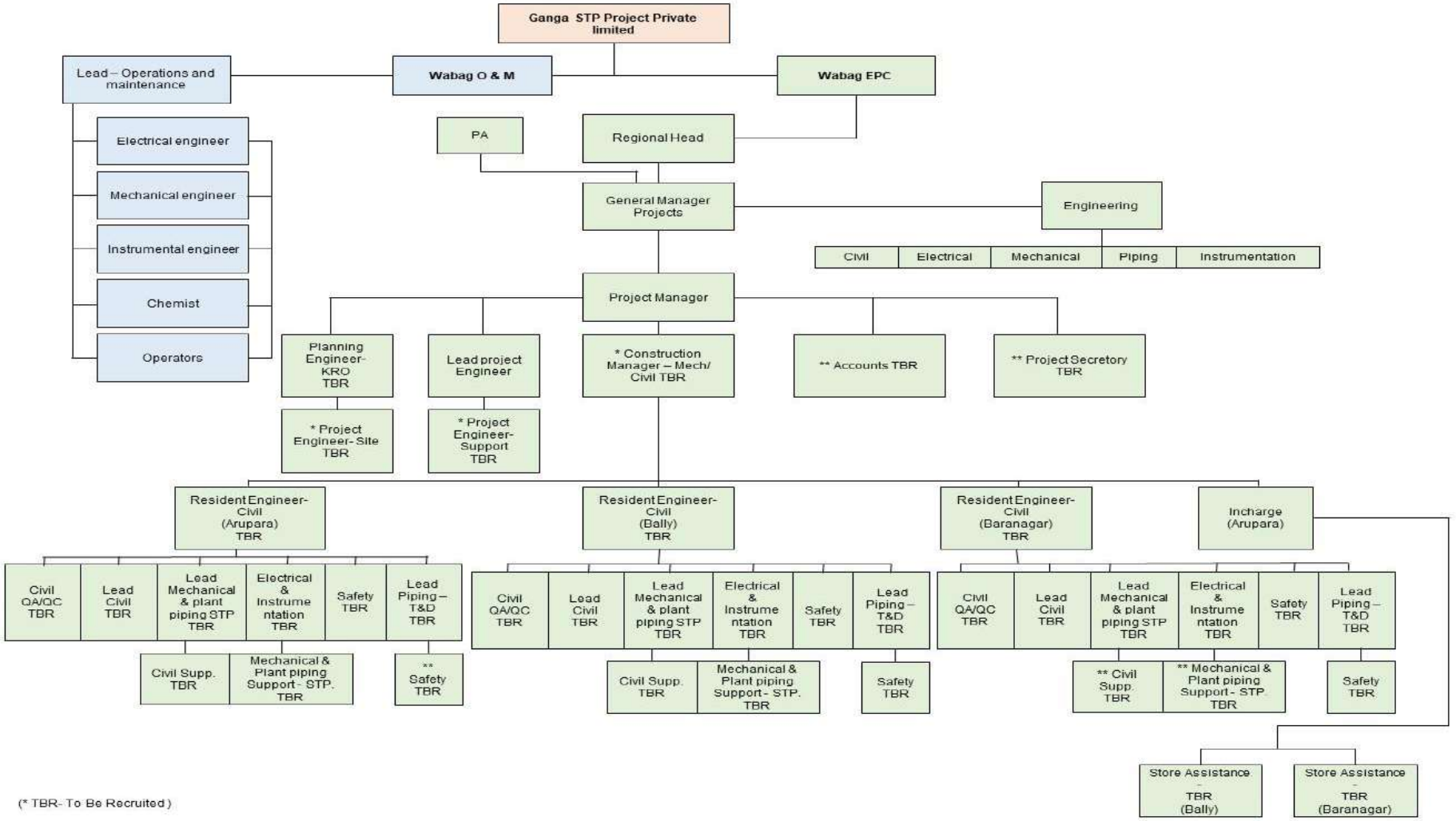
9. ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

The ESIA for upgradation and renovation of the sewage treatment plant in Bally STP has been undertaken to assess and report the environmental and social impacts of the project. In course of the project's planning and the ESIA, project design decision have been made taking into account the need to avoid, minimize and reduce adverse impacts. VA Tech Wabag Limited (hereinafter referred as Wabag) the EPC Contractor and operation and maintenance (O&M) provider for the project cycle of a 62 MLD STP in Bally as well as the construction and rehabilitation of effluent disposal pipelines, trunk sewers and pumping stations to convey the sewage to the STP is the responsible entity for ensuring that the mitigation measures as suggested in the Environmental and Social Management Plan (ESMP). Further, this ESMP provides project and site specific mitigation measures to minimize damage to the local environment and disruption to local communities.

9.1 Implementation of ESMP

M/s VA Tech Wabag Ltd (Wabag) will have ultimate responsibility for implementing the provisions of the ESMP during de-commissioning, construction and operation phase of the project. This role will include the on-going management of environmental and social impacts, monitoring of contractor performance as well as development of mechanisms for dealing with environmental and social problems.Wabag will also ensure that the activities of its contractors are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation.

Figure 9.1 Organisational Structure



9.2 EPC and O&M Contractor Management

The EPC and O&M contractor, i.e. M/s VA Tech Wabag Ltd (Wabag) will have a dedicated HSE department for the projects. VA Tech Wabag Ltd. has a well structured corporate level Occupational Health, Safety and Environmental Policy in place and also maintains an integrated management system (ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018) for ensuring effective operational integration and monitoring process (***Appendix G***). The HSE department take the overall responsibility for co-ordination of the actions required for environment and social management and mitigation and for monitoring the progress of the proposed ESMP for the project.Wabag will also ensure that the project owner KMDA and SPV formed under special provision i.e GSPPL are kept well informed about the developments regarding the project. However, ultimate responsibility for implementing the provisions of the ESMP will lie with Wabag and perform the following activities:

- Preparation of required documents on environmental and social management;
- Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Implementation of the health and safety measures;
- Collection of the statistics of health of workers;
- Providing support during routine medical check-ups of workers;
- Awareness and implementing safety programmes;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out environmental audits;
- Identify unsafe acts & conditions and suggest remedies;
- Develop safety culture and comply with company's HSE policy & standards requirements;
- Encourage and enforce the use of PPE's;
- Educate all employees for the use of PPE's & safe practices;
- Direct, coordinate and orient the safety activities;
- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

9.3 Inspection, Monitoring and Audit

Inspection and monitoring of the environmental and social impacts of the Project activities will increase the effectiveness of ESMP.Through the process of inspection and auditing, Wabag will ensure that the conditions stipulated in various permits are complied. The inspection and audits will be done by the project identified HSE staff in coordination with O & M sub-contractors and any other external agencies identified.The entire process of inspections and audits should being documented.The inspection and audit findings are to be implemented by the site In-charge in their respective areas.

To ensure contractor compliance to H&S requirements, E&S manager shall conduct daily checks and inspections. Findings from such inspections will be documented in the Monthly monitoring reports.

Independent audit shall be conducted during construction and once during operation stage to monitor the implementation of the ESMP and management plan which also includes the Livelihood Restoration Plan.

9.4 Reporting and Documentation

Wabag shall develop and implement a programme of reporting through all stages of the project cycle. Delegated personnel shall require to fully complying with the reporting programme in terms of both timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental check list, incident record register, environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

9.4.1 Documentation

Documentation is an important step in implementing ESMP. Wabag will establish a documentation and record keeping system to ensure recording and updating of documents per the requirements specified in ESMP. The documents should be kept as hardcopies as well as in electronic format. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to, identified personnel in form of the following:

- Master Environment Management System document;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register and issues attended/closed.
- Contractor H&S Performance Reports

9.4.2 Internal Reporting and Communication

Inspection and audits finding along with their improvement program are to be regularly reported to the senior management for their consideration. The same are also to be communicated within the staff working on the project. To maintain an open communication between the staff and management on HSE and social issues the followings are being used:

- Team Briefings,
- On-site work group meetings;
- Work Specific Instructions; and
- Meeting with stakeholders.

9.4.3 External Reporting and Communication

HSE In-charge is the responsible person for ensuring that communication with regulatory agencies and stakeholders are maintained as per the requirement. All complaints and enquiries are to be appropriately dealt with and records be maintained in a Complaint/Enquiry Register by the designated

staff of Wabag. All communications made to regulatory agencies should also be reported to Wabag corporate HSE Head.

9.4.4 ESMP Review and Amendments

The ESMP act as an environment and social management tool which needs to be reviewed periodically to address changes in the organisation, process or regulatory requirements. Following a review, HSE In-charge will be responsible for making the amendments in the ESMP and seeking approval from the senior management. The amended ESMP will be communicated to all the staff.

9.5 Training Programme and Capacity Building

Training is needed for effective implementation of ESMP. HSE Officer of EPC contractor, HSE In-charge of Wabag as well as Wabag Corporate HSE Head will ensure that Environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and during operations of the STP.

Also general environmental awareness will be increased among the projects' teams to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimising adverse environmental impacts, compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment will be imparted to the contractors and sub-contractors involved in the project. Some of the suggested training areas are as follows:

Table 9.1: Suggested E&S Trainings

Types of Trainings	Stakeholder	Frequency
HR Induction and Company code of Conduct	Contractor Workers and Wabag Staff	Monthly (as applicable)
Grievance Procedures and Redress Mechanism	Contractor Workers and Wabag Staff	Quarterly
Health & Safety Training	Contractor Workers and Wabag Staff	On joining (Induction training)
		Daily (Tool Box Talk)
		Monthly and Quarterly (refresher's training)
First Aid Training	First Aid Rider	Quaterly

9.6 Environmental Monitoring

The environmental monitoring programme has been devised with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;
- To verify compliance with statutory and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project area.

9.7 Performance Indicators and Monitoring Schedule

Physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each E&S performance indicator has been prepared for all phases of the Project and is presented in **Table 9.2**.

This includes parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

9.8 Environment and Social Management Plan

This section outlines the potential adverse impacts, mitigation measures, monitoring and management responsibilities during construction and operation phases of the Projects.

The purpose of ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designed to mitigate potentially adverse impacts, are implemented;
- List all suggested mitigation measures and control technologies, safeguards identified through the ESIA process;
- Provide Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place; and
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Projects.

In order to minimize adverse impacts during different phases of project lifecycles, mitigation measures, monitoring plan and responsibilities for its implementation are given in **Table 9.1**.

The responsibility for implementation of ESMP will primarily lies with EPC Contractor & O&M contractor HSE Department and HSE In-charge of Wabag, GSPPL and KMDA will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues.

Note:

1. Since at some instances, detailed project design related information and specifics of the project are yet to be finalized. GSPPL will evaluate environment and social risk and impacts associated with Change in Design, in line with IFC PS requirements. This may require project component specific review or commissioning a detailed ESIA, commensurate to the risks and impacts anticipated due to such changes.

Table 9.2: Environment and Social Management Plan

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Environmental Issues Associated with Site Construction Phase						
Drainage	Soil stripping and limited cutting, filling and levelling activities to make the site topography suitable for setting up of the STP. The removal of vegetation cover and top soil can increase the potential for soil erosion during a short period of time till the site is levelled and then stabilized with fill materials like gravel, and sand.	Surface runoff from the construction site may contain eroded earth, sand, aggregate, spilled oil, lubricant, paint residues etc., however the potential to reach drainage channel near and affecting the water quality.	Minor (Negative)	Site to develop an appropriate storm water drainage and flood water management plan, as best management practice (please refer section 5.4.4).	GSPPL	GSPPL
Visual and Aesthetics	Grading and cleaning of land for demolition activity Emptying of existing structures Demolition of existing structures Storage and disposal of demolition waste Storage and disposal of sludge/silt from	Loss of topsoil producing an offensive odour and visual impact	Minor (Negative)	Stacking of demolition waste, soil heaps and sludge/silt to be done away from settlements with provision of covers so that odour and fugitive emissions are restricted. All the construction activities will be restricted within the designated site; On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility. (Please refer to section 5.4.1)	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
	decommissioned structure					
Visual and Aesthetics	On-Site storage of excavated and construction materials; On-Site storage of construction waste; Off-Site disposal of construction waste; Earth work along the sewer pipeline route; De-silting of sewer pipelines; On-Site storage and Off-Site disposal of silt/sludge from sewer pipeline; and Renovation work at linked facilities.	The disposal of MSW in open area around the site can create odour nuisance.	Minor (Negative)	Provision of storage facility for construction materials within the site; Provision of temporary storage of wastes and collection will also be made at the site Sections excavated for pipeline route will be barricaded with tin sheets; Stacking of sections of pipeline to be done away from settlements with provision of wedges to ensure that rolling or movement of pipeline do not pose risks to passers-by; All the construction activities will be restricted within the designated site; On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility; Construction and municipal solid waste temporarily stored at the site will be transported to the designated disposal facility at regular intervals; (Please refer to section 5.4.1)	GSPPL	GSPPL
Soil Quality	Site clearing and preparation	Soil compaction	Minor (Negative)	Demarcation of routes for movement of heavy vehicles; Stripping and placing soils when dry, and not when wet. (Please refer to section 5.4.7)	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Soil Quality	Fuelling and operation of heavy machinery and transport vehicles	Soil contamination through spills and leaks	Minor (Negative)	Preparation of guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals; Storage areas for oil, fuel and chemicals to be surrounded by bunds or other containment devices to prevent any spilled oil, fuel or chemicals from contaminating soils, water or groundwater; Use of spill or drip trays to contain spills and leaks, and use of spill control kits to clean small spills and leaks; and Installation of oil/water separators to treat surface run-off from bounded areas prior to discharge to the storm water system. (Please refer to section 5.4.7)	GSPPL	GSPPL
Soil Quality	Storage and handling of chemicals	Soil contamination through spills and leaks	Minor (Negative)	Designated storage area with proper area arrangements (Please refer to section 5.4.7)	GSPPL	GSPPL
Soil Quality	Storage, handling and disposal of construction waste	Soil contamination	Minor (Negative)	Design processes to prevent/ minimise quantities of wastes generated and hazards associated with the waste generated; Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period; Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				types generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance); Store wastes in closed containers away from direct sunlight, wind and rain; Ensure storage area has an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; Dispose of waste by authorised vendor. The waste management plan (including C&D waste as well as Liquid waste) also should contain aspects of adequate storage, disposal, transportation route, training and record keeping for different categories of waste i.e. hazardous waste, non-hazardous waste, solid waste, e-waste, bio-medical waste, municipal solid waste and chemical waste		
Soil Quality	Generation of sanitary effluent	Soil contamination	Minor (Negative)	Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce; Septic tank and soak pit will be provided to treat domestic waste water. (Please refer to section 5.4.7)	GSPPL	GSPPL
Surface Water Quality	Erosion from excavation, levelling, filling and other activities	Increased sediment content of surface water	Minor (Negative)	Provision of channels, earth bunds or sand bag barriers on site to direct storm water to silt removal facilities;	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Protection of stockpiles by plastic sheeting to ensure that they are suitably secured against the wind at the end of each working day if rain is forecasted; Appropriate surface drainage will be designed and provided where necessary; Drainage systems, erosion control and silt removal facilities will be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit will be removed regularly; Any temporarily diverted drainage will be reinstated to its original condition when the construction work has finished or when the temporary diversion is no longer required; Temporary and permanent drainage pipes and culverts will be provided to facilitate runoff discharge. These will be designed for the controlled release of storm flows. (Please refer to section 5.4.5)		
Surface Water Quality	Fuelling and operation of heavy machinery and transport vehicles	Contamination of surface water	Minor (Negative)	Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor;	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Any oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal; Any surplus wastewater from the concrete batching plant will be treated to comply with discharge standards before it is discharged to the Sea; (Please refer to section 5.4.5)		
Surface Water Quality	Storage and handling of chemicals	Contamination of surface water	Minor (Negative)	Designated storage area with proper boundary (Please refer to section 5.4.5)	GSPPL	GSPPL
Surface Water Quality	Generation of sanitary effluent from on-site labour accommodation.	Contamination of surface water by sanitary effluent generated from on-site labour accommodation.	Minor (Negative)	Provide sanitation facilities (Please refer to section 5.4.5)	GSPPL	GSPPL
Ground Water	Fuelling and operation of heavy machinery and transport vehicles	Contamination of groundwater	Minor (Negative)	Proper SOP has to be followed during such kind of activity (Please refer to section 5.4.6)	GSPPL	GSPPL
Air Quality	Operation of heavy machinery and transport vehicles	Exhaust Emissions	Minor (Negative)	Minimise movement of construction vehicles and enforce a speed limit around the construction site; Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NOx, PM10 and SO2; Where available use low sulphur diesel (LSD) in HGVs and diesel powered equipment in collaboration with best management practices;	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Implement best practice procedures to control vehicle / equipment air emissions (such as turning off equipment when not in use); and Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts should be serviced/ replaced. (Please refer to section 5.4.2)		
Air Quality	C&D waste management and Sludge Handling	Dust	Minor (Negative)	As far as possible, locate the concrete batching plant away from sensitive receptors; Implementation of a periodic watering and sprinkling regime in particular during the dry season, at least two times during the day; Minimise the height from which fill materials are unloaded during site backfilling as far as possible. Where possible, this should be below the height of the hoarding around the Project site boundary; During construction, the approach road will be regularly maintained to keep it clean, free from mud and slurry. The approach road will be properly shaped and compacted by rolling to an even and uniform surface to receive pavement. Totally enclose any skips for material transport with impervious sheeting; and No waste will be burnt on or around the Project site.	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Noise	Heavy machinery operations for construction works	Increase in ambient noise levels	Minor (Negative)	Normal working hours of the contractor will be between 06:00 and 21:00 hours from Monday to Sunday. If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of the noise criteria at nearby sensitive receptors; Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; Low noise equipment should be used as far as practicable; The number of equipment operating simultaneously should be reduced as far as practicable; Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby sensitive receptors like Adarsha Nagar settlement as far as practicable; Acoustic enclosure should be erected around DG sets and other stationary noise generating equipment; (Please refer to section 5.4.3)	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Occupational Health and Safety	General construction activities	Health and safety of construction workforce	Moderate (Negative)	The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for working methods, plant utilisation, construction sequence and safety arrangements; Measures will be implemented to reduce the likelihood and consequence of the following hazards: falling from height; falling into water; entanglement with machinery; tripping over permanent obstacles or temporary obstructions; slipping on greasy oily walkways; falling objects; contact with dangerous substances; electric shock; variable weather conditions; lifting excessive weights; A Permit to Enter system will be established to ensure that only authorised persons gain entry to the site; All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; All workers will be properly informed, consulted and trained on health and safety issues;	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Personal Protective Equipment (PPE) shall be worn at all times on the Site. Women in the region generally wear “sarees”, which is not appropriate while working in hazard prone construction areas. If women will be working in the hazard prone areas, then the contractor needs to ensure proper outfit and PPEs. Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order; All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; All scaffolding will be erected and inspected in conformity with the Factories Act and the appropriate records maintained by the Contractor; Safety hoops or cages will be provided for ladders with a height in excess of two metres; When there is a risk of drowning lifejackets shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding; The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress.		

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				(Please refer to section 5.4.14)		
Community Health and Safety	Influx of construction workers	Increased prevalence of disease	Minor (Negative)	Barriers will be provided to prevent ingress of persons into the construction site and also to protect the public from exposure to hazards associated with the construction activities; Screening, surveillance and treatment of workers, through the provision of medical facilities and, where required, immunization programmes; Undertaking health awareness and education initiatives among workers; Avoiding collection of stagnant water; (Please refer to section 5.4.9)	GSPPL	GSPPL
Community Health and Safety	Road transportation	Traffic safety	Minor (Negative)	Road safety awareness building for residents living along the transportation route.	GSPPL	GSPPL
Social Issues Associated with the Construction Phase						
Loss of Income of Existing Workers	Prior to construction of the STP	The existing workers engaged under the contracting agencies at the Bally WSP and associated facilities, may be laid off during the new the new O&M phase.	Major (Negative)	As per IFC PS 2 guidelines, viable alternatives to retrenchment should be analysed. If retrenchment is necessary, to reduce the adverse impacts of retrenchment on the workers, a Retrenchment Plan should be developed, meeting IFC PS 2 requirements. The client should comply with all legal and contractual requirements related to notification of public authorities, and provision of information to,	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				and consultation with workers and their organizations. The client should ensure that all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner. All outstanding payments and social security benefits and pension contributions and benefits should be paid: (a) on or before termination of the working relationship to the workers, (b) where appropriate, for the benefit of the workers, or (c) Payment will be made in accordance with a timeline agreed through a collective agreement. (d) Where payments are made for the benefit of workers, workers will be provided with evidence of such payments. The abovementioned mitigations have been presented in a Labour Management Framework (LMF), which has been attached as Appendix. The Retrenchment Plan is required to be prepared prior to the closure of the contract of the workers, which has to be conducted in consultation with the affected parties and the Concessionaire.		

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				It should be noted that if the existing workers are redeployed into other alternate sites of KMDA and by the Concessionaire, then the impact would be reduced. Failing to which the Labour Management Plan would be effective. The existing workers (if they wish to continue work) may be accommodated or deputed into other such facilities (if there is such scope available) run by KMDA. Alternatively, these workers may be considered or given priority by the then O&M Agency, based on their selection and recruitment criteria, during the O&M phase (Please Refer Section 5.7)		
Access Disruption	Repair and Laying of new sewer line.	Access disruption for both residential, commercial and business operation during excavation work for laying of new rising mains, replacement and construction work.	Minor (Negative)	*Refer Section 5.5.1* ■ Inform all the stakeholders well in advance (at least 15 days) before the start of the construction work to enable shop owners to stock up and remain unaffected if goods vehicles are unable to reach them during construction; ■ Providing provision of wooden planks to ensure pedestrian access, signage with project details and contact details for grievance redress; and proper traffic management ■ Providing assistance to mobile vendors if any present during construction, to shift nearby locations if any;	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				■ The contractor should provide proper barricading and signage or notices to indicate the ongoing work. In case by-lanes towards the residential areas/shops are located from the replacement stretches, contractor to provide proper barricading and temporary alternate route for people to access their houses/shops ■ Alternative access route to be provided for the community to access their residential places and in case of any medical emergency.		
Structure Loss	Construction Phase	Commercial Structures	Moderate	■ A detailed assessment will be carried out during the detail measurement survey to determine the extent of impact, structure type and usage ■ Compensation will be provided to the affected as per replacement value as per the basic schedule of rates ■ In case of partial structural damage, the project will restore the affected structure to its original condition. ■ In the case tenant/leaseholder, the affected person will be assisted in identifying alternative location	GSPPL	GSPPL
Livelihood Restoration Plan for Affected Persons: Roadside Vendors	Construction Phase	Road side vendors, kiosk and shops operating their business near the project will face temporary livelihood/income loss during the laying of new sewer line, rising main and	Minor (Negative)	One time compensation will be paid for the temporary income loss as per the entitlements detailed out in the Livelihood Restoration Framework (LRF); A Resettlement Action Plan will be prepared for the Affected Persons. For the purpose of the Resettlement Action Plan (RAP) and identifying	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
		replacement along the RoW.		the PAHs, primary socio-economic data will be collected for the PAHs. The primary data comprised of quantitative and qualitative data collected via a range of tools and data gathering techniques. The primary data will be collected through the following methods: ■ *Census Survey*: A 100 percent census/enumeration of socio-economic characteristics will be carried out for all the PAHs to be impacted on account of the laying of new sewer line, renovation and replacement of sewer line. ■ *Inventory of losses*: An inventory of all structures and immovable assets, livelihood loss to be impacted for each PAH will be conducted during the RAP preparation. The contractor should ensure that construction work to take place during off-peak business hour and during the night to avoid major disruption. Prior to the start of the construction, the shops owners should be made aware of the construction work which will be made available in the local language. Moreover, the affected persons including the general public are to be informed about the project related requirements and information through reliable means of communication. Additionally, basic information such as location, impact estimates, entitlements and		

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				implementation schedule, will be presented to affected persons. During construction, the contractors should ensure that the structure near the RoW are not affected and excavation should be carried out to a possible extent to avoid any damages to residential and commercial structure. (Please refer to Section 5.5.2)		
Permanent Loss of Livelihood Persons: Fishermen Groups	Construction Phase	Fishing groups utilising the WSP in Kona will be affected by livelihood loss during the construction of the STP.	Major (Negative)	Provision of 60 days' notice period to the fishermen cooperatives prior to emptying the waste water from the WSP for construction; The fishermen to be allowed to fish out the remaining fish catch from the pond before start of work; Compensation for loss of income and investment. This will be determined in the Livelihood Restoration Plan (LRP); In case the affected person is not satisfied with the compensation, he/she has the right to express concern through formal application to the grievance process. (Please refer to Section 5.5.3)	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Gender Empowerment including Employment of Women	Civil construction during the construction phase of the project.	The civil construction work to be taken place at the STP can provide employment opportunities for women residing in the project area.	Moderate (Negative)	Ensure the implementation of the Gender Action Plan (GAP) for the project, which has been developed as a stand-alone document. Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work. Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment. Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements. Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise 50% of women members. (Please refer to Section 5.6)	GSPPL	GSPPL
Intra-state Migrant Workers & Labourers	Inflow of Migrant labourers & workers expected during construction phase of the project	Potential conflict with local community; Health risks due to spread of communicable diseases	Minor (Negative)	Provide adequate facilities to the workers and labourers such as properly constructed and well ventilated labour camps, clean and hygienic sanitation facilities, cooking areas etc. As per	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
		and sexually transmitted diseases Issue of Sanitation and hygiene		regulatory requirement to minimize the health related impacts; Separate toilet and bathing facilities for men and women; Creating awareness about local tradition and culture among outside migrant and encouraging respect for same; Conducting awareness programme about sexually transmitted diseases among the migrant workers, labourers and for community around project site; Proper disposal of wastes generated from the camp and construction activity to maintain general hygiene in the area;		
	Civil construction during the construction phase of the project.	The civil construction work to be taken place at the STP can provide employment opportunities for women residing in the project area.	Moderate (Negative)	Ensure the implementation of the Gender Action Plan (GAP) for the project. Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work. Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment. Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements.	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise 50% of women members. (Please refer to Section 5.6)		
Gender Empowerment including Employment of Women	Civil construction during the construction phase of the project.	The civil construction work to be taken place at the STP can provide employment opportunities for women residing in the project area.	Moderate	Refer Section 5.6 Ensure the implementation of the Gender Action Plan (GAP) for the project, which has been developed as a stand-alone document. Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work. Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment. Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements. Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Redressal Committee should also comprise 50% of women members		
Environmental Issues Associated with the Operation Phase						
Visual and Aesthetics	Physical presence of the STP; Illumination from the STP facility. Operation and Storage of Sludge increasing the Odour	Visual and Odour	Minor (Negative)	Appropriate shading of lights to prevent scattering Tree plantation and odour Monitoring (Please Refer Section 5.4.1)	GSPPL	GSPPL
Surface and ground water quality	Oil spills from oil tanks	Impact on soil and ground water environment Contaminated storm water runoff carrying contaminants to Sea Water	Moderate (Negative)	The secondary containment structures such as berms, dykes, or walls that could hold up to 110 % of the primary containment volume will be made of firm and impervious material at diesel and lubricating oil storage areas; SOPs will be prepared to manage any oil spills, leaks seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis; Empty drums will be sent for reuse or for recycling in line with CPCB guidelines; At all oil and diesel storage tank locations, emergency spill kits will be provided for the	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				operating personnel to use. Operating personnel will be trained to use such kits and dispose of them as part of hazardous waste. (Please Refer Section 5.4.5 and 5.4.6)		
Surface and ground water quality	Oily water-runoff	Contaminated storm water runoff carrying contaminants to Bagjola and Udaypur Khal	Moderate (Negative)	Oily water runoff collected in the oil handling & storage area and oil filled motors and pump bases will be collected in different sump and taken to a common oily waste water sump; The oily wastewater and storm runoff collected from specific areas mentioned above will be treated using an oil water separator; and Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream. The treated de-oiled water will be transferred to waste water chamber (Please Refer Section 5.4.5 and 5.4.6)	GSPPL	GSPPL
Surface and ground water quality	Spills of fuel, oil and chemicals	Impact on soil and ground water environment Occupational health and safety hazard Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel	Minor (Negative)	Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation; All chemicals will be stored in primary containers that have in-built secondary containment of capacity that is at least 110% of primary containment; The Spill prevention and response guidance presented in Sections 1.5 and 3.7 of the General IFC EHS Guidelines (2006) will be followed and implemented. (Please Refer Section 5.4.5 and 5.4.6)	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Surface and ground water quality	Discharge of domestic wastewater	Impact on Sea Water and channel water quality	Minor (Negative)	The sewage from the entire plant area will be collected and treated in septic tank/soak pit No untreated sewage will be directly discharged into Sea water or disposed of on land through the project life cycle; National and IFC Guidelines before discharge; and In order to monitor STP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of STP. (Please Refer Section 5.4.5 and 5.4.6)	GSPPL	GSPPL
Surface and ground water quality	Non-oily site or storm water runoff	Impact on Sea water quality	Minor (Negative)	Storm water and non-oily surface run off will be collected separately and disposed into Sea through for this stream of wastewater; The discharge system will be periodically inspected for blockages and cleaned at least once before the monsoon season to ensure its functioning; and Operating personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective action. (Please Refer Section 5.4.5 and 5.4.6)	GSPPL	GSPPL
Air Quality	Stack emissions	Impact on ambient air quality GHG emissions	Negligible (Negative)	The Project will adopt Gas Turbine system for captive power generation which has a relatively high energy-efficiency and low polluting per unit of power produced compared to other thermal power plants;	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
				Comply with the Emission guidelines for Combustion engines in given by CPC.Monitor ambient air quality in and around the Project site as per the Environment Monitoring Program formulated for the Project which will comply with National Regulatory requirements. (Please Refer Section 5.4.2)		
Noise	Plant operations	Impact on health of workers and staff	Negligible (Negative)	Noise monitoring along with health check-up on a regular interval (Please Refer Section 5.4.3)	GSPPL	GSPPL
Noise	Plant operations	Impact on health of workers and staff	Negligible (Negative)	All noise generating units would be acoustically enclosed; Use of rubber padding underneath high noise and vibration generating machines; Personnel working onsite in high noise generating areas will use ear plugs /ear muffs; (Please Refer Section 5.4.3)	GSPPL	GSPPL
Community Health and Safety	Plant operations	Impact on community assets such as water due to water intake and cooking water discharge Increased vehicular traffic in the region Exposure to site accidents and incidents	Minor (Negative)	Comply with the Community health and safety guidelines presented in Section 3.0 of the General EHS Guidelines published by IFC; Formulate and implement an On-site Emergency Management Plan in consultation and collaboration with local government authorities to streamline the emergency management response and strategy. Institute and operate a Community Grievance Redress System in line with IFC Performance	GSPPL	GSPPL

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
		Project Security		Standard 4 that pertains to Community Health, Safety and Security aspects; and If required, Project Security personnel will be engaged and trained in line with the recommendations of IFC Performance Standard 4. (Please Refer Section 5.4.13)		
Occupational Health and Safety	Project Operation Phase	Risk of accident and fatality to worker	Minor (Negative)	On job training for the workers shall be carried out; Work permit system shall be followed; PPEs to be provided and use of PPEs shall be encouraged; SOPs to be developed for operation and maintenance of the project site. (Please Refer Section 5.4.14)	GSPPL	GSPPL
Community Health and Safety and other issues	Project Operation Phase	Traffic Movement in newly constructed site approach road	Minor (Negative)	Awareness campaign among the community residing adjacent to the road Maintaining healthy relationship with community through CSR activity(Please Refer Section 5.4.13)	GSPPL	GSPPL
Social Issues Associated with the Operation Phase						
Community Health and Safety and other issues	Project Operation Phase	Traffic Movement in newly constructed site approach road	Minor (Negative)	Awareness campaign among the community residing adjacent to the road Maintaining healthy relationship with community through CSR activity (Please Refer Section 5.4.13)	GSPPL	GSPPL
Social Issues throughout the project Cycle						

Project Stage / Affected Aspect	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Mitigation Cost Source
Grievances Redress	Entire Project Cycle	Health and safety risk, Non-payment of wages for workers Community Grievances Compensation and Resettlement	Minor (Negative)	Awareness on the Grievance redress Mechanism Training on the process and GRM procedures	GSPPL	GSPPL
Consultation and Information Disclosure	Entire Project Cycle	Project Impacts and potential influence of stakeholders on the projects	Minor	Sharing of Emergency Preparedness procedures with workers and community Sharing of monitoring reports for E&S compliance Continuous engagement with stakeholders	GSPPL	GSPPL

The corresponding EHSS management and ESMS procedures in relation to the proposed mitigation measures as outlined in the Table 9.2 above with respect to the construction phase, needs to be developed by GSPPL prior to start of any development/ construction activity at the project sites or first disbursement by its lender, whichever is earlier. The following EHSS management plans shall be developed in accordance with the Good International Industry practice (GIIP).

- Development of ESMS Policy;
- Construction management plan for excavation/backfilling at site;
- Transportation of construction material and fugitive dust management plan;
- Noise management plan;
- Odour management plan;
- Lighting and illumination management plan;
- Construction and other solid waste management plan;
- Wastewater and sewage management plan;
- Traffic management plan;
- Hazardous materials and hazardous wastes management plan;
- Labor influx and worker accommodation management plan;
- Vectors and disease management plan;
- Occupational health and safety management plan;
- Emergency response plan;
- Security management plan;
- Contractor/sub-contractor management plan;
- Implemenation of Livelihood Restoration Plan for project affected person (related to fishing activity), within 6 months of takeover of Bally site by GSPPL.

The corresponding EHSS management and ESMS procedures in relation to the proposed mitigation measures as outlined in the Table 9.2 above with respect to the project operation phase, needs to be developed by GSPPL prior to start of operation of the Bally STP. The following EHSS management plans shall be developed in accordance with the Good International Industry practice (GIIP) and requirement of IFC's Performance Standards.

- Noise management plan;
- Odour management plan;
- Sludge and other solid waste management and disposal plan;
- On-site drainage management plan;
- Treated water discharge management plan;
- Equipment operation and maintenance plan;
- Hazardous materials and hazardous wastes management plan;
- Vectors and disease management plan;
- Occupational health and safety management plan;
- Standard Operating Procedure related to incident and accident management, recording and reporting system;

- Onsite and offsite emergency preparedness and response plan (including for fire, toxic gas release and chemical spills, medical emergencies and natural calamities);
- Worker/labour management plan (covering all applicable national labour laws, grievance redressal, on-site accomodation)
- Security management plan;
- Contractor/sub-contractor management plan.

Table 9.3: Environmental & Social Monitoring Programme for Project Life Cycle

Project Stage / Affected Component	Potential Impact / Mitigation	Parameters to be Monitored	Measurements	Frequency	Responsibility	Monitoring Cost		Budget
						Pre-Construction and Construction	Operation Phase	
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and operational manual	Visual inspection of all active work areas	Daily	GSPPL	Management Time	Management Time	Included in operation and maintenance (O&M) cost
Air Pollution	Stack emissions concentrations from Biogas power plant	NOx, CO, PM	CEM	Continuous	GSPPL	Rs. 100000	Rs.100000	ESMP Budget
	Ambient air quality	NOx, CO, PM10, SO2	Standard methods	Monthly	3rd Party Environmental Consultant / GSPPL	Rs. 40000	Rs. 40000	ESMP Budget
Noise	Noise generation by Plant equipment	Sound Pressure Level	Noise monitoring	Monthly Quarterly	Monitoring done by GSPPL and verification by 3rd Party Environmental Consultant	Rs. 24000	Rs. 24000	ESMP Budget
	Ambient noise	Ambient noise levels	Noise monitoring with data logger	24-hour observations with hourly noise levels, monthly	3rd Party Environmental Consultant/ GSPPL	Rs. 24000	Rs. 24000	ESMP Budget

				once at each location				
Soil	Soil and Sediment Contamination	pH, salinity, NH_4^+, total P, heavy metals, oil & grease	Standard analytical methods	Half Yearly	3rd Party Environmental Consultant/ GSPPL	NA	Rs. 24000	ESMP Budget
Water	Ground water quality	Drinking water quality parameters	Standard analytical methods	Monthly	3rd Party Environmental Consultant/ GSPPL	NA	Rs. 24000	ESMP Budget
	Wastewater	Temperature, chlorine, pH, BOD5, COD, oil & grease, heavy metals, total faecal coliform	Standard methods	Monthly	3rd Party Environmental Consultant/ GSPPL	NA	Rs. 24000	ESMP Budget
	Surface water quality	Temperature, conductivity, pH, DO, TDS	Potable water quality analyser	Monthly Quarterly	Monitoring done by GSPPL and verification by 3rd Party Environmental Consultant	NA	Rs. 24000	ESMP Budget
Occupational Health and Safety	Accidents or incidents due to operation and maintenance activities, workers' health Emergency preparedness –Mock drill record HSE training –Social	Near-misses, incidents, occupational diseases, dangerous occurrences	As to be defined in the H&S Plan to be prepared by RBLTL for the Project	As defined in H&S Plan	GSPPL	Management Time Rs. 20000 Rs. 20000 Rs. 20000	Rs. 720000	ESMP Budget

	Medical camp and Others for HSE-June 5th Environmental day celebration National safety Day					Rs. 25000 Rs. 150000		
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Incidents, accidents and community complaints	Based on occurrence	GSPPL	Management Cost	Management Cost	ESMP Budget
	Community disturbance and potential safety hazard due to waterway transportation	Accidents, incidents and complaints	Incidents, accidents and community complaints	Based on occurrence				
	Public concerns	Complaints from community	As per the grievance redress mechanism	Continuous				
LRP Implementation: Roadside Vendors	Temporary Income Loss: Road side vendors, kiosk and shops operating their business near the project will face temporary livelihood/income loss during the laying of new sewer line, rising main and replacement along the RoW.	All affected person are identified and consulted Affected person identified and IOL losses documented for compensation	Records of all affected persons and IOL	Once before construction work	GSPPL	The compensation for the Affected Persons (APs) has been outlined in the budget in the Livelihood Restoration Framework (LRF) which has been developed for the Project.		N/A
		Preparation of LRF for compensation	LRF Document	Before construction work	GSPPL			

		Status of Affected Persons compensated for losses	Compensation Document/Records Monitoring Reports	Prior to construction work.	GSPPL		
		Disclosure of project information prior to start of project.	As per SEP/ Information Disclosure Plan	Prior to start of construction	GSPPL		
		Implementation of GRM	GRM Register	Prior to start of construction and during LRP implementation	GSPPL		
LRP Implementation: Fishermen Groups	Fishing groups utilising the WSP in Kona will be affected by livelihood loss during the construction of the STP.	Compensation received by Affected Person (AP)	As per implementation of LRP	Once before construction work	GSPPL	The compensation for the Affected Persons (APs) has been outlined in the budget in the Livelihood Restoration Framework (LRF) which has been developed for the Project.	N/A
		Disclosure of project information prior to start of project. Provision of 45 days' notice period to the fishermen cooperatives prior to emptying the wastewater from the WSP for construction;	As per SEP/ Information Disclosure Plan	Prior to start of construction	GSPPL		
		Status of Affected Persons compensated for losses	Compensation Document/ Records	Prior to construction work.	GSPPL		

			Monitoring Reports					
		Disclosure of Environmental and Social Impact Assessment Report; Environmental and Social Management Plan Disclosure of Executive Summary of ESIA and ESMP Reports. Non-technical Summary of Project/ Brochures in Bengali	As per Information Disclosure Plan	Prior to start of construction	GSPPL			
Intra-state Migrant Workers & Labourers	Potential conflict with local community;	No of registered grievances and redressal status Status of implementation of Labour Management Plan	Incidents, accidents and community complaints	During operation of labour camp.	GSPPL	Management Cost	Management Time	ESMP Budget
	Health risks due to spread of communicable diseases and sexually transmitted diseases Issue of Sanitation and hygiene	Condition of labour camp, awareness of workers, complainant register	Incidents, accidents and community complaints	Every 15 days during operation of labour camp.				

		Status of implementation of CMP						
Gender Empowerment including Employment of women	The civil construction work to be taken place at the STP can provide employment opportunities for women residing in the project area.	Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work.	Number of women employed as a percentage of total persons employed in construction activities; Number of women workers earning same wage as men workers, as a percentage of total women workers employed in construction activities;	Continuous	GSPPL	Management Cost	Management Cost	ESMP Budget
		Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment.	Availability of basic amenities and separate toilet at campsite; and	Prior to start of construction				

		Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise 50% of women members	Number of women members at the Grievance Redressal Committee (GRC)	Continuous				
		Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements.	As per implementation of Stakeholder Engagement Plan (SEP) and Gender Action Plan (GAP)	Continuous				
Stakeholder Engagement and Grievance Redress	Health and safety risk, Non-payment of wages for workers Community Grievances Compensation and Resettlement	Awareness on the Grievance redress Mechanism Training on the process and GRM procedures	As per implementation of Grievance Redressal Mechanism (GRM) and Stakeholder Engagement Plan (SEP)	Continuous	GSPPL	Rs. 200000	Rs. 200000	ESMP Budget

Consultation and Information Disclosure	Project Impacts and status of implementation of ESMP	Disclosure of Environmental and Social Impact Assessment Report; Environmental and Social Management Plan Disclosure of Executive Summary of ESIA and ESMP Reports. Non-technical Summary of Project/ Brochures in Bengali Disclosure of Monthly Monitoring Plan	As per disclosure plan	Continuous		Management Cost	Management Cost	
Total						**Rs. 603000**	**Rs. 1204000**	

10. CONCLUSION AND RECOMMENDATIONS

It is understood from the ESIA study that the Project activities related to the development of the Bally STP may create some impacts on air quality, community health and safety during the construction phase. Limited disturbance is envisaged on the neighbouring community of Anandanagar and Bhattanagar as described in environmental setting, but it is understood to be short term and only during the construction phase. Moreover, impacts related to temporary livelihood loss and access disruption will also take place along the sewer lines and some of the fisherman utilising the WSP will also be affected by livelihood loss during the construction of the STP. However majority of these impacts are temporary and can be mitigated with proper mitigation measures.

Additionally, contractual workers presently engaged at the STP and MPS, may potentially be impacted by loss of income if they are not reengaged in the new O&M regime or redeployed to other facilities of KMDA. If so, a Labour Management Framework (LMF) has been developed to address the potential loss of income for these workers. Moreover, the development of the 62 MLD STP would improve the quality of Howrah Drainage Chanel through pacha khal and prevent direct discharge of raw sewage improving the hygiene aspect also.

The Environmental and Social Management Plan (ESMP) describes mitigation measures for impacts specific to the Project activities and also discusses implementation mechanisms. The implementation of the mitigation measures suggested can help in managing the negative impacts on air quality, ground water etc. whereas the economic opportunities in terms of local employment are assessed as positive.

Key mitigation measures proposed for addressing impacts include:

- Design consideration to avoid felling of mature trees to the extent possible within the project site.
- noise reduction measures to minimize disturbance to adjacent residential structures,
- dust emissions control measures during construction phase such as water sprinkling,
- covered transportation and storage of construction materials,
- provision of peripheral site drainage channels to prevent water logging situation,
- coordination with local communities for construction schedules;
- prior information about incoming vehicles carrying construction materials,
- Deployment of traffic marshals and access restriction for local people at the construction site.
- Compensation for Affected Persons as per the entitlements detailed in the Livelihood Restoration Framework (LRF);
- If feasible, the re-engagement or re-deployment of the existing workers into the new O&M regime or other KMDA facilities may be considered. In the event re-engagement or re-deployment of the workers does not take place, a Labour Management Framework (LMF) has been developed to address the potential loss of income.
- Ensure equitable participation of women in the workforce and decision-making. Gender specific mitigation measures have been detailed in the Gender Action Plan (GAP) developed for the project.
- Development of grievance redressal mechanism to receive and address any issues or concerns that might be reported by the neighbouring community.

To conclude, implementation of ESMP will help the Project to comply with national/state regulatory framework as well as to meet IFC requirement of the environmental and social performance.

APPENDIX A WABAG OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENTAL POLICY

OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENTAL POLICY

VA TECH WABAG LTD., as a market leader in the Indian water technology offers portfolio in the areas of municipal, industrial water and wastewater treatment, besides offering a full fledged state-of-the-art engineering services in line with global standards both in terms of quality and delivery.

VA TECH WABAG LTD., will undertake every reasonable effort to eliminate the hazards that cause incidents and injuries and aim to control or reduce wastage of natural resources, energy, materials and chemicals.

We shall strive to continually improve our Occupational Health, Safety and Environmental performance in our activities, products and services by implementing and maintaining the HSE Management Systems and by,

- Ensuring compliance with applicable legal and other requirements.
- Avoidance of incidents through prevention and safety awareness.
- Promotion of activities that could minimise environmental pollution.
- Optimising the utilisation of natural resources like energy, construction materials and reducing the waste generation.
- Promotion of measures aimed at enhancing the physical and emotional health of the people who work with or for our company.
- Creating awareness amongst our employees and stake holders by proactive communication, training and felicitation.
- Increasing green cover in and around the operational sites.

Mittal

Date : 23.08.2010

RAJIV MITTAL

APPENDIX B WABAG PROCESS DESIGN SPECIFICATIONS

sustainable solutions. for a better life. WABAG

PROJECT

POLLUTION ABATEMENT (INTERCEPTION AND DIVERSION WITH STP) WORKS FOR RIVER GANGA AT HOWRAH, BALLY AND BARANAGAR - KAMARAHATI MUNICIPAL TOWN IN WEST BENGAL INCLUDING 15 YEARS O&M BASED ON HYBRID ANNUITY BASED PPP MODE

IMPLEMENTING AGENCY

NATIONAL MISSION FOR CLEAN GANGA (NMCG)

PROJECT NO. & TENDER NO.

KMDA/WS/GAP/SE(N)/NIT-6/18-19 &
28 / SE (N)/GAP/W&S/KMDA of 2018-2019

CLIENT

KOLKATA METROPOLITAN DEVELOPMENT AUTHORITY (KMDA)

PROJECT ENGINEER

-

CONCESSIONAIRE

GANGA STP PROJECTS PRIVATE LIMITED

DOCUMENT TITLE

PROCESS DESIGN CALCULATION

BALLY SEWAGE TREATMENT PLANT

DOC. NUMBER	REV
10P153 - B0001 - 101	**0**

DISCIPLINE **PROCESS**

STAMPING AREA

REV. NO	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
0	2-Jul-19	Submitted for Approval	LK	RH	GG

REVISION HISTORY

TOTAL NO. OF SHEETS (INCLUDING THIS COVER) : 58

LIST OF HOLDs

HOLD N^{o}	PAGE N^{o}	DESCRIPTION

NOTES:

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NOTES:

1.0 INTRODUCTION

KOLKATA METROPOLITAN DEVELOPMENT AUTHORITY (KMDA) IN ASSOCIATION WITH NATIONAL MISSION FOR CLEAN GANGA (NMCG), HAS DECIDED TO IMPLEMENT THE **PROJECT** TITLED **"DEVELOPMENT OF SEWAGE TREATMENT PLANTS - KOLKATA INTEGRATED CITY AREA"** WHICH COMPRISES OF THE FOLLOWING COMPONENTS.

(I) CONSTRUCT, OPERATE AND MAINTAIN ONE STP AT BALLY WITH A PROPOSED CAPACITY OF 40 MLD

(II) RENOVATE, OPERATE AND MAINTAIN ONE EXISTING BALLY STP WITH A CAPACITY OF 22 MLD ALONG WITH BALLY ASSOCIATED INFRASTRUCTURE

(III) CONSTRUCT, OPERATE AND MAINTAIN ONE STP AT ARUPARA WITH A PROPOSED CAPACITY OF 65 MLD AND A SEPTAGE MANAGEMENT FACILITY OF 150 m^3 CAPACITY

(IV) RENOVATE, OPERATE AND MAINTAIN ARUPARA ASSOCIATED INFRASTRUCTURE

(V) CONSTRUCT, OPERATE AND MAINTAIN ONE STP AT BARANAGAR WITH A PROPOSED CAPACITY OF 60 MLD

(VI) RENOVATE, OPERATE AND MAINTAIN BARANAGAR ASSOCIATED INFRASTRUCTURE.

THIS DOCUMENT COVERS THE PROCESS DESIGN CALCULATIONS FOR BALLY SEWAGE TREATMENT PLANT TO BE CONSTRUCTED AS PART OF THIS **PROJECT**

THE OBJECTIVE OF THE DOCUMENT IS TO

- IDENTIFY THE SIZING CRITERIA CONSIDERED FOR EACH UNIT
- CALCULATE THE SIZE FOR EACH ITEM OF THIS SEWAGE TREATMENT PLANT

NOTES:

2.0 REFERENCES

1 MANUAL ON SEWERAGE AND SEWAGE TREATMENT, 3RD EDITION
CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANISATION (CPHEEO),
MINISTRY OF URBAN DEVELOPMENT, GOVERNMENT OF INDIA.

2 WASTE WATER ENGINEERING – TREATMENT AND REUSE, 4TH EDITION
METCALF & EDDY.
TATA MCGRAW HILL EDITION

3 HANDBOOK OF ENVIRONMENTAL ENGINEERING CALCULATIONS, 2ND EDITION
C. C. LEE AND SHUN DAR LIN
MC GRAW HILL EDITION

4 WASTEWATER TREATMENT PLANT - PLANNING, DESIGN AND OPERATION
SYED R QASIM
CRC PRESS

5 INDIAN STANDARD 14371 : 1996
MEASUREMENT OF LIQUID FLOW IN OPEN CHANNELS - PARSHALL AND SANIIRI FLUMES
BUREAU OF INDIAN STANDARDS

6 SCHEDULE 1-15 TENDER DOCUMENT

NOTES:

3.0 ACRONYMS, ABBREVATIONS AND DEFINITIONS

3.1 GENERAL ABBREVIATIONS

BOP	BOTTOM OF PIPE
C/S	CROSS SECTIONAL
CSA	CROSS SECTIONAL AREA
D/S	DOWNSTREAM
ID	INNER DIAMETER
I/L	INVERT LEVEL
KMDA	KOLKATA METROPOLITAN DEVELOPMENT AUTHORITY
LD	LIQUID DEPTH
MOC	MATERIAL OF CONSTRUCTION
MLSS	MIXED LIQUOR SUSPENDED SOLIDS
MLVSS	MIXED LIQUOR VOLATILE SUSPENDED SOLIDS
RAS	RETURN ACTIVATED SLUDGE
STP	SEWAGE TREATMENT PLANT
TS	TOTAL SOLIDS
U/S	UPSTREAM
WABAG	VA TECH WABAG LTD.
WAS	WASTE ACTIVATED SLUDGE

3.2 ACRONYMS FOR WASTEWATER CHARACTERISTICS

BOD	BIOCHEMICAL OXYGEN DEMAND
sBOD	SOLUBLE BIOCHEMICAL OXYGEN DEMAND
pBOD	PARTICULATE BIOLOGICAL OXYGEN DEMAND
COD	CHEMICAL OXYGEN DEMAND
DO	DISSOLVED OXYGEN
MPN	MOST PROBABLE NUMBER
TSS	TOTAL SUSPENDED SOLIDS
iTSS	INERT TOTAL SUSPENDED SOLIDS
VSS	VOLATILE SUSPENDED SOLIDS

3.3 ACRONYMS FOR WASTEWATER CHARACTERISTICS

°	ANGLE IN DEGREES
°C	DEGREE CELCIUS
atm	ATMOSPHERE
cm	CENTIMETER
cm²	SQUARE CENTI METER
d	DAY
g	GRAM
h	HOUR
J	JOULE
K	KELVIN
kg	KILO GRAMS
kJ	KILOJOULE

NOTES:

kN	KILO NEWTON
kPa	KILO PASCAL
kW	KILOWATT
L	LITER
LPH	LITRE PER HOUR
m	METRE
m²	SQUARE METER
m³	CUBIC METER
mg	MILLI GRAM
min	MINUTES
ML	MILLION LITRES
mL	MILLI LITRE
MLD	MILLION LITRES PER DAY
mm	MILLIMETER
mmWC	MILLIMETER OF WATER COLUMN
MT	METRIC TONNE
mWC	METER OF WATER COLUMN
Nos	NUMBERS
ppm	PARTS PER MILLION
s	SECONDS

NOTES:

4.0 CONVERSION FACTORS USED

ENERGY				
1 Watt - hour (W-h)	=	3.60	kiloJoule (kJ)	
1 Watt - Second (W-s)	=	1.00	Joule (J)	
FLOW				
1 Cubic Feet per Sec (ft^3/s)	=	0.03	Cubic metre per second (m^3/s)	
LENGTH				
1 foot	=	0.30	metre (m)	
1 inch	=	0.03	meter (m)	
POWER				
1 horsepower (hp)	=	0.75	kilowatt (kW)	
PRESSURE				
1 atmosphere (atm)	=	101.33	kilo Pascal (kPa)	
1 atmosphere (atm)	=	101.33	kilo Newton per Sq.m (kN / m^2)	
1 metre Water Column (mWC)	=	9810.00	N/m^2	
1 milli metre Water Column (mmWC)	=	9.81	N/m^2	
1 pound per square inch (psi)	=	6.89	kilo Pascal (kPa)	
TEMPERATURE				
1 degree Celcius (^oC)	=	C + 273.15	degree Kelvin (^oK)	
1 degree Fahrenheit(^oF)	=	0.555 (F-32)	degree Celcius (^oC)	

5.0 DESIGN BASIS

5.1 FLOW DATA

Reference:

AVERAGE FLOW (NOTE-2)		=	40	MLD
		=	40000	m^3/d
		=	1666.67	m^3/h
		=	0.463	m^3/s
PEAK FACTOR		=	2.25	
PEAK FLOW (NOTE-2)		=	90	MLD
		=	90000	m^3/d
		=	3750.00	m^3/h
		=	1.042	m^3/s
MINIMUM FLOW		=	20	MLD
		=	20000	m^3/d
		=	833.33	m^3/h
		=	0.231	m^3/s

5.2 RAW SEWAGE PARAMETERS

Reference: Schedule 10 : KPI

pH		=	6.5 - 8.0	
TOTAL SUSPENDED SOLIDS, TSS		=	< 600	
		=	600	mg/L
		=	37200	kg/d
BIOLOGICAL OXYGEN DEMAND, BOD		=	80 - 250	
		=	250	mg/L
		=	15500	kg/d
CHEMICAL OXYGEN DEMAND, COD		=	< 500	
		=	500	mg/L
		=	31000	kg/d
VOLATILE SUSPENDED SOLIDS, VSS		=	360	mg/L
		=	22320	kg/d
FECAL COLIFORMS	NOTE-1	=	10^7-10^8	MPN/100 mL
MINIMUM SEWAGE TEMPERATURE		=	20	^oC
MAXIMUM SEWAGE TEMPERATURE		=	30	^oC

NOTES:

1 AS PER CPHEEO MANUAL

2 THERE IS AN EXISTING TREATMENT FACILITY AT BALLY BASED ON WASTE STABILIZATION POND (W AND IS OF 30 MLD CAPACITY. THE PROPOSED 40 MLD STP IS TO BE ESTABLISHED AFTER CONVERSION OF THE PART OF THE WSP INTO USABLE LAND. THE REMAINING SECTION OF THE WSP WILL BE RETAINED FOR TREATING 22 MLD OF SEWAGE.

5.3 TREATED SEWAGE PARAMETERS

Reference: Schedule 10 : KPI

pH	=	6.5 - 9.0	
TOTAL SUSPENDED SOLIDS, TSS	<=	50	mg/L
BIOLOGICAL OXYGEN DEMAND, BOD	<=	20	mg/L
CHEMICAL OXYGEN DEMAND, COD	<=	100	mg/L
FECAL COLIFORMS	<=	1000	MPN/100 mL

5.4 DEWATERED SLUDGE CHARACTERISTICS

Reference: Schedule 10 : KPI

SLUDGE CONSISTENCY	>=	20%	
FECAL COLIFORMS	<=	2000000	MPN/g

5.5 SITE INFORMATION

AMBIENT TEMPERATURE	NOTE-1	MIN	=	15	deg C
	NOTE-1	MAX	=	45	deg C
	NOTE-1	AVE	=	25	deg C
RELATIVE HUMIDITY	NOTE-1	MIN	=		%
	NOTE-1	MAX	=		%
SITE ELEVATION			=	6	m

DETERMINATION OF ATMOSPHERIC PRESSURE

$$P_{atm,H} = P_{atm,0} \times \exp\left\{\frac{-gM(H-0)}{RT}\right\}$$

WHERE

$P_{atm,0}$	= ATMOSPHERIC PRESSURE AT ZERO ALTITUDE	=	101325	N/m²
g	= ACCELERATION DUE TO GRAVITY	=	9.81	m/s²
M	= MOLAR MASS OF AIR	=	28.97	kg/kg mole
H	= SITE ELEVATION	=	6.00	m
R	= UNIVERSAL GAS CONSTANT	=	8314.00	N.m/kgmole K
T	= SITE TEMPERATURE			

ATMOSPHERIC PRESSURE PREVAILING AT SITE (AT MINIMUM TEMPERATURE)	=	101253.0	N/m²
ATMOSPHERIC PRESSURE PREVAILING AT SITE (AT AVERAGE TEMPERATURE)	=	101255.4	N/m²
ATMOSPHERIC PRESSURE PREVAILING AT SITE (AT MAXIMUM TEMPERATURE)	=	101259.8	N/m²

NOTES:

1 AS PER METEROLOGICAL DATA FOR KOLKATA

6.0 INLET CHAMBER

INLET CHAMBER IS PROVIDED TO ARREST TURBULENCE

AVERAGE FLOW	=	62000	m³/d
	=	0.7176	m³/s
PEAK FLOW	=	139500	m³/d
	=	1.6146	m³/s
RETENTION TIME AT PEAK FLOW	=	10	s
VOLUME OF INLET CHAMBER REQUIRED	=	16.15	m³

DIMENSIONS OF INLET CHAMBER ARE ARRIVED TO ACCOMMODATE THE FINE SCREENS AND ISOLATION GATES

LIQUID DEPTH	**=**	**2.00**	**m**
LENGTH OF CHAMBER	**=**	**4.85**	**m**
WIDTH REQUIRED	=	1.67	m
WIDTH PROVIDED	**=**	**2.00**	**m**
FREEBOARD CONSIDERED	=	0.50	m
VOLUME PROVIDED	=	19.40	m³
RETENTION TIME PROVIDED	=	12	s

NOTES:

7.0 SCREEN CHAMBER

7.1 MECHANICAL SCREEN CHAMBER

TYPE MECHANICAL BAR, STEP TYPE SCREEN

DESIGN PEAK FLOW		=	139500	m³/d	
DESIGN AVERAGE FLOW		=	62000	m³/d	
DESIGN BASIS					
NO. OF WORKING UNITS		**=**	**2**	**Nos.**	
NO. OF STANDBY UNITS		**=**	**0**	**No.**	
ANGLE OF INCLINATION		=	40	°	
BAR WIDTH		=	2	mm	
BAR SPACING		=	6	mm	
MAX. VELOCITY THROUGH SCREENS		=	1.20	m/s	
SCREEN SIZING					
DESIGN PEAK FLOW THROUGH EACH SCREEN		=	0.8073	m³/s	
VELOCITY THROUGH SCREENS		=	1.2	m/s	
NET CLEAR AREA REQUIRED		=	0.68	m²	
LIQUID DEPTH CONSIDERED		=	1.10	m	
NET CLEAR WIDTH REQUIRED		=	0.6182	m	
NO. OF OPENINGS REQURIED		=	104	Nos.	
NO. OF OPENINGS CONSIDERED	NOTE-1	=	130	Nos.	HOLD-1
INSIDE WIDTH OF SCREEN		=	1.040	m	
SCREEN CHANNEL WIDTH REQUIRED		**=**	**1.500**	**m**	
FREE BOARD CONSIDERED		=	0.300	m	
TOTAL DEPTH OF SCREEN CHANNEL		=	1.400	m	
HORIZONTAL PROJECTION OF SCREEN	NOTE-1	=	3.800	m	
LENGTH UPSTREAM OF SCREEN		=	4.500	m	
LENGTH DOWNSTREAM OF SCREEN		=	1.500	m	
TOTAL LENGTH OF SCREEN CHANNEL REQUIRED		**=**	**9.800**	**m**	
DESIGN VALIDATION					
DESIGN PEAK FLOW		=	0.8073	m³/s	
NET CLEAR AREA FOR SCREENS		=	0.858	m	
VELOCITY THROUGH SCREENS		=	0.95	m/s	
		<=	1.2	m/s	Hence OK
VELOCITY IN APPROACH CHANNEL		=	0.49	m/s	
		>=	0.3	m/s	Hence OK

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 30

NOTES:

1 MANUFACTURER DATA TO BE FINALISED AS PER VENDOR RECOMMENDATION

HEAD LOSS THROUGH SCREEN AT CLEAN CONDITIONS

$$h_f = 0.0729\,(V_1^2 - v_2^2)$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 31

WHERE

V_1	=	VELOCITY THROUGH SCREENS	=	0.95	m/s
V_2	=	VELOCITY IN APPROACH CHANNEL	=	0.49	m/s

SUBSTITUTING THE VALUES,

HEAD LOSS THROUGH SCREEN AT CLEAN CONDITIONS	=	49	mm	

HEAD LOSS THROUGH SCREEN AT 50% CLOGGED CONDITIONS

$$h_f = 0.0729\,(V_1^2 - v_2^2)$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 31

WHERE

V_1	=	VELOCITY THROUGH SCREENS	=	1.9	m/s
V_2	=	VELOCITY IN APPROACH CHANNEL	=	0.49	m/s

SUBSTITUTING THE VALUES,

HEAD LOSS THROUGH SCREEN AT CLEAN CONDITIONS	=	246	mm	

7.2 MANUAL SCREEN CHAMBER

TYPE MANUAL BAR SCREEN

DESIGN PEAK FLOW	=	69750	m³/d
DESIGN AVERAGE FLOW	=	31000	m³/d

DESIGN BASIS

NO. OF WORKING UNITS	**=**	**1**	**No.**
NO. OF STANDBY UNITS	**=**	**0**	**No.**
ANGLE OF INCLINATION	=	45	°
BAR WIDTH	=	5	mm
BAR SPACING	=	6	mm
MAX. VELOCITY THROUGH SCREENS	=	1.20	m/s

SCREEN SIZING

DESIGN PEAK FLOW THROUGH EACH SCREEN	=	0.8073	m³/s
VELOCITY THROUGH SCREENS	=	1.2	m/s
NET CLEAR AREA REQUIRED	=	0.68	m²
LIQUID DEPTH CONSIDERED	=	1.10	m
NET CLEAR WIDTH REQUIRED	=	0.6182	m
NO. OF OPENINGS REQURIED	=	104	Nos.
NO. OF OPENINGS CONSIDERED	=	127	Nos.
INSIDE WIDTH OF SCREEN	=	1.402	m
SCREEN CHANNEL WIDTH REQUIRED	**=**	**1.450**	**m**
FREE BOARD CONSIDERED	=	0.300	m
TOTAL DEPTH OF SCREEN CHANNEL	=	1.400	m
HORIZONTAL PROJECTION OF SCREEN	=	1.400	m
LENGTH UPSTREAM OF SCREEN	=	6.900	m
LENGTH DOWNSTREAM OF SCREEN	=	1.500	m
TOTAL LENGTH OF SCREEN CHANNEL REQUIRED	**=**	**9.800**	**m**

DESIGN VALIDATION

DESIGN PEAK FLOW	=	0.8073	m³/s	
NET CLEAR AREA FOR SCREENS	=	0.8382	m	
VELOCITY THROUGH SCREENS	=	0.97	m/s	
	<=	1.2	m/s	Hence OK
VELOCITY IN APPROACH CHANNEL	=	0.51	m/s	
	>=	0.3	m/s	Hence OK

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 30

NOTES:

1 MANUFACTURER DATA TO BE FINALISED AS PER VENDOR RECOMMENDATION

HEAD LOSS THROUGH SCREEN AT CLEAN CONDITIONS

$$h_f = 0.0729\,(V_1^2 - v_2^2)$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 31

WHERE

V_1	=	VELOCITY THROUGH SCREENS	=	0.97	m/s
V_2	=	VELOCITY IN APPROACH CHANNEL	=	0.51	m/s

SUBSTITUTING THE VALUES,

HEAD LOSS THROUGH SCREEN AT CLEAN CONDITIONS			=	50	mm

HEAD LOSS THROUGH SCREEN AT 50% CLOGGED CONDITIONS

$$h_f = 0.0729\,(V_1^2 - v_2^2)$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 31

WHERE

V_1	=	VELOCITY THROUGH SCREENS	=	1.94	m/s
V_2	=	VELOCITY IN APPROACH CHANNEL	=	0.51	m/s

SUBSTITUTING THE VALUES,

HEAD LOSS THROUGH SCREEN AT CLEAN CONDITIONS			=	256	mm

NOTES:

8.0 GRIT CHAMBER

TYPE : DETRITOR TYPE WITH INTEGRAL GRIT CLASSIFIER

DESIGN BASIS

DESIGN PEAK FLOW	=	139500	m³/d
DESIGN AVERAGE FLOW	=	62000	m³/d
NO. OF WORKING UNITS	**=**	**2**	**Nos.**
NO. OF STANDBY UNITS	**=**	**0**	**No.**
MINIMUM SEWAGE TEMPERATURE	=	20	°C
SIZE OF GRIT PARTICLE	=	0.20	mm
REMOVAL EFFICIENCY REQUIRED	=	95%	
SPECIFIC GRAVITY OF GRIT PARTICLE	=	2.65	

SURFACE OVERFLOW RATE

FOR PARTICLE SIZE OF PARTICLE TO BE REMOVED BETWEEN 0.15 mm TO 0.20 mm HAZEN'S MODIFIED FORMULA TO BE USED

$$V_s = 60.6 \times (S_s - 1) \times d \times \frac{3T+70}{100}$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 40

WHERE

S_s	=	SPECIFIC GRAVITY OF PARTICLE	=	2.65	
d	=	DIA OF PARTICLE	=	0.02	cm
T	=	MINIMUM TEMPERATUER OF SEWAGE	=	20	°C

SUBSTITUTING THE VALUES

V_S = 60.6 x (2.65 - 1) x 0.02 x [(3 x 20 + 70) / 100]

SETTLING VELOCITIES OF PARTICLES, V_s	=	2.60	cm/s
	=	2246.4	m³/m²/d

HOWEVER, PERFORMANCE OF GRIT CHAMBER VARIES DUE TO TURBULENCE AND SHORT CIRCUITING RESULTING FROM EDDY, WIND AND DENSITY CURRENTS. HENCE ACTUAL PERFORMANCE OF GRIT CHAMBER IS TO BE CORRECTED BASED ON BASIN PERFORMANCE AS GIVEN BELOW

$$\eta = 1 - \left(1 + \frac{nV_S}{V_o}\right)^{-1/n}$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 40

WHERE

h	=	EFFICIENCY REQUIRED	=	95%	
n	=	BASIN PERFORMANCE INDEX (VERY GOOD)	=	0.125	

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 40

V_s	=	SETTLING VELOCITIES OF PARTICLES	=	2246.4	m³/m²/d

SUBSTITUTING AND REARRANGING THE VALUES

V_o = [0.125 x 2246.4] / { [(1 - 0.95) ^ (- 0.125)] - 1 }

SURFACE OVERFLOW RATE REQUIRED, V_o	=	618.3	m³/m²/d

NOTES:

DETRITOR SIZING

DESIGN FLOW PER UNIT	= 69750	m³/d
SURFACE OVERFLOW RATE REQUIRED	= 618.3	m³/m²/d
HENCE,		
SURFACE AREA REQUIRED	= 112.81	m²
SIZE OF GRIT CHAMBER REQUIRED	= 10.63	m
SIZE OF GRIT CHAMBER PROVIDED	**= 10.70**	**m**
LIQUID DEPTH CONSIDERED	**= 0.80**	**m**
FREEBOARD CONSIDERED	**= 0.30**	**m**

CRITICAL DISPLACEMENT VELOCITY

CRITICAL DISPLACEMENT VELOCITY TO INITIATE RE-SUSPENSION OF GRIT IS DERIVED FROM MODIFIED SHIELD'S FORMULA

$$V_c = K_c \times \sqrt{g \times (S_s - 1) \times d}$$

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 40

WHERE

K_c	=	CRITICAL DISPLACEMENT CO-EFFICIENT	= 4		
g	=	ACCELERATION DUE TO GRAVITY	= 9.81	m/s²	
S_s	=	SPECIFIC GRAVITY OF GRIT PARTICLE	= 2.65		
d	=	DIA OF GRIT PARTICLE	= 0.00020	m	

SUBSTITUTING THE VALUES

V_c = 4 x { [9.81 x (2.65 - 1) x 0.0002] ^ 0.5 }

CRITICAL DISPLACEMENT VELOCITY, V_c = 0.23 m/s

HORIZONTAL VELOCITY OF FLOW

HORIZONTAL VELOCITY OF FLOW SHOULD BE LESS THAN CRITICAL DISPLACEMENT VELOCITY

DESIGN FLOW	= 69750	m³/d	
SIZE OF GRIT CHAMBER	= 10.70	m	
LIQUID DEPTH OF GRIT CHAMBER	= 0.80	m	
HORIZONTAL VELOCITY OF FLOW, V_h	= 0.095	m/s	
	< 0.23	m/s	Hence OK

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 42

NOTES:

9.0 PARSHALL FLUME

Reference : Measurement of Liquid Flow in open channels - Parshall and Saniiri Flumes - IS 14371:1996

DESIGN BASIS

NO. OF WORKING UNITS	**=**	**1**	**No.**
NO. OF STANDBY UNITS	**=**	**0**	**No.**
FREEBOARD CONSIDERED	=	0.30	m
THROAT WIDTH CONSIDERED	**=**	**1.20**	**m**

DESIGN FLOW

		MIN	**NOR**	**MAX**	
FLOW	=	31	62	139.5	MLD
	=	31000	62000	139500	m³/d
	=	0.3588	0.7176	1.6146	m³/s
NO. OF WORKING UNITS	=	1	1	1	No.
DESIGN FLOW PER UNIT	=	0.3588	0.7176	1.6146	m³/s

DISCHARGE RANGE OF PARSHALL FLUME FOR SELECTED THROAT WIDTH: > = 0.04 m³/s and < = 2 m³/s

DISCHARGE EQUATION OF PARSHALL FLUME

$$Q = C H_a^n$$

Reference : Measurement of Liquid Flow in open channels - Parshall and Saniiri Flumes - IS 14371:1996

WHERE

Q	= FREEFLOW DISCHARGE THROUGH FLUME, m³/s		
C	= DISCHARGE CONSTANT	=	2.904
n	= DISCHARGE CO-EFFICIENT	=	1.577
H_a	= LIQUID DEPTH IN CONVERGING SECTION OF FLUME, m		

SUBTITUTING THE VALUES IN DISCHARGE EQUATION FOR VARIOUS FLOW SCENARIOS

		MIN	**NOR**	**MAX**	
FREE FLOW DISCHARGE THROUGH FLUME	=	0.3588	0.7176	1.6146	m³/s
LIQUID DEPTH IN CONVERGING SECTION OF FLUME	=	0.266	0.413	0.69	m
RATIO OF LIQUID DEPTH, H_b/H_a RATIO	=	0.70	0.70	0.70	

Reference : Measurement of Liquid Flow in open channels - Parshall and Saniiri Flumes - IS 14371:1996

LIQUID DEPTH DOWNSTREAM	=	0.180	0.280	0.480	m

NOTES:

APPROACH CHANNEL

WIDTH OF APPROACH CHANNEL	=	2.00	m
LIQUID DEPTH IN APPROACH CHANNEL	=	0.790	m
MAXIMUM DESIGN FLOW PER UNIT	=	1.6146	m³/s

FROUDE NUMBER OF THE APPROACH CHANNEL SHOULD BE LESS THAN 0.5

Reference : Measurement of Liquid Flow in open channels - Parshall and Saniiri Flumes - IS 14371:1996

$$Froude\ Number = \frac{V}{\left(g \times \frac{A}{w}\right)^{0.5}}$$

WHERE

V	=	VELOCITY OF FLOW IN APPROACH CHANNEL	=	1.03	m/s
g	=	ACCELERATION DUE TO GRAVITY	=	9.810	m/s²
A	=	AREA OF FLOW IN APPROACH CHANNEL	=	1.580	m²
W	=	WIDTH OF APPROACH CHANNEL	=	2.00	m

SUBSTITUTING THE VALUES,

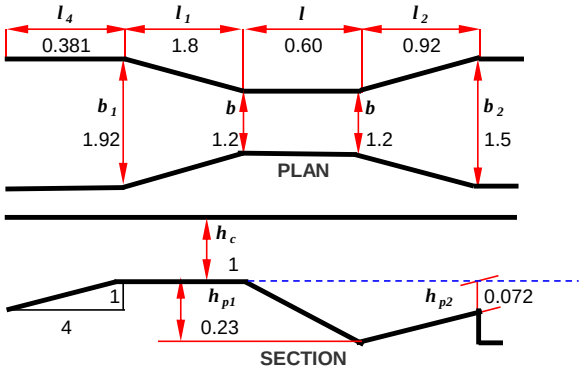
FROUDE NUMBER	=	0.37	
	<=	0.5	Hence OK

DESIGN SUMMARY

FLUME FLOW RANGE, m³/s			
Min	0.040	Max	2.00
FLUME DIMENSIONS, m			
l_e	1.836	l	0.600
l_1	1.800	l_2	0.920
b_2	1.500	h_{p2}	0.072
b_1	1.920	h_{p1}	0.230
h_c	1.000	l_4	0.381
b	1.200	FL	1.288

CHANNEL DIMENSIONS, m			
	U/S	FLUME	D/S
LD	0.790	--	0.790
WIDTH	2.00	1.20	2.00
LENGTH	12.00	3.32	6.00

PARSHALL FLUME DIMENSIONAL SKETCH



Reference : IS 14371:1996

TOTAL LENGTH OF PARSHALL FLUME CHANNEL = 21.40 m

NOTES:

10.0 PRIMARY TREATMENT

PRIMARY TREATMENT IS PROVIDED TO REMOVE THE SETTABLE SOLIDS.
RETURN FLOW FROM DIGESTER AND CENTRIFUGE ARE RECEIVED AT PRIMARY CLARIFIER
EXCESS SLUDGE FROM SECONDARY TREATMENT IS ALSO RECEIVED AT SECONDARY CLARIFIER

MASS BALANCE

RAW SEWAGE AVERAGE FLOW	=	62000.00	m³/d
RETURN FLOW	=	450	m³/d
EXCESS SLUDGE FLOW	=	1000	m³/d
PRIMARY INLET AVERAGE FLOW	=	63450.00	m³/d
RAW SEWAGE PEAK FLOW	=	139500.00	m³/d
RETURN FLOW	=	450	m³/d
EXCESS SLUDGE FLOW	=	1000	m³/d
PRIMARY INLET PEAK FLOW	=	140950.00	m³/d

		RAW SEWAGE	RETURN FLOW	EXCESS SLUDGE	PRIMARY INLET
AVG. FLOW m³/d		62000.00	450.00	1000.00	63450.00
TSS	mg/l	600.00	5800.00	8040	754.14
	kg/d	37200	2610.00	8040.00	47850.0
BOD	mg/l	250.00	1442.23	2105	287.7
	kg/d	15500	649.00	2105.00	18254.0
VSS	mg/l	360.00	2242.23	3349	420.46
	kg/d	22320	1009.00	3349.00	26678.0

10.1 PRIMARY DISTRIBUTION CHAMBER

DISTRIBUTION CHAMBER IS INTEGRAL PART OF PRIMARY CLARIFIER ARRANGEMENT.
FLOW ENTERS PRIMARY CLARIFIER THROUGH OPENING PROVIDED IN THE FEED CHANNEL.
ISOLATION GATES ARE PROVIDED AT THE INLET OF EACH CLARIFIER TO FACILITATE MAINTENANCE

NOTES:

10.1 PRIMARY CLARIFIER

TYPE LAMELLA CLARIFIER WITH INTEGRAL THICKENER ARRANGEMENT

DESIGN AVERAGE FLOW	=	63450.00	m³/d
DESIGN PEAK FLOW	=	140950.00	m³/d
NO. OF UNITS	**=**	**2**	**Nos.**
SURFACE LOADING RATE ON PLATES AT AVERAGE FLOW	=	30	m³/m²/d
SURFACE LOADING RATE ON PLATES AT PEAK FLOW	=	60	m³/m²/d

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 53

PLATE AREA REQUIRED PER UNIT AT AVERAGE FLOW	=	1057.5	m²
PLATE AREA REQUIRED PER UNIT AT PEAK FLOW	=	1174.584	m²
HENCE, DESIGN PLATE AREA REQUIRED PER UNIT	=	1174.584	m²

PLATE DIMENSIONS

LENGTH OF PLATE	**=**	**2.00**	**m**
WIDTH OF PLATE	**=**	**1.20**	**m**
THICKNESS OF PLATE	**=**	**2**	**mm**
MATERIAL OF CONSTRUCTION	=	PVC	
ANGLE OF INCLINATION FOR PLATE	=	55	Deg
PROJECTED AREA OF ONE PLATE	=	2 X 1.2 X Cos 55°	
	=	1.3766	m²

LENGTH OF CLARIFIER

NO. OF PLATES REQUIRED PER UNIT	=	853.3	Nos.
NO. OF ROWS CONSIDERED	=	8	Nos.
NO. OF PLATES REQUIRED PER ROW	=	107	Nos.
VERTICAL SPACING PROVIDED BETWEEN PLATES	=	84	mm
HORIZONTAL CENTRE-TO-CENTRE PLATE SPACING	=	(84 + 2) / Sin 55°	
	=	105	mm
CLEARANCE PROVIDED TO ACCOMMODATE PLATES	=	1.25	m
INCLINATION SPACE FOR PLATES	=	2 X Cos 55°	
	=	1.15	m
LENGTH OF THE UNIT REQUIRED	=	13.53	m
LENGTH OF THE UNIT CONSIDERED	**=**	**13.70**	m
NO. OF PLATES CONSIDERED	=	108	Nos.
SURFACE LOADING RATE PROVIDED	=	26.67	Nos
SURFACE LOADING RATE PROVIDED	=	59.25	Nos.

NOTES:

	WIDTH OF CLARIFIER			
	WIDTH OF THE CLARIFIER CONSIDERED	**=**	**13.70**	**m**
	WALL THICKNESS OF LAUNDERS	=	0.25	m
	WIDTH OF LAUNDER	=	0.64	m
	NO. OF SUPPORTS	=	7	Nos.
	WIDTH OF SUPPORT	=	0.23	m
	WIDTH OF CENTRAL SUPPORT	=	0.94	**m**
	DEPTH OF CLARIFIER			
	HORIZONTAL VELOCITY BELOW PLATES	=	0.03	m/s
	HORIZONTAL AREA REQUIRED BELOW PLATES	=	12.24	m^2
	WIDTH OF THE CLARIFIER PROVIDED	=	13.700	m
	HENCE, DEPTH REQUIRED BELOW PLATES	=	0.90	m
	SPACE REQUIRED ABOVE PLATES	=	0.90	m
	VERTICAL HEIGHT OF PLATES	=	2 X Sin 55°	
		=	1.64	m
	SPACE REQUIRED FOR SLUDGE COMPRESSION	=	2.40	m
	SPACE REQUIRED FOR SLUDGE SCRAPPER	=	0.20	m
	HENCE, TOTAL SIDE WATER DEPTH REQUIRED	=	6.04	m
	SIDE WATER DEPTH PROVIDED	**=**	**6.10**	**m**
	FREEBOARD CONSIDERED	=	0.30	m
	TYPE OF SLUDGE COLLECTION	=	CENTRAL SCRAPPER	
	DIA OF SLUDGE HOPPER AT BOTTOM	=	1	m
	SLOPE OF HOPPER	=	1 in	12
	HEIGHT OF HOPPER PROVIDED	**=**	**0.53**	**m**

NOTES:

SLUDGE BALANCE

DESIGN AVERAGE FLOW	=	63450.00	m³/d
TSS FROM RAW SEWAGE	=	37200.0	kg/d
TSS FROM RETURN FLOWS	=	2610.0	kg/d
TSS FROM EXCESS SLUDGE	=	8040.0	kg/d
TSS REDUCTION FROM RAW SEWAGE AND RETURN FLOWS	=	60%	
TSS REDUCTION FROM EXCESS SLUDGE	=	60%	
THICKENED SLUDGE CONSISTENCY	=	6%	
THICKENED SLUDGE DENSITY	=	1020	kg/m³
THICKENED SLUDGE SOLIDS	=	28710	kg/d
HENCE, THICKENED SLUDGE FLOWRATE	=	469.12	m³/d
BOD FROM RAW SEWAGE	=	15500.0	kg/d
BOD FROM RETURN FLOWS	=	649.0	kg/d
BOD FROM EXCESS SLUDGE	=	2105.0	kg/d
BOD REDUCTION FROM RAW SEWAGE AND RETURN FLOWS	=	30%	
BOD REDUCTION FROM EXCESS SLUDGE	=	60%	
BOD IN THICKENED SLUDGE	=	6108.00	kg/d
VSS FROM RAW SEWAGE	=	22320.0	kg/d
VSS FROM RETURN FLOWS	=	1009.0	kg/d
VSS FROM EXCESS SLUDGE	=	3349.0	kg/d
VSS REDUCTION FROM RAW SEWAGE AND RETURN FLOWS	=	60%	
VSS REDUCTION FROM EXCESS SLUDGE	=	60%	
VSS IN THICKENED SLUDGE	=	16007.00	kg/d

MASS BALANCE

		PRIMARY INLET	THICKENED SLUDGE	PRIMARY OUTLET
FLOWRATE	m³/d	63450.00	469.12	62980.88
TSS	mg/l	754.14	61199.7	303.91
	kg/d	47850.00	28710.00	19140.0
BOD	mg/l	287.70	13020.13	192.86
	kg/d	18254.00	6108.00	12146.0
VSS	mg/l	420.46	34121.34	169.44
	kg/d	26678.00	16007.00	10671.0

NOTES:

NO. OF BATCHES FOR SLUDGE WITHDRAWAL	=	24	Nos.
TIME INTERVALE BETWEEN EACH BATCH	=	60.00	min
BATCH VOLUME	=	9.774	m^3
DURATION OF SLUDGE WITHDRAWAL PER BATCH	=	5.00	min
HENCE,			
SLUDGE WITHDRAWAL FLOWRATE	=	117.29	m^3/h
SLUDGE PIPE SIZE	=	150	mm
VELOCITY IN SLUDGE PIPELINE	=	1.84	m/s

SLUDGE WITHDRAWAL FROM CLARIFIER WILL BE CONTROLLED BASED ON TIMER.

MASS BALANCE		PRIMARY OUTLET	POND INLET	AERATION INLET
FLOWRATE	m^3/d	62980.88	22000.00	40980.88
TSS	mg/l	303.91	303.91	303.90
	kg/d	19140.00	6686.02	12453.98
BOD	mg/l	192.86	192.86	192.85
	kg/d	12146.00	4242.92	7903.08
VSS	mg/l	169.44	169.44	169.43
	kg/d	10671.00	3727.68	6943.32

11.0 AERATION TANK

AVERAGE FLOW	=	40980.88	m³/d
PEAK FLOW	=	90980.88	m³/d

INFLUENT CHARACTERISTICS

BOD	=	192.86	mg/l
TSS	=	303.91	mg/l
VSS	=	169.44	mg/l

EFFLUENT CHARACTERISTICS DESIRED

BOD	=	15	mg/l
TSS	=	20	mg/l
VSS	=	12	mg/l

DESIGN BASIS

TYPE CONVENTIONAL ACTIVATED SLUDGE PROCESS

NO. OF BASINS	**=**	**2**	**Nos.**
MLSS CONCENTRATION	=	3000	mg/l
MLVSS / MLSS RATIO	=	0.80	
MLVSS CONCENTRATION	=	2400	mg/l

VOLUME OF AERATION TANK

$$V = \frac{Y \times Q \times (S_O - S) \times \theta_C}{\{(1 + k_d \times \theta_c) \times X_V\}}$$

WHERE

Y	=	YIELD CO-EFFICIENT	=	0.5	g VSS / g BOD
Q	=	DESIGN FLOW	=	40980.88	m³/d
S_o	=	INLET BOD CONCENTRATION	=	192.86	mg/L
S	=	OUTLET BOD CONCENTRATION	=	15	mg/L
θ_c	=	SLUDGE RETENTION TIME	=	6	d
k_d	=	DECAY COEFFICIENT	=	0.06	d^{-1}
X_v	=	MLVSS CONCENTRATION IN AERATION TANK	=	2400	mg/L

SUBSTITUTING THE VALUES

V = [0.5 x 40980.88 x (192.86 - 15) x 6] / [(1 + 0.06 x 6) x 2400]

TOTAL VOLUME OF AERATION TANK REQUIRED	=	6699.32	m³
NO. OF TANKS	=	2	Nos.
VOLUME OF EACH TANK REQUIRED	=	3350	m³
LIQUID DEPTH	**=**	**5.65**	**m**
WIDTH OF AERATION TANK	**=**	**30.50**	**m**
LENGTH OF AERATION TANK REQUIRED	=	19.45	m
LENGTH OF AERATION TANK PROVIDED	**=**	**19.80**	**m**
FREEBOARD CONSIDERED	**=**	**0.50**	**m**
TOTAL DEPTH OF AERATION TANK PROVIDED	=	6.15	m

NOTES:

VOLUME OF EACH AERATION TANK PROVIDED				=	3412.04	m³
HYDRAULIC RETENTION PROVIDED				=	4	h

FOOD TO MICROORGANISM RATIO

$$F/M = \frac{Q\,S_O}{V\,X}$$

WHERE

Q	=	DESIGN FLOW	=	40980.88	m³/d
S_o	=	INLET BOD CONCENTRATION	=	192.86	mg/L
V	=	VOLUME OF AEARATION TANK	=	6824.08	m³
X	=	MLSS CONCENTRATION IN AERATION TANK	=	3000	mg/L

SUBSTITUTING THE VALUES

F/M = (40980.88 x 192.86) / (6824.08 x 3000)

F/M RATIO	=	0.3861	kg BOD / kg MLSS . d

OBSERVED YIELD

$$Y_{OBS} = \frac{Y}{(1 + k_d\theta_c)}$$

WHERE

Y	=	YIELD CO-EFFICIENT	=	0.5	g VSS / g BOD
θ_c	=	SLUDGE RETENTION TIME	=	6	d
k_d	=	DECAY COEFFICIENT	=	0.06	d^{-1}

SUBSTITUTING THE VALUES

Y_{OBS} = 0.5 / [1 + (0.06 x 6)]

OBSERVED YIELD	=	0.3680	g VSS / g BOD

BIOMASS GENERATED

$$P_{X,TSS} = \frac{Y_{OBS} \times Q \times (S_0 - S)}{0.8} + Q \times (TSS_{in} - VSS_{in})$$

WHERE

Y_{OBS}	=	OBSERVED YIELD	=	0.3680	g VSS / g BOD
Q	=	DESIGN FLOW RATE	=	40980.88	m³/d
S_o	=	INLET BOD CONCENTRATION	=	192.86	mg/L
S	=	OUTLET BOD CONCENTRATION	=	15	mg/L
TSS_{in}	=	INLET TSS CONCENTRATION	=	303.91	mg/L
VSS_{in}	=	INLET VSS CONCENTRATION	=	169.44	mg/L

SUBSTITUTING THE VALUES

$P_{X,TSS}$ = { { [0.368 x 40980.88 x (192.86 - 15)] / 0.8 } + { 40980.88 x (303.91 - 169.44) } } / 1000

$P_{X,TSS}$	=	8863.58	kg/d

NOTES:

OXYGEN REQUIREMENT

$$R_O = \frac{Q \times (S_0 - S)}{f} - 1.42 \times Q \times Y_{OBS} \times (S_0 - S)$$

WHERE

Q	=	DESIGN FLOW RATE	=	40980.88	m³/d
S_o	=	INLET BOD CONCENTRATION	=	192.86	mg/L
S	=	OUTLET BOD CONCENTRATION	=	15	mg/L
f	=		=	0.68	
Y_{OBS}	=	OBSERVED YIELD	=	0.3680	g VSS / g BOD

SUBSTITUTING THE VALUES

R_O = { { [40980.88 x (192.86 - 15)] / 0.68 } - { 1.42 x 40980.88 x 0.368 x (192.86 - 15) } } / 1000

OXYGEN REQUIRED	6911	kg/d
INLET BOD	192.86	mg/l
OUTLET BOD	15.00	mg/l
BOD REMOVED	7289.00	kg/d
OXYGEN REQUIRED FOR BOD REMOVAL	1.00	kg O_2 / kg BOD
OXYGEN REQUIRED FOR BOD REMOVAL	7289	kg/d
OXYGEN PROVIDED	7289	kg/d

DESIGN VALIDATION

MLSS CONCENTRATION	3000	mg/l
	1500-3000	mg/l
SOLIDS RETENTION TIME	6.00	d
	5-8	d
HYDRAULIC RETENTION TIME	4.00	h
	4-6	h
F/M RATIO	0.386	kg BOD / kg MLSS.d
	0.3-0.4	kg BOD / kg MLSS.d
OXYGEN PROVIDED	1.00	kg O_2 / kg BOD_r
	0.8-1.0	kg O_2 / kg BOD_r

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 64

TREATED SEWAGE FROM AERATION TANK OVERFLOWS THROUGH A WEIR INTO AERATION EFFLUENT CHANNEL WHICH IN TURN ACTS AS DISTRIBUTION CHAMBER FOR SECONDARY CLARIFIER

NOTES:

12.0 AERATION AIR REQUIREMENT

OXYGEN REQUIRED	=	7289.00	kg/d	
AERATION TIME	=	24.00	h	
NO. OF BASINS	=	2	Nos.	
AERATION REQUIRED PER BASIN	=	151.86	kg/h	

DESIGN DATA

MAXIMUM LIQUID TEMPERATURE	=	20.00	30.00	°C
PERCENT OXYGEN CONCENTRATION IN BASIN	=	17.95	17.95	%

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 429

SITE TEMPERATURE	=	15.00	45.00	°C
ALTITUTE OF THE PLANT SITE	=	6.00	6.00	m
ATMOSPHERIC PRESSURE AT ZERO ALTITUDE, $P_{atm,0}$	=	101.30	101.30	kPa
DO CONCENTRATION IN TANK, C_L	=	1.00	1.00	mg/l

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 69

ALPHA	=	0.65	0.65	

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 430

BETA	=	0.95	0.95	

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 430

FOULING FACTOR	=	0.90	0.90	

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 430

DETERMINATION OF ATMOSPHERIC PRESSURE AT ALTITUDE

$$P_{atm,H} = P_{atm,0} \times \exp\left\{\frac{-gM(H-0)}{RT}\right\}$$

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 1738

WHERE

$P_{atm,0}$	=	ATMOSPHERIC PRESSURE AT ZERO ALTITUDE	=	101	101	kPa
g	=	ACCELERATION DUE TO GRAVITY	=	9.81	9.81	m/s²
M	=	MOLAR MASS OF AIR	=	28.97	28.97	kg/kg mole
H	=	SITE ELEVATION	=	6.00	6.00	m
R	=	UNIVERSAL GAS CONSTANT	=	8314.00	8314.00	N.m/kgmole K
T	=	SITE TEMPERATURE	=	288.15	318.15	deg K

SUBSTITUING THE VALUES

$P_{atm,H}$	=	101.3 x exp { [- 9.81 x 28.97 x (6 - 0)] / [8314 x 288.15] }
$P_{atm,H}$	=	101.3 x exp { [- 9.81 x 28.97 x (6 - 0)] / [8314 x 318.15] }

ATMOSPHERIC PRESSURE AT SITE ALTITUDE, $P_{atm,H}$	=	101.23	101.24	kPa

NOTES:

DETERMINATION OF ATMOSPHERIC PRESSURE AT POINT OF RELEASE

LIQUID DEPTH IN AERATION TANK	=	5.650	5.650 m
DIFFUSER SUBMERGENCE	=	0.300	0.300 m
EFFECTIVE AERATION DEPTH	=	5.350	5.350 m
PRESSURE EQUIVALENT TO WATER COLUMN	=	5.35 x 9810 / 1000	
	=	52.48	52.48 kPa
PRESSURE AT DEPTH OF RELEASE, P_d	=	153.71	153.72 kPa

DETERMINATION OF DISSOLVED OXYGEN SATURATION CONCENTRATION IN CLEAN WATER

OXYGEN SATURATION CONCENTRATION $C_{s,T}$	=	9.08	7.54 mg/l

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 1745

$$C_{S,T,H} = C_{S,T} \times \exp\left\{\frac{-gM(H-0)}{RT}\right\}$$

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 430

WHERE

$C_{s,T}$	=	OXYGEN SATURATION CONCENTRATION	=	9.08	7.54 mg/l
g	=	ACCELERATION DUE TO GRAVITY	=	9.81	9.81 m/s²
M	=	MOLAR MASS OF AIR	=	28.97	28.97 kg/kg mole
H	=	SITE ELEVATION	=	6.00	6.00 m
R	=	UNIVERSAL GAS CONSTANT	=	8314.00	8314.00 N.m/kgmole K
T	=	SITE TEMPERATURE	=	288.15	318.15 deg K

SUBSTITUING THE VALUES

$C_{s,T,H}$	=	9.08 x exp { [- 9.81 x 28.97 x (6 - 0)] / [8314 x 288.15] }
$C_{s,T,H}$	=	7.54 x exp { [- 9.81 x 28.97 x (6 - 0)] / [8314 x 318.15] }

DISSOLVED OXYGEN SATURATION CONCENTRATION IN CLEAN WATER	=	9.08	7.54 mg/l
AT ALTITUDE H AND TEMPERATURE T, $C_{s,T,H}$			

DETERMINATION OF AVERAGE DISSOLVED OXYGEN SATURATION CONCENTRATION IN AERATION TANK

$$C_{\hat{S},T,H} = C_{S,T,H} \times \left(\frac{1}{2}\right) \times \left\{\left(\frac{P_d}{P_{atm,H}}\right) + \left(\frac{O_t}{21}\right)\right\}$$

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 430

WHERE

$C_{s,T,H}$	=	OXYGEN SATURATION CONCENTRATION	=	9.08	7.54 mg/l
P_d	=	PRESSURE AT DEPTH OF RELEASE	=	153.71	153.72 kPa
$P_{atm,H}$	=	ATMOSPHERIC PRESSURE AT SITE ALTITUDE	=	101.23	101.24 kPa
O_t	=	PERCENT OXYGEN LEAVING THE TANK	=	17.95	17.95 %

SUBSTITUTING THE VALUES

$C_{\hat{s},T,H}$	=	9.08 x (1 / 2) x { (153.7135 / 101.23) + (17.95 / 21) }
$C_{\hat{s},T,H}$	=	7.54 x (1 / 2) x { (153.7235 / 101.24) + (17.95 / 21) }

AVERAGE OXYGEN CONCENTRATION AT DEPTH OF RELEASE	=	10.78	8.95 mg/l

NOTES:

DETERMINATION OF STANDARD OXYGEN TRANSFER RATE

$$SOTR = \frac{AOTR}{\left\{\left(\frac{\beta . C_{\hat{S},T,H} - C_L}{C_{S,20}}\right) \times 1.024^{T-20} \times \alpha \times F\right\}}$$

Reference : Waste Water Engineering – Treatment and Reuse, 4th Edition, Metcalf & Eddy, Page no. 430

WHERE

AOTR	= ACTUAL OXYGEN TRANSFER RATE REQUIRED	151.86	151.86	kg/h
β	= SALINITY SURFACE TENSION CORRECTION FACTOR	0.95	0.95	
$C_{\hat{S},T,H}$	= AVERAGE OXYGEN CONCENTRATION	10.78	8.95	mg/l
C_L	= OPERATING DISSOLVED OXYGEN CONCENTRATION	1.00	1.00	mg/l
$C_{s,20}$	= DISSOLVED OXYGEN CONCENTRATION AT 20 DEG C	9.08	9.08	mg/l
T	= OPERATING TEMPERATURE	20.00	30.00	deg C
α	= OXYGEN TRANSFER CORRECTION FACTOR FOR WASTWATER	0.65	0.65	
F	= FOULING FACTOR	0.90	0.90	

SUBSTITUTING THE VALUES

SOTR = 151.86 / { [((0.95 x 10.78) - 1) / 9.08] x [1.024 ^ (20 - 20)] x 0.65 x 0.9 }

SOTR = 151.86 / { [((0.95 x 8.95) - 1) / 9.08] x [1.024 ^ (30 - 20)] x 0.65 x 0.9 }

STANDARD OXYGEN TRANSFER RATE REQUIRED	255.07	247.84	kg/h

DETERMINATION OF AERATION AIR REQUIRED

STANDARD OXYGEN TRANSFER RATE REQUIRED	255.07	247.84	kg/h
STANDARD OXYGEN TRANSFER EFFICIENCY	26.75%	26.75%	
FRACTION OF OXYGEN IN AIR	23.18%	23.18%	
DENSITY OF AIR 1 atm 20 deg C	1.21	1.21	kg/m³
AIR REQUIRED [1 atm , 20 deg C]	3399.70	3303.40	m³/h

12.1 AERATION AIR BLOWER

DESIGN FLOW RATE [1 atm , 20 deg C]	3399.70	m³/h	
NO. OF DUTY BLOWERS PER BASIN	1	No.	
TOTAL NO. OF BASINS	2	Nos.	
TOTAL NO. OF DUTY BLOWERS	**2**	**Nos.**	
TOTAL NO. OF STANDBY BLOWERS	**1**	**No.**	
CAPACITY REQUIRED [1 atm , 20 deg C]	3739.67	m³/h	
CAPACITY PROVIDED [1 atm , 20 deg C]	**4230.00**	**m³/h**	
MASS FLOWRATE OF AIR PROVIDED	5118.30	kg/h	
TYPE	**TWIN LOBE**		
OPERATION	CONTINUOUS		
FLUID HANDLED	AIR		
VFD OPERATION	YES		

NOTES:

SUCTION CONDITIONS:

TEMPERATURE	MAX	=	45.00	deg C
	MIN	=	15.00	deg C
ATMOSPHRIC PRESSURE		=	1.00	kg/cm²
RELATIVE HUMIDITY	MAX	=		
	MIN	=		

12.2 AERATION DIFFUSERS

TYPE = TUBE

FURTHER DETAILS WILL BE FURNISHED WITH DIFFUSER MANUFACTURER DOCUMENTATION

NOTES:

13.0 SECONDARY CLARIFIER

DESIGN AVERAGE FLOW	=	40980.88	m³/d
DESIGN PEAK FLOW	=	90980.88	m³/d
RAS RATIO CONSIDERED	=	0.60	
RAS FLOWRATE	=	24588.53	m³/d
MLSS CONCENTRATION IN AERATION TANK	=	3000	mg/L
DESIGN INFLUENT SOLIDS AT AVERAGE FLOW	=	196709	kg/d
DESIGN INFLUENT SOLIDS AT PEAK FLOW	=	346709	kg/d

DESIGN BASIS

TYPE SQUARE TYPE CLARIFIER

NO. OF UNITS	**=**	**2**	**Nos.**
SURFACE OVERFLOW RATE AT AVERAGE FLOW	=	35	m³/m²/d
SURFACE OVERFLOW RATE AT PEAK FLOW	=	50	m³/m²/d
SOLIDS LOADING RATE AT AVERAGE FLOW	=	140	kg/m²/d
SOLIDS LOADING RATE AT PEAK FLOW	=	210	kg/m²/d
AREA REQUIRED AT AVERAGE FLOW BASED ON SOR	=	585.45	m²
AREA REQUIRED AT PEAK FLOW BASED ON SOR	=	909.81	m²
AREA REQUIRED AT AVERAGE FLOW BASED ON SOLIDS LOADING	=	702.54	m²
AREA REQUIRED AT PEAK FLOW BASED ON SOLIDS LOADING	=	825.5	m²

HENCE,

SURFACE AREA OF CLARIFIER REQUIRED	=	909.81	m²

INLET COLUMN

FLOW FROM AERATION TANK ENTERS CLARIFIER THROUGH A CENTRAL COLUMN.

DESIGN INFLUENT FLOWRATE PER UNIT	=	57784.71	m³/d
VELOCITY THROUGH COLUMN	=	1.2	m/s
DIA OF COLUMN REQUIRED	=	0.85	m
DIA OF COLUMN PROVIDED	=	0.90	m
WALL THICKNESS	=	250	mm
OD OF COLUMN PROVIDED	=	1.4	m
SURFACE AREA OF COLUMN PROVIDED	=	1.54	m²

NOTES:

CLARIFIER SIZING

PLAN AREA OF CLARIFIER REQUIRED	=	911.35	m²
SIZE OF CLARIFIER REQUIRED	=	30.19	m
SIZE OF CLARIFIER PROVIDED	**=**	**30.50**	**m**
SIDE WATER DEPTH	**=**	**3.5**	**m**
FREE BOARD CONSIDERED	=	0.3	m
VOLUME OF CLARIFIER PROVIDED	=	3255.88	m³
HYDRAULIC RETENTION TIME PROVIDED	=	3.82	h
TYPE OF SLUDGE COLLECTION	=	CENTRAL SCRAPPER	
DIA OF SLUDGE HOPPER AT BOTTOM	=	1	m
SLOPE OF HOPPER	=	1 in	12
HEIGHT OF HOPPER PROVIDED	**=**	**1.23**	**m**

OVERFLOW WEIR

TYPE PERIPHERAL INSIDE, DOUBLE WEIR

WIDTH OF LAUNDER	=	0.50	m
WALL THICKNESS	=	0.20	m
CLERANCE FROM WALL	=	1.00	m
NO. OF SIDES OF OVERFLOW	=	2	Nos.
LENGTH OF WEIR	=	220.8	m
WEIR LOADING RATE	=	92.9	m³/m.d

DESIGN VALIDATION

SURFACE LOADING RATE AT AVERAGE FLOW	=	22.07	m³/m²/d
	<=	15-35	
SURFACE LOADING RATE AT PEAK FLOW	=	48.99	m³/m²/d
	<=	40-50	
SOLIDS LOADING RATE AT AVERAGE FLOW	=	105.91	kg/m²/d
	<=	70-140	
SOLIDS LOADING RATE AT PEAK FLOW	=	186.67	kg/m²/d
	<=	210	
WEIR LOADING RATE	=	92.9	m³/m/d
	<=	185	

Reference : CPHEEO Manual on Sewerage and Sewage Treatment Plants, 3rd Edition, Page 5 - 53

NOTES:

13.1 RAS SUMP AND PUMPS

SLUDGE FROM SECONDARY CLARIFIER IS RETURNED TO AERATION TANK AS RAS

RETURN SLUDGE RATIO

$$Q_R = \frac{X}{(X_R - X)}$$

WHERE

X	=	MLSS CONCENTRATION IN AERATION TANK	=	3000	mg/L
X_R	=	MLSS CONCENTRATION IN RETURN SLUDGE	=	8000	mg/L

SUBSTITUTING THE VALUES

Q_R = 3000 / (8000 - 3000)

RETURN SLUDGE RATIO REQUIRED	=	0.600	unitless
RETURN SLUDGE RATIO PROVIDED	=	0.60	unitless
DESIGN AVERAGE FLOW	=	40980.88	m³/d
RETURN SLUDGE FLOW	=	24588.53	m³/d

EXCESS SLUDGE

BIOMASS GENERATED FROM AERATION TANK	=	8863.58	kg/d
DESIGN AVERAGE FLOW	=	40980.88	m³/d
TSS IN SECONDARY CLARIFIER OUTLET	=	20	mg/L
HENCE, TSS IN EXCESS SLUDGE	=	8043.97	kg/d
MLSS CONCENTRATION	=	8000	mg/L
HENCE, EXCESS SLUDGE FLOW RATE	=	1000.5	m³/d

EXCESS SLUDGE WILL BE BLEED TO PRIMARY CLARIFIER THROUGH A VALVE PROVIDED IN THE RAS HEADER

13.2 RAS SUMP

RAS FLOW RATE	=	24588.53	m³/d
EXCESS SLUDGE FLOW RATE	=	1000.5	m³/d
TOTAL SLUDGE FLOW RATE	=	25589.03	m³/d
RETENTION TIME CONSIDERED	=	5	min
VOLUME OF SUMP REQUIRED	=	88.9	m³
TYPE	=	ATMOSPHERIC, OPEN	
SHAPE	=	RECTANGULAR	
LIQUID DEPTH	**=**	**3.00**	**m**
LENGTH OF THE SUMP CONSIDERED	**=**	**5.00**	**m**
WIDTH OF THE SUMP REQUIRED	=	5.93	m
WIDTH OF THE SUMP PROVIDED	**=**	**6.00**	**m**
VOLUME OF SUMP PROVIDED	=	90.00	m³

NOTES:

13.3 RAS PUMP

DAILY SLUDGE FLOW RATE	=	25589.03	m³/d	
OPERATING HOURS PER DAY	=	24.0	h	
NO. OF DUTY PUMPS	**=**	**2**	**Nos.**	
NO. OF STANDBY PUMPS	**=**	**1**	**No.**	
CAPACITY OF PUMP REQUIRED	=	533.11	m³/h	
CAPACITY OF PUMP PROVIDED	**=**	**535.00**	**m³/h**	
TYPE	**=**	**SUBMERSIBLE**		
OPERATION	=	CONTINUOUS		
FLUID HANDLED	=	0.8 % RAS SLUDGE		
VFD OPERATION	=	NO		

MASS BALANCE

EXCESS SLUDGE	=	1000.50	m³/d	
DESIGN AVERAGE FLOW TO AERATION TANK	=	40980.88	m³/d	
DESIGN PEAK FLOW TO AERATION TANK	=	90980.88	m³/d	
AVERAGE FLOW FROM SECONDARY CLARIFIER	=	39980.38	m³/d	
PEAK FLOW FROM SECONDAY CLARIFIER	=	89980.38	m³/d	
TSS IN TREATED SEWAGE	=	20.00	mg/l	
	=	799.61	kg/d	
BOD IN TREATED SEWAGE	=	15.00	mg/l	
	=	599.71	kg/d	
pBOD IN TREATED SEWAGE	=	12.56	mg/l	
(0.65 x 1.42 x 0.68 x TSS)	=	501.87	kg/d	
sBOD IN TREATED SEWAGE	=	2.44	mg/l	
	=	599.71	kg/d	
TSS IN EXCESS SLUDGE	=	8043.97	kg/d	
VSS IN EXCESS SLUDGE	=	3352.88107	kg/d	
SOLIDS DUE TO BIOMASS	=	3352.881	kg/d	
pBOD IN EXCESS SLUDGE	=	2104.40	kg/d	
(0.65 x 1.42 x 0.68 x BIOMASS SOLIDS)				
sBOD IN EXCESS SLUDGE	=	2.45	kg/d	
BOD IN EXCESS SLUDGE	=	2106.85	kg/d	

NOTES:

			AERATION INLET	EXCESS SLUDGE	SECONDARY OUTLET
AVG. FLOW	m^3/d		40980.88	1000.50	39980.38
TSS	mg/l		467.10	8040	20
	kg/d		19140.00	8043.97	799.61
BOD	mg/l		296.40	2105.8	15
	kg/d		12146.00	2106.85	599.71
VSS	mg/l		260.40	3351.3	12
	kg/d		10671.00	3352.88	479.77

NOTES:

14.0 DISINFECTION SECTION

DISINFECTION OF TREATED SEWAGE IS ACHIEVED THROUGH CHLORINATION.
A CHLORINE CONTACT TANK IS PROVIDED TO ACHIEVE EFFECTIVE MIXING OF CHLORINE IN TREATED SEWAGE AND PROVIDE SUFFICIENT CONTACT TIME TO ACHIEVE DISINFECTION

14.1 CHLORINE CONTACT TANK

DESIGN AVERAGE FLOW	=	40000.00	m³/d
RETENTION TIME	=	30	min
NO. OF UNITS	**=**	**1**	**No.**
VOLUME OF TANK REQUIRED	=	833.34	m³
LIQUID DEPTH CONSIDERED	**=**	**3.90**	**m**
PASS WIDTH	=	3.90	m
NO. OF BAFFLES	=	6	Nos.
HENCE, NO. OF PASSES	=	7	Nos.
EFFECTIVE LENGTH OF PASS	=	27.3	m
BAFFLE WALL THICKNESS	=	0.2	m
TOTAL LENGTH OF CHLORINE CONTACT TANK	**=**	**28.5**	**m**
WIDTH OF TANK REQUIRED	=	7.827	m
WIDTH OF TANK PROVIDED	**=**	**7.90**	**m**
FREEBOARD CONSIDERED	=	0.3	m

14.2 CHLORINATION

DESIGN AVERAGE FLOW	=	40000	m³/d
CHLORINE DOSAGE CONSIDERED	=	10.00	mg/L
CHLORINATION CAPACITY REQUIRED	=	16.67	kg/h
NO. OF WORKING UNITS	=	1	No.
NO. OF STANDBY UNITS	=	1	No.
CAPACITY OF EACH CHLORINATOR REQUIRED	=	17	kg/h
CAPACITY OF EACH CHLORINATOR PROVIDED	**=**	**17**	**kg/h**

NOTES:

15.0 SLUDGE DIGESTION SYSTEM

THICKENED SLUDGE WILL BE ANAEROBICALLY DIGESTER IN SLUDGE DIGESTER.

SLUDGE FROM PRIMARY CLARIFIER IS RECEIVED AT DIGESTER FEED SUMP

15.1 DIGESTER FEED SUMP

THICKENED SLUDGE FLOWRATE	=	469.12	m^3/d
BATCH VOLUME OF SLUDGE FROM THICKENER	=	9.774	m^3
NO. OF BATCHES CONSIDERED FOR STORAGE	=	3	Nos.
WORKING VOLUME OF SUMP REQUIRED	=	29.32	m^3
TYPE	**=**	**ATMOSPHERIC, OPEN**	
SHAPE	=	SQUARE	
LIQUID DEPTH	**=**	**3.00**	**m**
LENGTH OF THE TANK CONSIDERED	**=**	**3.60**	**m**
WIDTH OF THE TANK REQUIRED	=	2.72	m
WIDTH OF THE TANK PROVIDED	**=**	**2.80**	**m**
VOLUME OF EACH TANK PROVIDED	=	30.24	m^3

15.2 DIGESTER FEED SUMP AGITATOR

A LOW SPEED AGITATOR IS PROVIDED IN THE TANK TO KEEP THE SOLIDS IN SUSPENSION.

TYPE	**=**	**LOW SPEED TURBINE**	
		VERTICAL MOUNTED	
NO. OF AGITATOR PER TANK	=	1	No.
SIZE OF TANK	**=**	**2.80**	**m**

15.3 DIGESTER FEED PUMPS

THICKENED SLUDGE FLOWRATE	=	469.12	m^3/d
OPERATING HOURS	=	24.0	h
NO. OF DUTY PUMPS	**=**	**2**	**Nos.**
NO. OF STANDBY PUMPS	**=**	**1**	**No.**
CAPACITY OF PUMP REQUIRED	=	9.78	m^3/h
CAPACITY OF PUMP PROVIDED	**=**	**10.00**	**m^3/h**
TYPE	**=**	**SCREW**	
OPERATION	=	CONTINUOUS	
FLUID HANDLED	=	6 % THICKENED SLUDGE	
VFD OPERATION	=	NO	

NOTES:

15.4 SLUDGE DIGESTER

TYPE **MESOPHILIC SINGLE STAGE HIGH RATE ANAEROBIC DIGESTION**
CONTINUOUS FEED AND CONTINUOUS WITHDRAWL

THICKENED SLUDGE FLOW RATE		=	469.12	m³/d
TSS IN THICKENED SLUDGE		=	28710.00	kg/d
VSS IN THICKENED SLUDGE		=	16007.00	kg/d
BOD IN THICKENED SLUDGE		=	6108.00	kg/d
NO. OF DIGESTERS		**=**	**2**	**Nos.**
SLUDGE DIGESTION TEMPERATURE		=	35	deg C
SRT REQUIRED		=	10	d

Reference: CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

DIGESTER STORAGE VOLUME REQUIRED		=	2346	m³
SIDE WATER DEPTH CONSIDERED		**=**	**7**	**m**
GRIT ACCUMULATION SPACE		=	0.6	m
FREEBOARD CONSIDERED		=	0.6	m
TOTAL SIDE WATER DEPTH		=	8.2	m
DIA OF DIGESTER REQUIRED		=	20.66	m
DIA OF DIGESTER PROVIDED		**=**	**20.80**	**m**
DIA OF CONE AT THE TOP		=	4	m
HEIGHT OF TOP CONE PROVIDED		=	3.20	m
HEIGHT OF GAS COLLECTION DOME		=	1.2	m
DIA OF SLUDGE HOPPER AT BOTTOM		=	5	m
SLOPE OF HOPPER		=	1 in	6
HEIGHT OF HOPPER PROVIDED		**=**	**1.32**	**m**
VSS DESTRUCTION		=	50%	

Reference: CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

THICKENED SLUDGE VSS		=	16007.00	kg/d
VSS DESTROYED		=	8004.00	kg/d
GAS PRODUCED	1 atm 20 deg C	=	0.9	m³/kg VSS destroyed
		=	7204.00	m³/d

Reference: CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

VSS LOADING RATING		=	2.87	kg/m³/d
			1.6 - 6.4	kg/m³/d

Reference: CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

NOTES:

MASS BALANCE

TSS IN THICKENED SLUDGE	=	28710.00	kg/d
VSS DESTROYED	=	8004.00	kg/d
SOLIDS IN DIGESTER AFTER DIGESTION	=	20706.00	kg/d
BOD STABILISATION IN DIGESTER	=	60%	
BOD IN DIGESTER AFTER DIGESTION	=	2443.2	kg/d

HIGH RATE DIGESTERS ARE OPERATED ON CONTINUOUS WITHDRAWL MODE. HENCE DIGESTED SLUDGE FLOW RATE IS EQUAL TO THE DIGESTER FEED FLOWRATE

		DIGESTER FEED	DIGESTED SLUDGE
FLOW	m³/d	469.12	469.12
TSS	mg/l	61199.70	44138
	kg/d	28710.00	20706.00
BOD	mg/l	13020.20	5208.1
	kg/d	6108.00	2443.20
VSS	mg/l	34121.40	17059.7
	kg/d	16007.00	8003.00

15.5 DIGESTER MIXING PUMP

VOLUME OF EACH DIGESTER	=	2786.4	m³
MIXING TURNDOWN PER DAY	=	3	Nos.
CAPACITY OF PUMP REQUIRED	=	8359.2	m³/d
OPERATING HOURS	=	24	h
NO. OF DUTY PUMPS / DIGESTER	**=**	**1**	**No.**
NO. OF STANDBY PUMPS	**=**	**1**	**No.**
CAPACITY OF PUMP REQUIRED	=	348.30	m³/h
CAPACITY OF PUMP PROVIDED	**=**	**350.00**	**m³/h**
TYPE	**=**	**CENTRIFUGAL, NON-CLOG**	
OPERATION	=	CONTINUOUS	
FLUID HANDLED	=	6 % DIGESTER SLUDGE	
VFD OPERATION	=	NO	

NOTES:

15.6 DIGESTER HEATING

TO MAINTAIN THE DIGESTER TEMPERATURE, FEED TO THE DIGESTER IS HEATED ALONG WITH RECIRCULATION FROM DIGESTERS. HEAD LOSSES ACROSS DIGESTER WALL AND ROOF IS ALSO COMPENSATED.

DESIGN BASIS

DIGESTER DESIGN TEMPERATURE		=	35	^{o}C
WINTER AVERAGE AMBIENT TEMPERATURE		=	15	^{o}C
SUMMER AVERAGE AMBIENT TEMPERATURE		=	45	^{o}C
MINIMUM SEWAGE TEMPERATURE		=	20	^{o}C
MAXIMUM SEWAGE TEMPERATURE		=	30	^{o}C
AVERAGE WINTER GROUND TEMPERATURE		=	20	^{o}C
AVERAGE SUMMER GROUND TEMPERATURE		=	32	^{o}C

DIGESTER DIMENSIONAL DATA

NUMBER OF DIGESTERS		=	2	Nos.
DIAMETER OF CYLINDRICAL PART	D	=	20.80	m
HEIGHT OF CYLINDRICAL PART	h	=	8.20	m
HEIGHT OF CYLINDER BELOW GROUND	h_3	=	2.00	m
HEIGHT OF UPPER CONE	h_1	=	3.20	m
HEIGHT OF UPPER DOME	h_2	=	1.20	m
HEIGHT OF BOTTOM CONE	h_4	=	1.32	m
DIAMETER OF BOTTOM CONE	d_b	=	5.00	m

NOTES:

FEED SLUDGE HEATING

		SUMMER	WINTER	
FEED SLUDGE TEMPERATURE	=	30	20	
DIGESTER TEMPERATURE REQUIRED	=	35	35	

HEAT REQUIRED, **Q = m Cp dT**

WHERE

m	=	SLUDGE FEEDING FLOW RATE	=	20.00	20.00	m³/h
C_p	=	SPECIFIC HEAT FOR SLUDGE	=	1.162	1.162	kwh/(m³.K)
dT	=	DIFFERENCE IN TEMPERATURE	=	5	15	K

SUBSTITUTING THE VALUES

HEAT REQUIRED FOR FEED SLUDGE HEATING, Q	=	116.2	348.6	kW

HEAT LOSS FROM UPPER DOME

DIAMETER OF CYLINDRICAL PART	**D**	=	20.80 m
DIAMETER OF UPPER CONE	**d**	=	1 in m
HEIGHT OF UPPER CONE	**h**	=	3.20 m

ANGLE OF UPPER CONE — **α = ATAN (h / [(D / 2) - (d / 2)])**

= ATAN { 3.2 / [(20.8 / 2) - (1 in / 2)] } = #VALUE! °

UPPER DOME & CONE SURFACE AREA — **A = π h [(D/2) + (d/2)] / Sin α + π d h_1**

#VALUE! = #VALUE! m²

HEAT TRANSFER COEFFICIENT OF UPPER DOME

LAYER	l	d	d/l	1/a	1/k	k
	W/(m.K)	m	m².K/W	m².K/W	m².K/W	W/(m².K)
SLUDGE / CONCRETE				0.130		
CONCRETE	2.50	0.40	0.160			
CONCRETE / FRESH AIR				0.040		
TOTAL			0.160	0.170	0.330	**3.04**
					∑1/a + ∑d/l	

HEAT LOSS CALCULATION, **$q = k A (T_1 - T_2)$**

WHERE				SUMMER	WINTER
k	=	HEAT TRANSFER COEFFICIENT	=	3.04	3.04 W/(m².K)
A	=	SURFACE AREA OF UPPER DOME & CONE	=	0.00	0.00 m²
T_1	=	DIGESTER TEMPERATURE	=	35	35 °C
T_2	=	AMBIENT TEMPERATURE	=	45	15 °C

SUBSTITUTING THE VALUE

= 3.04 x 0 x (35 - 45) @ WINTER

= 3.04 x 0 x (35 - 15) @ SUMMER

HEAT LOSS FROM UPPER DOME	=	0	0 W
	=	0	0 kW

NOTES:

HEAT LOSS FROM CYLINDRICAL PART ABOVE GROUND

DIAMETER OF CYLINDRICAL PART	D	= 20.80	m
HEIGHT OF CYLINDER ABOVE GROUND	h	= 6.20	m
SURFACE AREA OF CYLINDER ABOVE GROUND	A = π D h	= 405.14	m²

HEAT TRANSFER COEFFICIENT OF CYLINDER ABOVE GROUND

LAYER	l	d	d/l	1/a	1/k	k
	W/(m.K)	m	m².K/W	m².K/W	m².K/W	W/(m².K)
SLUDGE / CONCRETE				0.130		
CONCRETE	2.50	0.40	0.160			
CONCRETE / FRESH AIR				0.040		
TOTAL			0.160	0.170	0.330	**3.04**
					∑1/a + ∑d/l	

HEAT LOSS CALCULATION, $q = k A (T_1 - T_2)$

WHERE			SUMMER	WINTER	
k	=	HEAT TRANSFER COEFFICIENT	3.04	3.04	W/(m².K)
A	=	SURFACE AREA OF CYLINDRICAL PART	405.14	405.14	m²
T_1	=	DIGESTER TEMPERATURE	35	35	°C
T_2	=	AMBIENT TEMPERATURE	45	15	°C

SUBSTITUTING THE VALUE

HEAT LOSS FROM CYLINDRICAL PART ABOVE GROUND	=	-12317	24633	W
	=	-12.317	24.633	kW

HEAT LOSS FROM CYLINDRICAL PART BELOW GROUND

DIAMETER OF CYLINDRICAL PART	D	= 20.80	m
HEIGHT OF CYLINDER BELOW GROUND	h	= 2.00	m
SURFACE AREA OF CYLINDER BELOW GROUND	A = π D h	= 130.69	m²

HEAT TRANSFER COEFFICIENT OF CYLINDER ABOVE GROUND

LAYER	l	d	d/l	1/a	1/k	k
	W/(m.K)	m	m².K/W	m².K/W	m².K/W	W/(m².K)
SLUDGE / CONCRETE				0.130		
CONCRETE	2.50	0.60	0.240			
CONCRETE / GROUND				0.130		
TOTAL			0.240	0.260	0.500	**2.00**
					∑1/a + ∑d/l	

HEAT LOSS CALCULATION, $q = k A (T_1 - T_2)$

WHERE			SUMMER	WINTER	
k	=	HEAT TRANSFER COEFFICIENT	2.00	2.00	W/(m².K)
A	=	SURFACE AREA OF CYLINDRICAL PART	130.69	130.69	m²
T_1	=	DIGESTER TEMPERATURE	35	35	°C
T_2	=	GROUND TEMPERATURE	32	20	°C

SUBSTITUTING THE VALUE

HEAT LOSS FROM CYLINDRICAL PART BELOW GROUND	=	785	3921	W
	=	0.785	3.921	kW

NOTES:

HEAT LOSS FROM LOWER CONE

DIAMETER OF CYLINDRICAL PART	D	= 20.80	m
DIAMETER OF BOTTOM CONE	d	= 5.00	m
HEIGHT OF LOWER CONE	h	= 1.32	m

ANGLE OF BOTTOM CONE $\beta = ATAN (h / [(D / 2) - (d / 2)])$

= ATAN { 1.32 / [(20.8 / 2) - (5 / 2)] } = 9.49 °

LOWER CONE SURFACE AREA $A = \pi h [(D/2) + (d/2)] / Sin \beta$

= PI x 1.32 x [(20.8 / 2) + (5 / 2)] / SIN 9.49 = 324.46 m²

HEAT TRANSFER COEFFICIENT OF LOWER CONE

LAYER	l	d	d/l	1/a	1/k	k
	W/(m.K)	m	m².K/W	m².K/W	m².K/W	W/(m².K)
SLUDGE / CONCRETE				0.130		
CONCRETE	2.50	0.35	0.140			
CONCRETE / GROUND				0.130		
TOTAL			0.140	0.260	0.400	**2.50**
					∑1/a + ∑d/l	

HEAT LOSS CALCULATION, $q = k A (T_1 - T_2)$

WHERE					
k	=	HEAT TRANSFER COEFFICIENT	=	2.50	2.50	W/(m².K)
A	=	SURFACE AREA OF LOWER CONE	=	324.46	324.46	m²
T_1	=	DIGESTER TEMPERATURE	=	35	35	°C
T_2	=	GROUND TEMPERATURE	=	32	20	°C

SUBSTITUTING THE VALUES

HEAT LOSS FROM LOWER DOME	=	2434	12168	W
	=	2.434	12.168	kW

HEAT LOSS SUMMARY

HEAT LOSS FROM UPPER DOME	=	0	0	kW
HEAT LOSS FROM CYLINDER ABOVE GROUND	=	-12.317	24.633	kW
HEAT LOSS FROM CYLINDER BELOW GROUND	=	0.785	3.921	kW
HEAT LOSS FROM BOTTOM CONE	=	2.434	12.168	kW
TOTAL HEAT LOSS FROM DIGESTER	=	-9.098	40.722	kW
NO. OF DIGESTERS	=	2	2	Nos.
HEAT LOSS TO BE COMPENSATED FOR DIGESTER	=	-18.196	81.444	kW

NOTES:

15.7 SLUDGE RECIRCULATION PUMPS

TO MAINTAIN TEMPERATURE IN DIGESTER, A PART OF THE DIGESTER SLUDGE IS RECIRCULATED TO HEAT EXCHANGER ALONG WITH THE FEED SLUDGE. SLUDGE RECIRCULATION PUMPS ARE PROVIDED TO FACILITATE THIS RECIRCULATION

MIXING FACTOR CONSIDERED	=	3		
FEED SLUDGE FLOW RATE	=	20.00	m^3/h	
RECIRCULATION FLOW RATE REQUIRED	=	60.00	m^3/h	
NO. OF DUTY PUMPS	**=**	**2**	**Nos.**	
NO. OF STANDBY PUMPS	**=**	**2**	**Nos.**	
CAPACITY OF PUMP REQUIRED	=	30.00	m^3/h	
CAPACITY OF PUMP PROVIDED	**=**	**30.00**	**m^3/h**	
TYPE	**=**	**SCREW**		
OPERATION	=	CONTINUOUS		
FLUID HANDLED	=	6 % DIGESTER SLUDGE		
VFD OPERATION	=	NO		

15.8 SLUDGE HEAT EXCHANGER

HEAT REQUIRED FOR FEED SLUDGE	=	116.2	348.6	kW
HEAT LOSS FROM DIGESTER	=	-18.196	81.444	kW
TOTAL HEAT REQUIRED	=	98.004	430.044	kW
SAFETY FACTOR	=	20%	20%	
HEAT EXCHANGER CAPACITY REQUIRED	=	117.7	516.1	kW
HEAT EXCHANGER CAPACITY	=	516.1	kW	

TYPE : PIPE IN PIPE HEAT EXCHANGER

NO. OF UNITS	**=**	**2**	**Nos.**	
HEAT EXCHANGER CAPACITY REQUIRED	=	259	kW	
HEAT EXCHANGER CAPACITY PROVIDED	**=**	**260**	**kW**	

COLD FLUID

FEED SLUDGE FLOWRATE	=	20.00	m^3/h
FEED SLUDGE TEMPERATURE	=	20	^oC
RECIRCULATION SLUDGE FLOWRATE	=	60	m^3/h
RECIRCULATION SLUDGE TEMPERATURE	=	35	^oC
COLD FLUID FEED TEMPERATURE	=	31.25	^oC
COLD FLUID FLOWRATE PER EXCHANGER	=	40	m^3/h

NOTES:

FEED FLOWRATE	=	40	m³/h	
SPECIFIC HEAT CAPACITY OF FEED	=	1.162	kwh/(m³.K)	
HEAT EXCHANGER CAPACITY	=	260	kW	
HENCE, INCREASE IN TEMPERATURE	=	5.6	°C	
SLUDGE TEMPERATURE AFTER HEATING	=	36.90	°C	

HOT WATER REQUIREMENT

HEAT EXCHANGER CAPACITY	=	260	kW	
HOT WATER SUPPLY TEMPERATURE	=	80	°C	
HOT WATER RETURN TEMPERATURE	=	60	°C	
HOT WATER SPECIFIC HEAT CAPACITY	=	1.162	kwh/(m³.K)	
HOT WATER FLOWRATE REQUIRED PER HEAT EXCHANGER	=	11.19	m³/h	
TOTAL HOTWATER REQUIRED	=	22.38	m³/h	

HEAT EXCHANGER DESIGN SUMMARY

TYPE	PIPE IN PIPE HEAT EXCHANGER			
NO. OF UNITS	**=**	**2**	**Nos.**	
CAPACITY	**=**	**260**	**kW**	
		SLUDGE	**HOTWATER**	
SUPPLY TEMPERATURE	=	31.25	80.00	
RETURN TEMPERATURE	=	36.90	60.00	
FLOW RATE	=	40.00	11.50	
SPECIFIC HEAT CAPACITY	=	1.162	1.162	

15.9 HOT WATER PUMPS

A CLOSED LOOP CIRCUIT IS PROVIDED FOR HOT WATER. HOT WATER PUMPS CIRCULATE THE HOT WATER THROUGH SLUDGE HEAT EXCHANGER AND GAS ENGINE HEAT RECOVERY UNITS.

HOT WATER FLOW RATE REQUIRED	=	22.38	m³/h	
NO. OF DUTY PUMPS	**=**	**1**	**No.**	
NO. OF STANDBY PUMPS	**=**	**1**	**No.**	
CAPACITY OF PUMP REQUIRED	=	22.38	m³/h	
CAPACITY OF PUMP PROVIDED	**=**	**23.00**	**m³/h**	
TYPE	**=**	**CENTRIFUGAL**		
OPERATION	=	CONTINUOUS		
FLUID HANDLED	=	HOT WATER (80 deg C)		
VFD OPERATION	=	NO		

NOTES:

15.10 HOT WATER BUFFER TANK

A BUFFER TANK IS PROVIDED AS MAKEUP PROVISION FOR HOT WATER CLOSED LOOP

HOT WATER FLOWRATE	=	23	m³/h
RETENTION TIME CONSIDERED	=	5	min
CAPACITY OF TANK REQUIRED	=	2	m³
TYPE	=	**ATMOSPHERIC, CLOSED**	
	=	**INSULATED**	
SHAPE	=	CIRCULAR	
EFFECTIVE LIQUID DEPTH	**=**	**1.50**	**m**
DIA OF THE TANK REQUIRED	=	1.31	m
DIA OF THE TANK PROVIDED	**=**	**1.40**	**m**
FREEBOARD	=	0.30	m
CLEARANCE FOR LOW LEVEL	=	0.20	m
TOTAL DEPTH OF TANK PROVIDED	=	2.00	m
VOLUME OF EACH TANK PROVIDED	=	3.00	m³

NOTES:

16.0 SLUDGE DEWATERING SECTION

16.1 DIGESTED SLUDGE SUMP

SLUDGE FROM DIGESTER IS COLLECTED IN THIS SUMP AND THEN FED TO CENTRIFUGE

DAILY SLUDGE FLOW RATE	=	469.12	m³/d
HOURLY FLOW RATE OF SLUDGE	=	19.55	Nos.
NO. OF COMPARMENTS	=	2	Nos.
RETENTION TIME	=	6	h
WORKING VOLUME OF EACH COMPARTMENT REQUIRED	=	58.64	m³
TYPE	**=**	**ATMOSPHERIC, OPEN**	
SHAPE	=	RECTANGULAR	
LIQUID DEPTH	**=**	**3.00**	**m**
LENGTH OF THE TANK CONSIDERED	**=**	**3.90**	**m**
WIDTH OF THE TANK REQUIRED	=	5.01	m
WIDTH OF THE TANK PROVIDED	**=**	**5.00**	**m**
VOLUME OF EACH TANK PROVIDED	=	58.50	m³

SLUDGE COLLECTED IN THE TANK WILL BE ALLOWED TO SETTLE. SUPERNATANT WILL BE WITHDRAWN FROM THE SUMP

MASS BALANCE

DIGESTED SLUDGE FLOWRATE	=	469.12	m³/d
TSS IN DIGESTED SLUDGE	=	20706.00	kg/d
TSS IN SUPERNATANT	=	4000	mg/L
DENSITY OF SUPERNATANT	=	1000	kg/m³
CENTRIFUGE FEED CONSISTENCY	=	6%	
DENSITY OF CENTRIFUGE FEED SLUDGE	=	1050	kg/m³

BASED ON ITERATIVE MASS BALANCE ACROSS CENTRIFUGE FEED SUMP

DIGESTED SLUDGE FLOWRATE	=	319.15	m³/d
DIGESTED SLUDGE SOLIDS	=	20107	kg/d

		DIGESTED SLUDGE	CENTRIFUGE FEED	SUPERNATANT
FLOW	m³/d	469.12	319.15	149.97
TSS	mg/l	44138.00	63001.8	3995
	kg/d	20706.00	20107.00	599.00
BOD	mg/l	5208.10	6245.4	3000
	kg/d	2443.20	1993.20	450.00
VSS	mg/l	17059.70	24350.4	1544.09278
	kg/d	8003.00	7771.43	231.57

NOTES:

16.2 DIGESTED SLUDGE SUMP AGITATOR

A LOW SPEED AGITATOR IS PROVIDED IN THE TANK TO KEEP THE SOLIDS IN SUSPENSION.

TYPE	**=**	**LOW SPEED TURBINE**	
		VERTICAL MOUNTED	
NO. OF AGITATOR PER TANK	=	2	Nos.
SIZE OF TANK	**=**	**5.00**	**m**

16.3 CENTRIFUGE FEED PUMP

DAILY SLUDGE FLOW RATE	=	319.15	m^3/d
CENTRIFUGE OPERATING HOURS PER DAY	=	16.0	h
CENTRIFUGE OPERATING DAYS PER WEEK	=	7.0	d
NO. OF DUTY PUMPS	**=**	**1**	**No.**
NO. OF STANDBY PUMPS	**=**	**1**	**No.**
CAPACITY OF PUMP REQUIRED	=	19.95	m^3/h
CAPACITY OF PUMP PROVIDED	**=**	**20.00**	**m^3/h**
TYPE	**=**	**SCREW**	
OPERATION	=	INTERMITTENT	
FLUID HANDLED	=	6 % DIGESTED SLUDGE	
VFD OPERATION	=	NO	

NOTES:

16.4 CENTRIFUGE

TYPE	=	**SOLID BOWL**	
NO. OF DUTY UNITS	=	**1**	**No.**
NO. OF STANDBY UNITS	=	**1**	**No.**
DESIGN SLUDGE FLOWRATE	=	319.15	m³/d
DESIGN POLYMER FLOW RATE	=	63.20	m³/d
DESIGN HYDRAULIC FLOW	=	382.35	m³/d
OPERATING HOURS PER DAY	=	16.0	h
OPERATING DAYS PER WEEK	=	7.0	d
CAPACITY OF CENTRIFUGE REQUIRED	=	23.90	m³/h
CAPACITY OF CENTRIFUGE PROVIDED	=	**25.00**	**m³/h**
DESIGN INLET SOLIDS	=	20107.00	kg/d
SOLIDS HANDLING CAPACITY OF CENTRIFUGE	=	1256.70	kg/h
SOLIDS CAPTURE RATE	=	90%	
DEWATERED CAKE SOLIDS	=	18096.3	kg/d
DEWATERED CAKE CONCENTRATION	=	20%	
DEWATERED CAKE DENSITY	=	1100	kg/m³
DEWATERED CAKE FLOWRATE	=	82.26	m³/d
	=	90.486	T/d

MASS BALANCE

DEWATERED CAKE	=	82.26	m³/d	
	=	5.150	m³/h	
CENTRATE FLOW RATE	=	300.09	m³/d	

		CENTRIFUGE FEED	DEWATERED CAKE	CENTRATE
FLOW RATE	m³/h	19.95	5.15	18.76
	m³/d	319.15	82.26	300.09
TSS	mg/l	63001.80	219989.06	6700.324
	kg/d	20107.00	18096.30	2010.70
BOD	mg/l	6245.40	21807.44	664.201
	kg/d	1993.20	1793.88	199.32
VSS	mg/l	24350.40	3898.98	3898.957
	kg/d	7771.43	6994.29	777.14

NOTES:

16.5 DWPE DOSING SYSTEM

PURPOSE	**=**	**DEWATERING AID**		
CHEMICAL	**=**	**DEWATERING POLYELECTROLYTE**		
FORM	=	DRY POWDER		
COMMERCIAL GRADE CONCENTRATION	=	100%		
DWPE REQUIREMENT				
DESIGN SOLIDS TO CENTRIFUGE	=	20107.00	kg/d	
DWPE DOSAGE CONSIDERED	=	2.5	kg/T of Solids	
HENCE,				
DWPE REQUIRED (100%)	=	50.27	kg/d	
DWPE REQUIRED (COMMERCIAL GRADE)	=	50.27	kg/d	
SOLUTION CONCENTRATION IN PREPARATION TANK	=	0.20%		
SOLUTION DENSITY	=	1000	kg/m³	
SOLUTION VOLUME IN PREPARATION TANK	=	25.135	m³/d	
DWPE DOSING TANK				
SOLUTION CONCENTRATION IN DOSING TANK	=	0.20%		
DENSITY OF SOLUTION	=	1000	kg/m³	
STORAGE VOLUME REQUIRED	=	25.135	m³	
NO. OF DUTY UNITS	**=**	**1**	**No.**	
NO. OF STANDBY UNITS	**=**	**0**	**No.**	
VOLUME OF EACH TANK REQUIRED	=	25.14	m³	
TYPE	**=**	**ATMOSPHERIC VERTICAL TANK**		
SHAPE	**=**	**SQUARE**		
LIQUID DEPTH OF TANK PROVIDED	**=**	**3.00**	**m**	
SIZE OF TANK PROVIDED	**=**	**3.00**	**m**	
FREEBOARD	=	0.30	m	
TOTAL DEPTH PROVIDED	=	3.30	m	
VOLUME OF EACH TANK PROVIDED	=	27.00	m³	
DWPE DOSING TANK AGITATOR				
TYPE	**=**	**TURBINE**		
		VERTICAL MOUNTED		
NO. OF AGITATOR PER TANK	=	1	No.	
SIZE OF TANK	**=**	**3.00**	**m**	
TOTAL DEPTH OF TANK	**=**	**3.30**	**m**	

NOTES:

DWPE DOSING PUMPS

DESIGN FLOW RATE	=	1.571	m³/h
NO. OF DUTY PUMPS	**=**	**1**	**No.**
NO. OF STANDBY PUMPS	**=**	**1**	**No.**
CAPACITY OF PUMP REQUIRED	=	1571	LPH
CAPACITY OF PUMP PROVIDED	**=**	**1975**	**LPH**
TYPE	**=**	**METERING**	
OPERATION	=	INTERMITTENT	
FLUID HANDLED	=	0.2% DWPE	
VFD OPERATION	=	NO	

PE ONLINE DILUTION UNIT

INLINE DILUTION UNIT IS PROVIDED TO DILUTE THE POLYELECTROLYTE SOLUTION

SOLUTION CONCENTRATION FROM PUMP	=	0.20%	
VOLUMETRIC FLOWRATE FROM PUMP	=	1975	LPH
SOLUTION CONCENTRATION AFTER DILUTION	=	0.10%	
DILUTION RATIO	=	1 : 2	
POWER WATER REQUIRED	=	1975	LPH
VOLUMETRIC FLOWRATE AFTER DILUTION	=	3950	LPH

STORAGE REQUIRED

POLYELECTROLYTE WILL BE RECEIVED IN CARBOUYS.

STORAGE SPACE REQUIRED	=	15	d
CHEMICAL REQUIRED	=	50.27	kg/d
STORAGE REQUIRED	=	754.05	kg
NET WEIGHT OF CARBOUY	=	25	kg
NO. OF CARBOUYS TO BE STORED	=	31	Nos.

NOTES:

17.0 GAS HANDLING SECTION

17.1 BIO GAS HOLDER

BIOGAS HOLDER IS PROVIDED FOR STORAGE OF BIOGAS GENERATED FROM ANAEROBIC DIGESTION

BIOGAS GENERATED	1 atm	20 °C	=	7204.00	m³/d

TYPE: MEMBRANE GAS HOLDER

NO. OF UNITS		=	**1**	**No.**
STORAGE TIME REQUIRED		=	**25%**	
VOLUME OF EACH GAS HOLDER REQUIRED		=	1801	m³
VOLUME OF EACH GAS HOLDER PROVIDED		=	**2150**	**m³**
STORAGE TIME PROVIDED		=	7.17	h

DIMENSIONS OF GAS HOLDER TO BE FINALISED AS PER MANUFACTURER STANDARD

17.2 BIO GAS FLARE

BIOGAS FLARE IS PROVIDED FOR FLARING OF EXCESS BIOGAS GENERATED OR DURING EMERGENCY CONDITIONS

TYPE: SELF ASPIRATING TYPE FLARE BURNER, WITH PILOT BURNER, STACK AND IGNITION SYSTEM

NO. OF WORKING UNITS		=	**1**	**No.**
NO. OF STANDBY UNITS		=	**1**	**No.**
FLARING CAPACITY REQUIRED		=	120%	
CAPACITY OF FLARE REQUIRED	[1 atm , 20 °C]	=	361	m³/h
CAPACITY OF FLARE PROVIDED	**[1 atm , 20 °C]**	=	**375**	**m³/h**

17.3 BIO GAS BLOWER

BIOGAS BLOWER TRANSFERS THE BIOGAS FROM HOLDER TO GAS ENGINE THROUGH GAS SCRUBBER

TYPE: TWIN LOBE BLOWER

NO. OF WORKING UNITS		=	**1**	**No.**
NO. OF STANDBY UNITS		=	**1**	**No.**
CAPACITY OF BLOWER REQUIRED	[1 atm , 20 °C]	=	301	m³/h
CAPACITY OF BLOWER PROVIDED	**[1 atm , 20 °C]**	=	**305**	**m³/h**

NOTES:

17.4 BIO GAS SCRUBBER

A SCRUBBER IS PROVIDED FOR REDUCING THE H2S CONCENTRATION IN THE BIOGAS

TYPE: CHEMICAL SCRUBBER WITH BIOLOGICAL REGENERATION OF CAUSTIC

NO. OF WORKING UNITS		=	**1**	**No.**
NO. OF STANDBY UNITS		=	**1**	**No.**
CAPACITY OF SCRUBBER REQUIRED	[1 atm , 20 °C]	=	301	m³/h
CAPACITY OF SCRUBBER PROVIDED	**[1 atm , 20 °C]**	=	**305**	**m³/h**

17.5 BIO GAS ENGINE

A GAS ENGINE IS PROVIDED TO GENERATE ELECTRICITY FROM BIOGAS

TYPE SINGLE FUEL GAS ENGINE

NO. OF WORKING UNITS		=	**1**	**No.**
NO. OF STANDBY UNITS		=	**0**	**No.**
CALORIFIC VALUE	1 atm deg C	=	5200	kCal/m³
		=	6.04	kW/m³
EFFICIENCY OF GAS ENGINE		=	38%	
BIOGAS AVAILABLE	[1 atm , 20 °C]	=	7204.00	m³/d
CAPACITY OF GAS ENGINE REQUIRED		=	689	kWe
CAPACITY OF GAS ENGINE PROVIDED		=	**635**	**kWe**

17.6 JACKET HEAT RECOVERY UNIT

TYPE **PLATE HEAT EXCHANGER**

NO. OF UNITS	=	**1**	**No.**
ENGINE JACKET HEAT AVAILABLE	=	**300**	**kW**
ENGINE HT CIRCUIT FLOW RATE	=	23.3	m³/h
HT CIRCUIT SUPPLY TEMPERATURE	=	90	°C
HT CIRCUIT RETURN TEMPERATURE	=	70	°C
HT CIRCUIT WATER SPECIFIC HEAT CAPACITY	=	1.162	kwh/(m³.K)
HOT WATER SUPPLY TEMPERATURE	=	80	°C
HOT WATER RETURN TEMPERATURE	=	60	°C
HOT WATER SPECIFIC HEAT CAPACITY	=	1.162	kwh/(m³.K)
HOT WATER FLOWRATE	=	13.00	m³/h

NOTES:

JACKET WATER HEAT RECOVERY UNIT SUMMARY

TYPE	**PLATE HEAT EXCHANGER**			
NO. OF UNITS		**=**	**1**	**No.**
CAPACITY		**=**	**300**	**kW**
			HT WATER	**HOT WATER**
SUPPLY TEMPERATURE		=	90.00	60.00
RETURN TEMPERATURE		=	70.00	80.00
FLOW RATE		=	23.30	13.00
SPECIFIC HEAT CAPACITY		=	1.162	1.162

17.7 EXHAUST HEAT RECOVERY UNIT

TYPE	**FLUE GAS HEAT EXCHANGER**		
NO. OF UNITS	**=**	**1**	**No.**
TOTAL HEAT REQUIRED FOR SLUDGE HEATING	=	520	kW
HEAT AVAILABLE FROM HT CIRCUIT	=	302	kW
HEAT REQUIRED FROM EXHAUST GAS	=	218	kW
HOT WATER SUPPLY TEMPERATURE	=	80	^{o}C
HOT WATER RETURN TEMPERATURE	=	60	^{o}C
HOT WATER SPECIFIC HEAT CAPACITY	=	1.162	kwh/(m³.K)
HOT WATER FLOWRATE	=	9.40	m³/h
EXHAUST GAS FLOW RATE	=	2590	kg/h
EXHAUST GAS SUPPLY TEMPERATURE	=	35	^{o}C
EXHAUST HEAT AVAILABLE (COOLED TO 120°C)	=	315	kW

NOTES:

18.0 COMMON FACILITIES

18.1 PLANT WATER SUMP

PLANT WATER SUMP IS PROVIDED TO PUMP DISINFECTED EFFLUENT FOR DISTRIBUTION THROUGHOUT THE PLANT FOR FLUSHING PURPOSES

WATER REQUIRED AS WASH WATER AND FOR FLUSHING PURPOSES	=	30.00	m^3/h
(SCREENS, DETRITOR, CLARIFIERS, CENTRIFUGE)			
WATER REQUIRED FOR ONLINE DILUTION FOR CENTRIFUGE	=	1.98	m^3/h
TOTAL REQUIREMENT	=	31.98	**m^3/h**
DESIGN CAPACITY	=	35	**m^3/h**
HYDRAULIC RETENTION TIME PROVIDED	=	15	min
OPERATING VOLUME REQUIRED	**=**	**8.75**	**m^3**
LIQUID DEPTH	**=**	**3.90**	**m**
LENGTH OF THE TANK CONSIDERED	**=**	**2.00**	**m**
WIDTH OF THE TANK REQUIRED	=	1.12	m
WIDTH OF THE TANK PROVIDED	**=**	**1.50**	**m**
VOLUME OF EACH TANK PROVIDED	=	11.70	m^3

18.2 PLANT WATER PUMPS

DESIGN FLOW RATE	=	35.00	m^3/h
NO. OF DUTY PUMPS	**=**	**1**	**No.**
NO. OF STANDBY PUMPS	**=**	**1**	**No.**
CAPACITY OF PUMP REQUIRED	=	35.00	m^3/h
CAPACITY OF PUMP PROVIDED	**=**	**35.00**	**m^3/h**
TYPE	**=**	**HORIZONTAL CENTRIFUGAL**	
OPERATION	=	INTERMITTENT	
FLUID HANDLED	=	TREATED SEWAGE	
VFD OPERATION	=	NO	

NOTES:

18.3 PLANT DRAIN SUMP

PLANT DRAIN SUMP IS PROVIDED TO COLLECT DRAINS AND OVERFLOW FROM VARIOUS PROCESS UNITS TO ARUPARA MAIN PUMPING STATION

DESIGN DRAIN FLOW RATE CONSIDERED	=	20.00	**m³/h**
HYDRAULIC RETENTION TIME PROVIDED	=	20	min
OPERATING VOLUME REQUIRED	**=**	**6.67**	**m³**
LIQUID DEPTH	**=**	**2.50**	**m**
DIAMTER OF THE TANK CONSIDERED	**=**	**2.00**	**m**
VOLUME OF EACH TANK PROVIDED	=	8.00	m³

18.4 PLANT DRAIN PUMPS

DESIGN FLOW RATE	=	20.00	m³/h
NO. OF DUTY PUMPS	**=**	**1**	**No.**
NO. OF STANDBY PUMPS	**=**	**1**	**No.**
CAPACITY OF PUMP REQUIRED	=	20.00	m³/h
CAPACITY OF PUMP PROVIDED	**=**	**20.00**	**m³/h**
TYPE	**=**	**HORIZONTAL CENTRIFUGAL**	
OPERATION	=	INTERMITTENT	
FLUID HANDLED	=	TREATED SEWAGE	
VFD OPERATION	=	NO	

NOTES:

19.0 ANNEXURES

ANNEXURE - 1 LITERATURE REFERENCES

APPENDIX C KMDA LAND DECLARATION LETTER

Kolkata Metropolitan Development Authority

DECLARATION

This is to certify that all the STP facilities in Baranagar, Arupara and Bally under the Namami Gange Mission Project**(Pollution Abatement (Interception and Diversion with STP) Works for River Ganga at Howrah, Bally & Baranagar-Kamarahati Municipal Town in West Bengal Including 15 Years O&M Based on Hybrid Annuity Based PPP Mode)**, and as described in the below table are under the ownership of KMDA and that –

(i) During execution of the project, if it is necessary to acquire any land or ROW and if any re-settlement issues raised then KMDA will short out the said issue as per decision and direction of the Govt. of West Bengal.

(ii) There are no land issues or dispute, grievance or court case raised against these lands by a private individual or corporation in relation to the land area of the STP and its associated infrastructure such as pumping station, lifting station, I&D structures at Baranagar, Bally and Arupara project sites. (or if there are land claims, dispute or court cases, KMDA or Land Revenue Department may just state the status and how these are being addressed.)

STP Locations	Facilities	Ownership
Baranagar	STP is located in Matkol area	KMDA
	Main Pumping Station located at Rabindranath Tagore Road	KMDA
	I&D 1 (Goli Ghat Drain) and I&D 2 (Dhakshineswar Drain) are located in Kamarhati municipality whereas I&D 3 (Lock Gate Drain) and I&D 4 (Old PS drain)	KMDA
Arupara	STPand one MPS located at Dharsh area under HMC,	KMDA
	Ichapur MPSlocated at Ramrajatala on Kamardanga Road	KMDA
	(i) BESU lifting station is located near Shibpur BE College, (ii) Foreshore road lifting station is located in Shibpur, (iii) Roundtank lifting station located at Mullick Fatak on Roundtank lane	KMDA
Bally	Waste Stabilization Pond based STP is located under Bally-Jagacha Block	KMDA
	Lift Stations: (i) Hanuman Jute Mill (LS – 1) on Girish Ghosh Road, (ii) Belur Math (LS – 2), (iii) Bally Khal (LS - 3), (iv) Panchanantala (LS – 4), (v) Saltgola LS – 5, and (vi) Golabari LS – 6	KMDA
	Kona MPS under Bally-Jagacha block	KMDA

Superintending Engineer,
North Circle, GAP Wing,
W & S SECTOR, KMDA.

APPENDIX D DUTCH INTERVENTION VALUE

Soil Remediation Circular 2009

Table 1 Groundwater target values and soil and groundwater intervention values[9]

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[7] shallow (< 10 m –gl) (µg/l)	National background concentration groundwater (BC) deep (> 10 m –gl) (µg/l)	Target value groundwater[7] (incl. BC) deep (> 10 m –gl) (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
1 Metals					
Antimony	-	0.09	0.15	22	20
Arsenic	10	7	7.2	76	60
Barium	50	200	200	[8]	625
Cadmium	0.4	0.06	0.06	13	6
Chromium	1	2.4	2.5	-	30
Chromium III	-	-	-	180	-
Chromium VI	-	-	-	78	-
Cobalt	20	0.6	0.7	190	100
Copper	15	1.3	1.3	190	75
Mercury	0.05	-	0.01	-	0.3
Mercury (inorganic)	-	-	-	36	-
Mercury (organic)	-	-	-	4	-
Lead	15	1.6	1.7	530	75
Molybdenum	5	0.7	3.6	190	300
Nickel	15	2.1	2.1	100	75
Zinc	65	24	24	720	800

APPENDIX E AMBIENT AIR QUALITY MONITORING RESULT

Sl. No.	Date of Monitoring	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	NH3 (µg/m3)	HC as CH4(ppm)	H2S (µg/m3)
AAQ-1, GAP Office									
1	16.06.2019 to 17.06.2019	98.8	55.7	7.8	37.7	0.68	25.6	1.73	<10.0
2	19.06.2019 to 20.06.2019	84.5	48.9	6.9	29.6	0.57	19.2	2.31	<10.0
3	24.06.2019 to 25.06.2019	71.6	43.4	7.2	31.5	0.46	21.3	1.54	<10.0
4	27.06.2019 to 28.06.2019	60.9	36.3	6.5	26.3	0.66	17.5	1.24	<10.0
AAQ-2, Sapuipara									
1	16.06.2019 to 17.06.2019	36.3	60.9	6.3	28.4	0.45	18.6	1.75	<10.0
2	19.06.2019 to 20.06.2019	64	35.9	7.2	31.6	0.53	22.7	2.32	<10.0
3	24.06.2019 to 25.06.2019	55.4	34.7	6.6	27.2	0.42	17.3	1.28	<10.0
4	27.06.2019 to 28.06.2019	47.6	28.8	6.2	23.5	0.34	14.6	1.88	<10.0
AAQ-3, Chakpara									
1	16.06.2019 to 17.06.2019	52.3	22.6	6.4	34.2	0.56	22.5	2.06	<10.0
2	19.06.2019 to 20.06.2019	43.5	27.1	6	26.3	0.36	15.3	1.26	<10.0
3	24.06.2019 to 25.06.2019	54.9	33.5	6.7	36.2	0.52	23.8	1.3	<10.0
4	27.06.2019 to 30.6.2019	43.8	27.1	6	25.3	0.46	17.5	1.89	<10.0

APPENDIX F AMBIENT NOISE QUALITY MONITORING RESULTS

Location code		N-1	N-2	N-3	N-4
Location Name		GAP Office	Near Bhattanagar Road	Chakpara	Near Bhattanagar Railway station
Time (in Hrs.)	(06.00-07.00) hrs	48.2	53.9	52.7	50.8
	(07.00-08.00) hrs	49.7	50.7	51.9	52.4
	(08.00-09.00) hrs	49.8	55	53.5	55.2
	(09.00-10.00) hrs	50.2	56.7	62.7	60.1
	(10.00-11.00) hrs	52.5	60.6	58.8	58.9
	(11.00-12.00) hrs	52.3	63.5	62.9	61.2
	(12.00-13.00) hrs	52.1	63.8	64.9	60.7
	(13.00-14.00) hrs	52.6	70.7	66.8	59.1
	(14.00-15.00) hrs	45.3	64.9	66.2	56.3
	(15.00-16.00) hrs	47.2	63.5	67.4	57.2
	(16.00-17.00) hrs	46	64	66.3	57.3
	(17.00-18.00) hrs	49.2	62.6	57.5	54.1
	(18.00-19.00) hrs	48.7	61.2	55.4	51.8
	(19.00-20.00) hrs	48.8	56.6	53.5	52.4
	(20.00-21.00) hrs	49.1	53.7	53.4	49.3
	(21.00-22.00) hrs	49.9	51.7	56.4	53.3
	(22.00-23.00) hrs	52.4	50.3	48.5	47.2
	(23.00-00.00) hrs	48.8	49.1	48.8	45.3
	(00.00-01.00) hrs	45.7	46.3	44.1	42.6
	(01.00-02.00) hrs	45.8	46.5	37	41.3
	(02.00-03.00) hrs	46.5	47.3	38.5	39.6
	(03.00-04.00) hrs	46.7	48.6	37.2	40.3
	(04.00-05.00) hrs	46.2	49.7	40.5	40.2
	(05.00-06.00) hrs	48.3	52.6	44.1	42.6

APPENDIX G CPCB DESIGNATED BEST USE WATER QUALITY CRITERIA

Designated Best Use Water Quality Criteria

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH betwwn 6.0 to 8.5 Electrical Conductivity at 25C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

Traceability: https://cpcb.nic.in/wqstandards/

APPENDIX H TRAFFIC MONITORING DATA

LOCATION : Bhattanagar Road -Up							
SL. NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	Total	PCU
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES		
	(Hours)	(Truck, Bus,Dumper, Tanker, Trailer)	(Car,Jeep,Van, Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	Numbers	
1	09.00-10.00	0	0	3	4	7	4.25
2	10.00-11.00	0	0	4	7	11	6.5
3	11.00-12.00	0	0	7	7	14	8.75
4	12.00-13.00	0	0	4	5	9	5.5
5	13.00-14.00	0	0	2	3	5	3
6	14.00-15.00	0	0	2	5	7	4
7	15.00-16.00	0	0	2	4	6	3.5
8	16.00-17.00	0	0	11	4	15	10.25
9	17.00-18.00	0	0	12	3	15	10.5
10	18.00-19.00	0	0	3	2	5	3.25
11	19.00-20.00	0	0	2	2	4	2.5
12	20.00-21.00	0	0	1	2	3	1.75
13	21.00-22.00	0	0	0	1	1	0.5
14	22.00-23.00	0	0	0	0	0	0
15	23.00-00.00	0	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0	0
19	3.00-4.00	0	0	0	0	0	0
20	4.00-5.00	0	0	1	2	3	1.75
21	5.00-6.00	0	0	3	2	5	3.25
22	6.00-7.00	0	0	5	7	12	7.25
23	7.00-8.00	0	0	4	12	16	9
24	8.00-9.00	0	0	4	11	15	8.5
Total Numbers		**0**	**0**	**70**	**83**	**153**	**94**

LOCATION : Bhattanagar Road -Down							
SL. NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	Total	PCU
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES		
	(Hours)	(Truck, Bus,Dumper, Tanker, Trailer)	(Car,Jeep,Van, Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	Numbers	
1	09.00-10.00	0	0	2	3	5	3
2	10.00-11.00	0	0	5	8	13	7.75
3	11.00-12.00	0	0	6	8	14	8.5
4	12.00-13.00	0	0	3	5	8	4.75
5	13.00-14.00	0	0	1	2	3	1.75
6	14.00-15.00	0	0	2	4	6	3.5
7	15.00-16.00	0	0	3	5	8	4.75
8	16.00-17.00	0	0	10	3	13	9
9	17.00-18.00	0	0	12	2	14	10
10	18.00-19.00	0	0	2	1	3	2
11	19.00-20.00	0	0	1	2	3	1.75
12	20.00-21.00	0	0	0	3	3	1.5
13	21.00-22.00	0	0	1	0	1	0.75
14	22.00-23.00	0	0	0	0	0	0
15	23.00-00.00	0	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0	0
19	3.00-4.00	0	0	0	0	0	0
20	4.00-5.00	0	0	1	1	2	1.25
21	5.00-6.00	0	0	2	3	5	3
22	6.00-7.00	0	0	4	9	13	7.5
23	7.00-8.00	0	0	6	13	19	11
24	8.00-9.00	0	0	5	10	15	8.75
Total Numbers		**0**	**0**	**66**	**82**	**148**	**90.5**

APPENDIX I HOUSEHOLD SOCIO-ECONOMIC SURVEY FORMAT

Household Socio-Economic Survey – ESIA, KMDA Sewerage Project

Questionnaire No.					STP Location:		Baranagar □	Bally □	Arupara □					
Date					Facility wise Component									
Name of Investigator					Name of Respondent									
Name of the Municipality /GP:					Relationship with HOH									
Municipal/ GP Ward No.:					HOH		Male □	Female □						
Name of Para/Hamlet:					Total No. of Family Members									
Caste:	General □	SC □	ST □	OBC □	Religion:	Hindu □	Muslim □	Christian □	Sikh □	Others □				

Family Member Details (List Details of All Family Members)													
Relationship with Respondent													**Codes: M**-Mother, **F**-Father, **W**- Wife, **HU –** Husband, **D**-Daug **SIL**-Son-in-Law, **DIL**-Daughter -in-Law, **GS**- Grandson, **GD**-G Law, **SISL**-Sister-in-Law, **N**-Niece, **NP**-Nephew, **O** – Other sp
Age													
Sex													**Code: M-**Male, **F**-Female
Marital Status													**Codes**: **M**-Married, **UM**- Unmarried, **D**-Divorced/Separated, **W**
Educational Qualification													**Codes: IL-**Illiterate, **FL-**Functionally Literate, **P-**Primary, **UP-**U Higher Secondary, **G-**Graduation, **PG-**Post Graduation
Continuing Education (Yes													**Y**-Yes, **N**-No
Does the member suffer fr													**Codes: ND**-No Disability, **M**-Mental, **V**-Visual, **S**-Speech, **L**-Lo
Primary Occupation of Working Members of the Family													
Primary Occupation													**Codes: F**-Farmer, **AL**- Agricultural Labour, **DL**- Daily Labour, land), **RA**-Rural Artisan, **SG**-Service (Govt.), **SP –** Service (Pr Employment, **T –** Trading, **C –** Commercial business, shops e Sharecropper/ Lessee, **AH –** Animal Husbandry, **HW –** Small- Unpaid Family Work, **O**-Others Specify **U-**unable to work
Approximate Income (Per family member (in INR)													
Secondary Occupation of Working Members of the Family													
Secondary Occupation													**Codes: F**-Farmer, **AL**- Agricultural Labour, **DL**- Daily Labour, land), **RA**-Rural Artisan, **SG**-Service (Govt.), **SP –** Service (Pr Employment, **T –** Trading, **C –** Commercial business, shops e Sharecropper/ Leasee, **AH –** Animal Husbandry, **HW –** Small- Unpaid Family Work, **O**-Others Specify
Approximate Income (Per family member (in INR)													

Approximate Family Income (Per Month/ Annum) (in INR)						
General Details						
Status of accommodation (house/ shop)			**Codes: O**-Owned, **R**-Rented, **S-** Squatter, **E -** Encroacher			
Quality of Life						
Electricity	Yes □	No □	Any other light source, specify: Solar □ Kerosene □ Bio-gas □ Others □			
Source of Drinking Water	Pond □ Well □	Tap Water □	Tube Well/Deep Tube	Khal (Canal) □	Other □ Specify-	
Drinking water source	Own □			Shared □		
Source of Water for Dome washing/ bathing)	Pond □ Well □	Tap Water □	Tube Well/ Deep Tube	Khal (Canal) □	Other Specify □	
Sanitation Arrangement	Open defecation □	Non-sanitary/ *Kutcha* □		Sanitary non-wate	Sanitary with water sealed □	
Soak pit □	Septic tank □	Public Toilet □	Open drain/nearby open are		Any other, specify……	
Fuel for cooking/heating	Coal □	Gul □	Firewood □	LPG □	Kerosene □	Other Specify □
	Bio-gas □	Dried Cow dung with straw, leafs □				
Residence details						
Typology of Housing/Accomm	**Roof**	**Wall**		**Floor**	**Boundary**	
	RCC □	Brick/ Cement □	Tin (GI She	Mud/ cow dung □	Bricks/cement □	
	Straw/ bamb	Mud/ un--burnt Bricks □		Wood /bamboo □	Barbed Wire □	
					Mud wall □	
	Tin (GI Shee	Straw/ bamboo/ polythene/pl		Brick /Cement □	Vegetation □	
	Tally □	Wood □		Floor Tiles □	Dry Wood □	
	Others, speci	Others, specify		Other, specify	No Boundary □	
House/ shop structure	Kutcha □	Semi-pucca □		Pucca □		
What are the movable assets	Refrigerator □	Television □	Cable TV/DTH con	Cycle □	Three-Wheeler □	
	Bike/Two-wh	Mobile/Telephone □	Computer □	Sewing Machine □	Ceiling Fan □	
	Water Pump	Mixer/Grinder □	Radio □	Others □ Specify-		
Access to Social Amenities						
Are there Primary Schools nearby (within 1 – 1.5	Yes □	No □				
Are there Secondary Schools nearby	Yes □	No □				
Are there Colleges nearby	Yes □	No □				
Are there Hospitals nearby	Private Hospital □	Govt. Hospital □	Other specify……	None □		

When you experience a health problem, whi	Private Hospital □	Govt. Other specify……
Do any household members have any perma	Yes □ (if yes explain by giving the membe	Asthma □ Breathing problem □ Cancer □ Diabetes □ Diarrhoea □
	No □	Any other, specify……
Did any of the household members suffer from any water borne diseases within the last 12 months?		
Yes □ (if yes explain by giving the member code)	No □	
Do the locality faces water-logging situation frequently in the last one year? ……. ……..		
Did any of the family members suffer from any vector borne diseases or water borne diseases in last three months? …… ……		
Did you get any foul smell due to STP operations? Yes □ No □		

Signature of the Respondent

APPENDIX J CONSEQUENCE ANALYSIS & QUANTITATIVE RISK ASSESSMENT FOR CHLORINE TONNER STORAGE

1. Risk Assessment – Chlorine Tonner Storage

This section on Risk Assessment (RA) aims to provide a systematic analysis of the major risks that may arise from storage of chlorine tonner as part of the new sewage treatment plant at Bally by GSPPL.
The RA process outlines rational evaluations of the identified risks based on their significance and provides the outline for appropriate preventive and risk mitigation measures. The output of the RA will contribute towards strengthening of the Emergency Response Plan (ERP) in order to prevent damage to personnel, infrastructure and receptors in the immediate vicinity of the plant. Additionally, the results of the RA can also provide valuable inputs for keeping risk at As Low As Reasonably Practicable (ALARP) and arriving at decisions for mitigation of high risk events.

1.1. RA - Methodology

The risk assessment process is primarily based on likelihood of occurrence of the risks identified and their possible hazard consequences particularly being evaluated through hypothetical accident scenarios. With respect to the proposed project, major risks viz. leaks from chlorine tonners is evaluated through a risk matrix generated to combine the risk severity and likelihood factor. Risk associated with the chemical storages have been determined semi-quantitatively as the product of likelihood/probability and severity/consequence by using order of magnitude data (*risk ranking = severity/consequence factor X likelihood/probability factor*). Significance of such project related risks was then established through their classification as high, medium, low, very low depending upon risk ranking.

1.2. Chlorine Storage Details & Associated Hazards

The details of chlorine tonner storage for the proposed expansion project is presented in the **Table 1.1** below.

Table 1.1: Chlorine Tonner Details

Sl. No.	Component	Value
1	Tank Type	Tonner
2	Diameter (m)	0.8
3	Height (m)	2.0
4	Storage (kg)	780
5	Pressure (kg/cm2)	Ambient
6	Temperature (degree C)	Ambient

For chlorine to be stored and handled for the proposed project, the following hazards have been identified and presented in **Table 1.2** below. For the hazard rating of the toxic chemicals to be used for the proposed project, the National Fire Protection Agency (NFPA) 704 rating system has been used. Chemical substances are rated for degree of HEALTH RISK, FLAMMABILITY and REACTIVITY, on a scale of 0 to 4 as described below
Health Risk

- Level 4 – Can affect health or cause serious injury, during periods of very short exposure, even though prompt medical treatment is given.

- Level 3 – Can affect health or cause serious injury, during periods of short exposure, even though prompt medical treatment is given.
- Level 2 – Can cause incapacitation or residual injury, during intense or continued exposure, unless prompt medical treatment is provided.
- Level 1 – Cause irritation upon exposure, but only minor injury is sustained even if no medical treatment is provided.
- Level 0 – Offer no unusual hazards upon exposure to fire conditions.

Flammability

- Level 4 – Completely vaporize at normal pressure and temperature and burn readily.
- Level 3 – Liquids and solids that can be ignited under the most ambient conditions.
- Level 2 – Must be moderately heated before ignition can occur.
- Level 1 – Must be strongly heated before ignition will occur.
- Level 0 – Will not burn.

Reactivity

- Level 4 – Capable of explosive decomposition at normal temperatures and pressure.
- Level 3 – Easily capable of explosive decomposition, but require an ignition source or will react explosively with water.
- Level 2 – Easily undergo a violent reaction, but do not explosively decompose.
- Level 1 – Normally stable, but become explosive at elevated temperatures and pressure.
- Level 0 – Stable even under exposure to fire.

Table 1.2: Hazards of Chlorine

Sl. No.	Component	Value
1	NFPA Hazard Rating - Health	4
2	NFPA Hazard Rating - Flammability	0
3	NFPA Hazard Rating - Reactivity	0
4	Toxicity	High toxic chemical with life threatening health effects likely to be experienced at a concentration of 20ppm and above for an hour of exposure (AEGL-3).

Source: https://cameochemicals.noaa.gov/ and **https://www.epa.gov/aegl/access-acute-exposure-guideline-levels-aegls-values#chemicals**

1.3. Chlorine Storage Failure – Frequency Analysis

The frequency analysis of the hazards identified with respect to the proposed project was undertaken to estimate the likelihood of their occurrences during the project life cycle. Hazard frequencies in relation to the proposed project were estimated based on the analysis of historical

accident frequency data and professional judgment. Based on the range of probabilities arrived at for different potential hazards that may be encountered with respect to the storage and handling of flammable and toxic chemicals including fuel with respect to the expansion project, the following frequency categories and criteria have been defined (Refer **Table 1.3**)

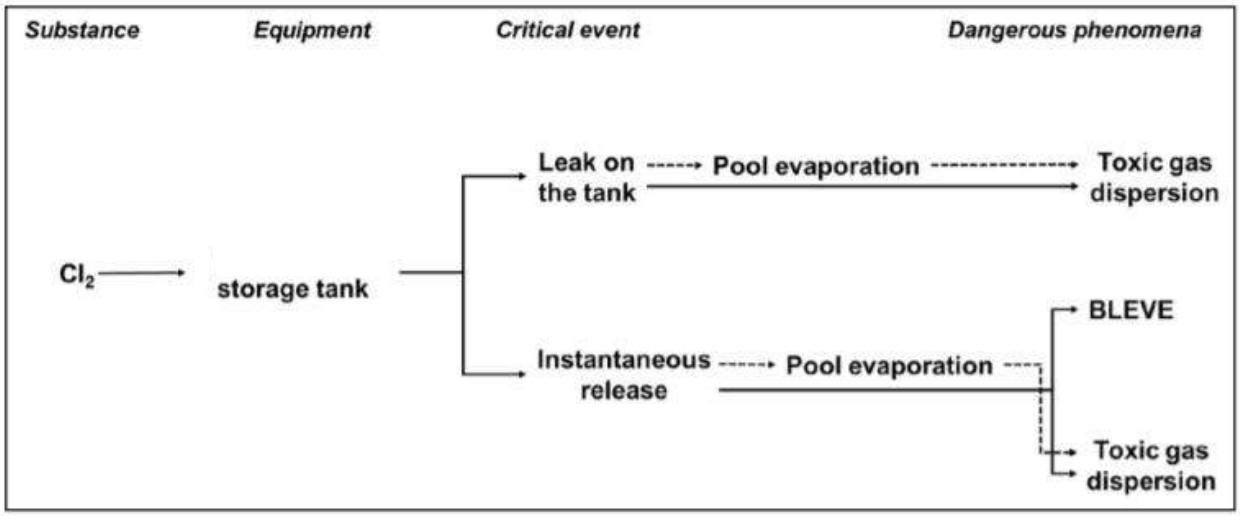
Table 1.3: Frequency Categories and Criteria

Likelihood Ranking	Criteria Ranking (cases/year)	Frequency Class
5	Likely to occur often in the life of the project, with a probability greater than 10^{-1}	Frequent
4	Will occur several times in the life of project, with a probability of occurrence less than 10^{-1}, but greater than 10^{-2}	Probable
3	Likely to occur sometime in the life of a project, with a probability of occurrence less than 10^{-2}, but greater than 10^{-3}	Occasional/Rare
2	Unlikely but possible to occur in the life of a project, with a probability of occurrence less than 10^{-3}, but greater than 10^{-6}	Remote
1	So unlikely it can be assumed that occurrence may not be experienced, with a probability of occurrence less than 10^{-6}	Improbable

Source: Guidelines for Developing Quantitative Safety Risk Criteria – Centre for Chemical Process and Safety

The most credible scenario of chlorine tonner will be toxic vapour cloud dispersion. Event tree analysis (ETA) for chlorine release (both from leak and instantaneously) indicates formation of chlorine pool, followed by evaporation and toxic gas dispersion (Refer **Figure 1.1**).

Figure 1.1: Event Tree Analysis – Chlorine Tank Failure



In order to determine the probability of a toxic vapour cloud occurring, the failure rate needs to be modified by the probability of the material finding an ignition source. The probability of any of the aforesaid incident occurring in the event of a release is therefore equal to the product of the

failure rate and the probability of ignition. The frequency of the possible release scenarios has been presented in Table 1.4 below.

Table 1.4: Chlorine Storage – Failure Rate

Sl. No.	Release Type	Failure Rate (per vessel year)	Frequency Rating
1	Catastrophic	2×10^{-6}	Remote
2	50mm diameter hole	5×10^{-6}	Remote
3	25mm diameter hole	5×10^{-6}	Remote
4	13mm diameter hole	1×10^{-5}	Remote
5	6mm diameter hole	4×10^{-5}	Remote

Source: http://www.hse.gov.uk/landuseplanning/failure-rates.pdf

1.4. Chlorine Storage Failure – Consequence Analysis

In parallel with the frequency analysis, hazard prediction / consequence analysis exercises were undertaken to assess the likely impact of project related risks on onsite personnel, infrastructure and environment. In relation to the proposed project as well as the existing activities have been considered, the estimation of the consequences for each possible event has been based on either accident frequency, consequence modeling or professional judgment, as appropriate. Overall, the consequence analysis takes into account the following aspects:

- Nature of impact on environment and community;
- Occupational health and safety;
- Asset and property damage;
- Corporate image; and
- Timeline for restoration of property damage.

The following criteria for consequence rankings (Refer **Table 1.5**) have been drawn up in context of the possible consequences of the risk events that may occur during the proposed project operations:

Table 1.5 Severity Categories and Criteria

Consequence	Ranking	Criteria Definition
Catastrophic	5	• Multiple fatalities/permanent total disability to more than 50 persons. • Net negative financial impact of >10 crores • International media coverage • Loss of corporate image and reputation
Major	4	• Single fatality/permanent total disability to one or more persons • Net negative financial impact of 5 -10 crores • National stakeholder concern and media coverage.
Moderate	3	• Short term hospitalization & rehabilitation leading to recovery

Consequence	Ranking	Criteria Definition
		• Net negative financial impact of 1-5 crores • State wide media coverage
Minor	2	• Medical treatment injuries • Net negative financial impact of 0.5 – 1 crore • Local stakeholder concern and public attention
Insignificant	1	• First Aid treatment • Net negative financial impact of <0.5 crores. • No media coverage

Risk Evaluation

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. The significance of the risk is expressed as the product of likelihood and the consequence of the risk event, expressed as follows:

Significance = Likelihood X Consequence

The **Table 1.6** below illustrates all possible product results for the five likelihood and consequence categories while the **Table 1.7** assigns risk significance criteria in three regions that identify the limit of risk acceptability. Depending on the position of the intersection of a column with a row in the risk matrix, hazard prone activities have been classified as low, medium and high thereby qualifying for a set of risk reduction / mitigation strategies.

Table 1.6 Risk Matrix

			Likelihood →				
			Frequent	**Probable**	**Unlikely**	**Remote**	**Improbable**
			5	**4**	**3**	**2**	**1**
Consequence ↑	**Catastrophic**	**5**	25	20	15	10	5
	Major	**4**	20	16	12	8	4
	Moderate	**3**	15	12	9	6	3
	Minor	**2**	10	8	6	4	2
	Insignificant	**1**	5	4	3	2	1

Table 1.7 Risk Criteria and Action Requirements

S.N.	Risk Significance	Criteria Definition & Action Requirements
1	**High (16 – 25)**	**"Risk requires attention"** – Project HSE Management need to ensure that necessary mitigation are adopted to ensure that possible risk remains within acceptable limits
2	**Medium (10 – 15)**	**"Risk is tolerable"** – Project HSE Management needs to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementation of all practicable controls.
3	**Low (5 – 9)**	**"Risk is acceptable"** – Project related risks are managed by well-established controls and routine processes/procedures. Implementation of additional controls can be considered.

S.N.	Risk Significance	Criteria Definition & Action Requirements
4	**Very Low (1 – 4)**	**"Risk is acceptable"** – All risks are managed by well-established controls and routine processes/procedures. Additional risk controls need not to be considered

1.4.1. Consequence Analysis – Chlorine Tonner

The main hazards associated with the storage and handlings of chlorine with respect to the proposed project are toxic vapour cloud resulting from the leak/failure of tonners. The hazards may be realised following tank overfilling and leaks/failures in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. all of which can release significant quantities of toxic material on failure.

Risk Modelling Scenarios

In addition to overfill, the scenarios considered for chlorine tonner were leaks and catastrophic failures. Factors that have been identified as having an effect on the integrity of tanks are related to design, inspection, maintenance, and corrosion[1]. The following representative scenarios for the tanks were considered (Refer **Table 1.8**).

Table 1.8 Chlorine Tonner – Risk Modelling Scenarios

S.No	Chemical Name	Total Storage (kg)	Event	Scenario
1	Chlorine	780	Toxic gas release	2.5mm leak
2			Toxic gas release	5mm leak
3			Toxic gas release	10mm leak (worst case scenario)

The chemical storage tank and container failure scenarios have been modeled using ALOHA and interpreted in terms of Toxic Level of Concern (LOC) encompassing the following threshold values (measured in kilowatts per square meter) and ppm respectively to create the default threat zone.

Toxic Level of Concern

Toxic Level of Concern has been interpreted in the form of Acute Exposure Level Guidelines (AEGLs) and Emergency Response Planning Guidelines (ERPGs) calculated for– 60 minutes. AEGL "levels" are dictated by the severity of the toxic effects caused by the exposure, with Level 1 being the least and Level 3 being the most severe. All levels are expressed as parts per million or milligrams per cubic meter (ppm or mg/m^3) of a substance above which it is predicted that the general population could experience, including susceptible individuals:

AEGL-1 (Yellow): *Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure;*

AEGL-2 (Orange): *Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape; and*

AEGL-3 (Red): *Life-threatening health effects or death.*

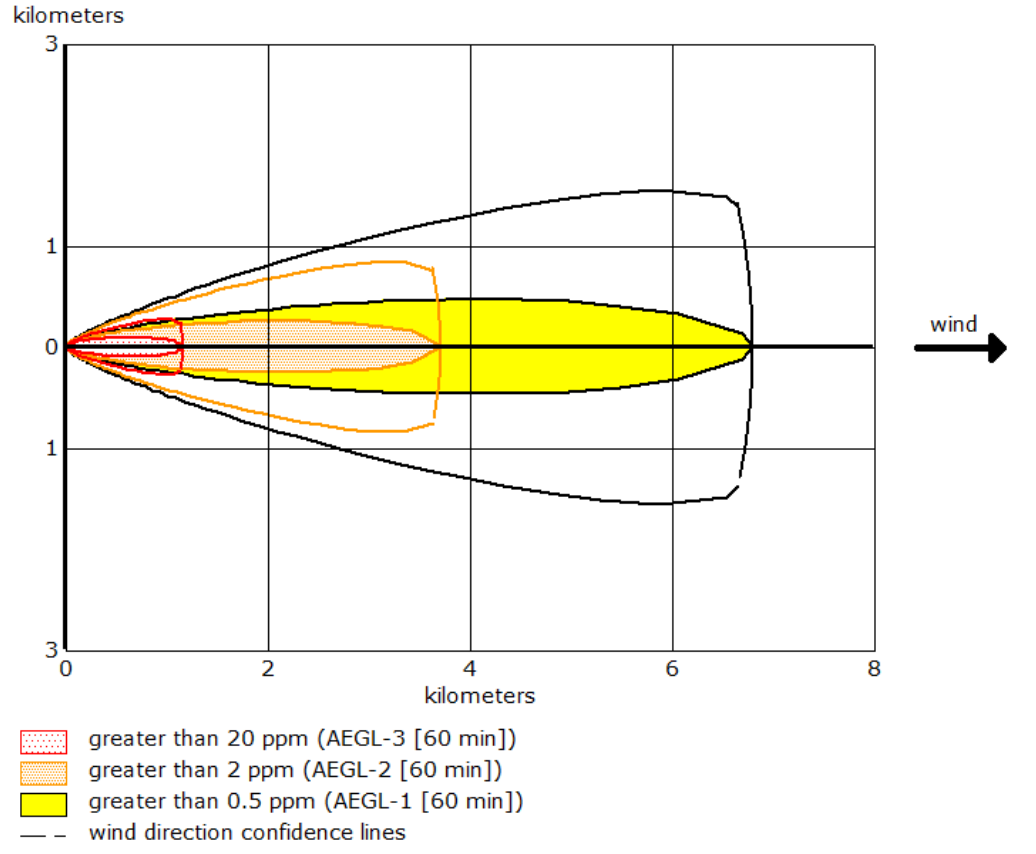
The risk contours for hypothetical risk scenarios considered for chlorine storage have been have been presented in **Figure 1.2** to **Figure 1.4** below.

Scenario 1: Chlorine Tonner – 2.5 mm leak

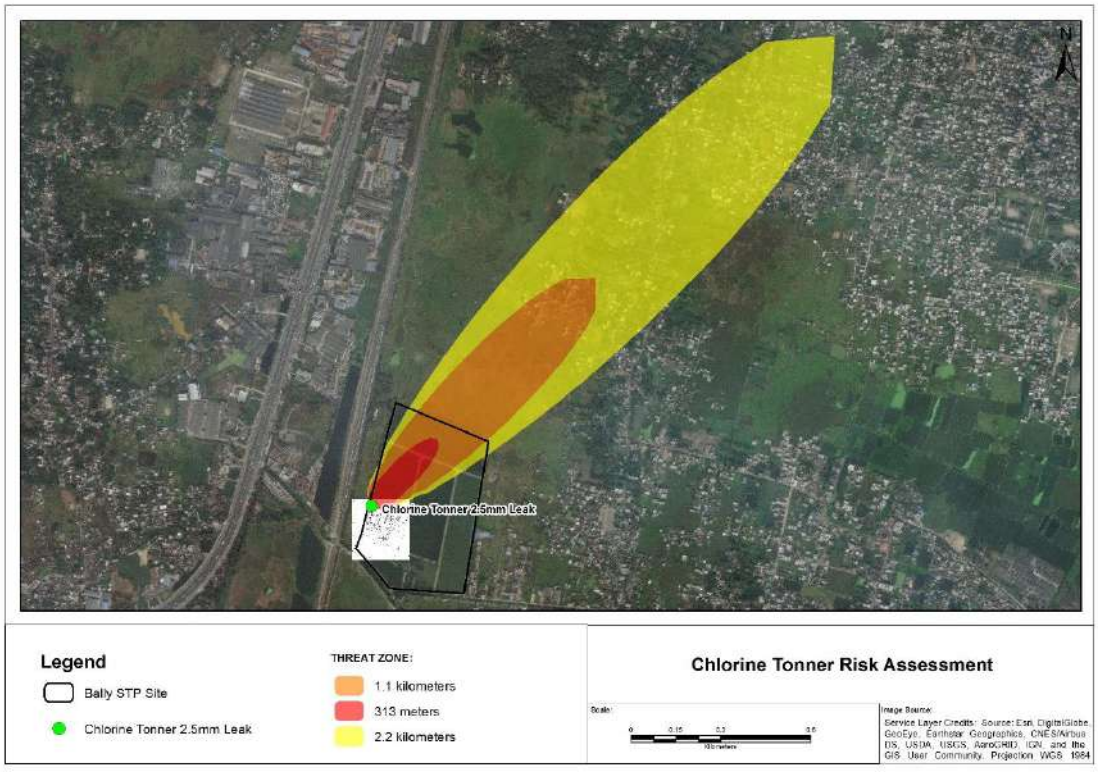
The toxic vapour threat zone plot for chlorine tonner leak of 2.5mm is represented in **Figure 1.2** below.

[1] AEA Technology, HSE Guidance Document

Figure 1.2: Threat Zone Plot – Chlorine Tonner (2.5mm leak)



Source: ALOHA



THREAT ZONE:

Threat Modelled: Toxic Level of Concern

Model Run: Gaussian

Red : 1200 meters --- (20 ppm = AEGL-3 [60 min])

Orange: 3700 meters --- (2 ppm = AEGL-2 [60 min])

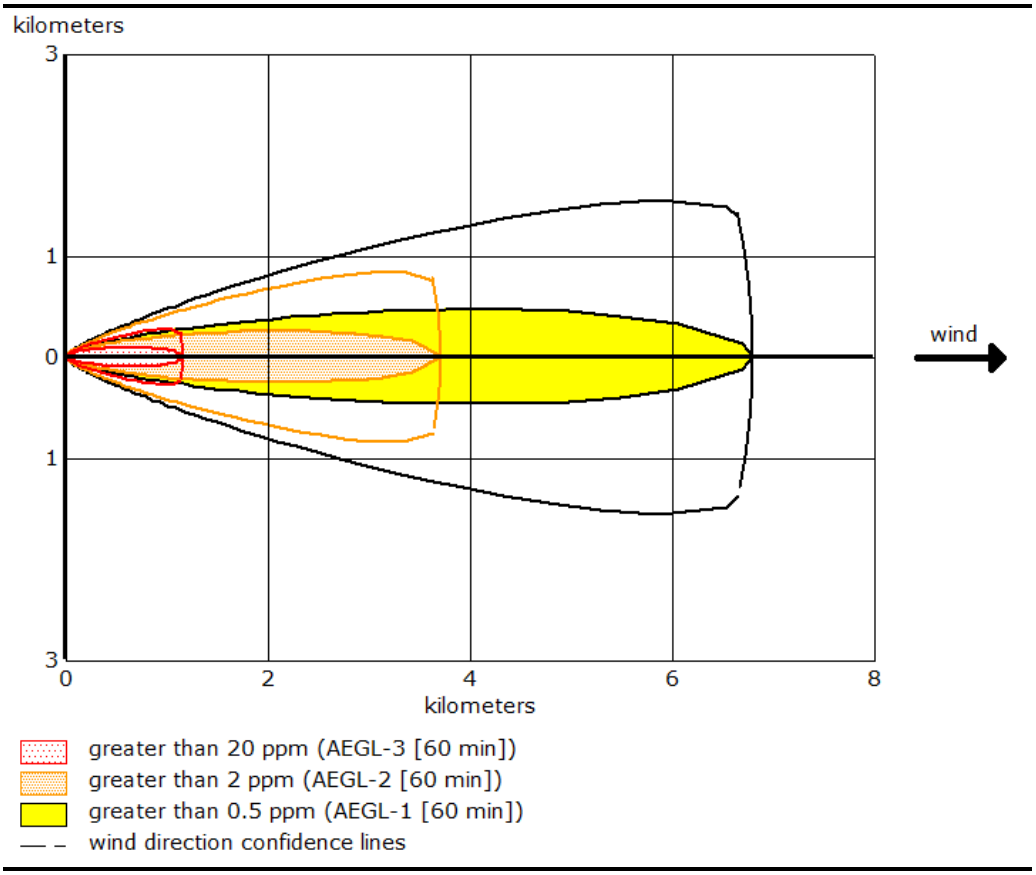
Yellow: 6800 meters --- (0.5 ppm = AEGL-1 [60 min])

The maximum effect resulting from failure of chlorine tonner (2.5mm leak) will be experienced within a maximum radial distance of 1200m from the source with potential lethal effects within 1 hour.

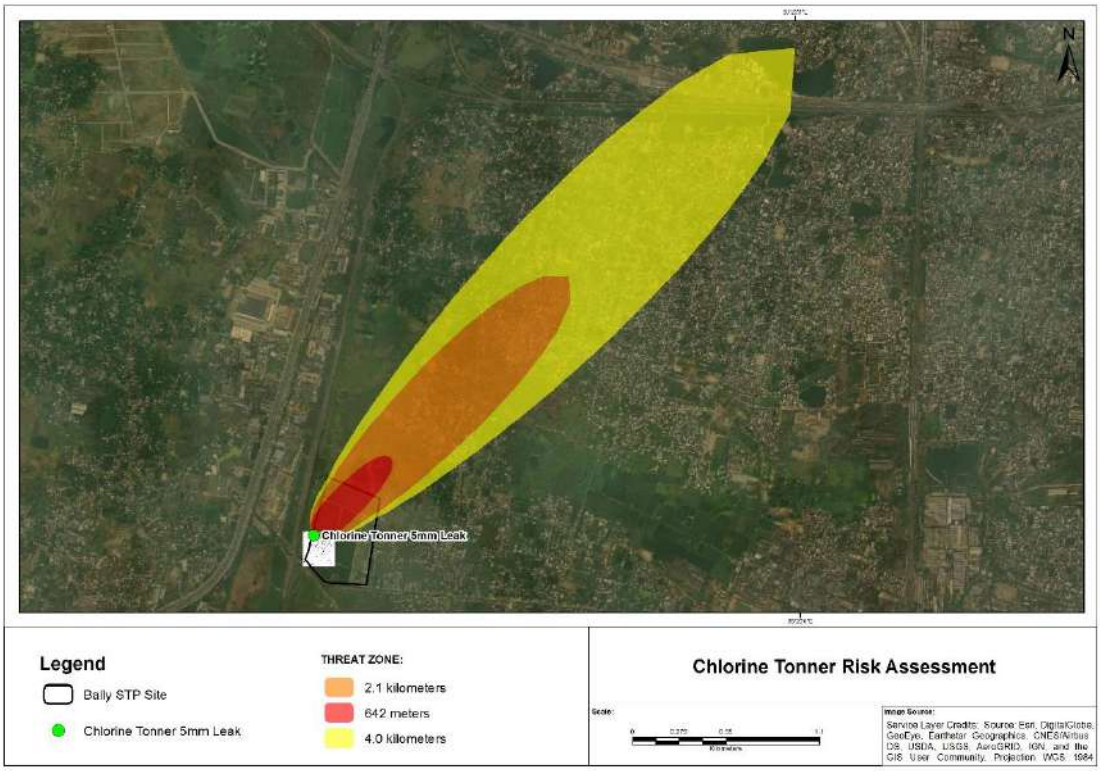
Scenario 2: Chlorine Tonner – 5 mm leak

The toxic vapour threat zone plot for chlorine tonner leak of 5mm is represented in **Figure 1.3** below.

Figure 1.3: Threat Zone Plot – Chlorine Tonner (5mm leak)



Source: ALOHA



THREAT ZONE:

Threat Modelled: Toxic Level of Concern

Model Run: Gaussian

Red : 1200 meters --- (20 ppm = AEGL-3 [60 min])

Orange: 3700 meters --- (2 ppm = AEGL-2 [60 min])

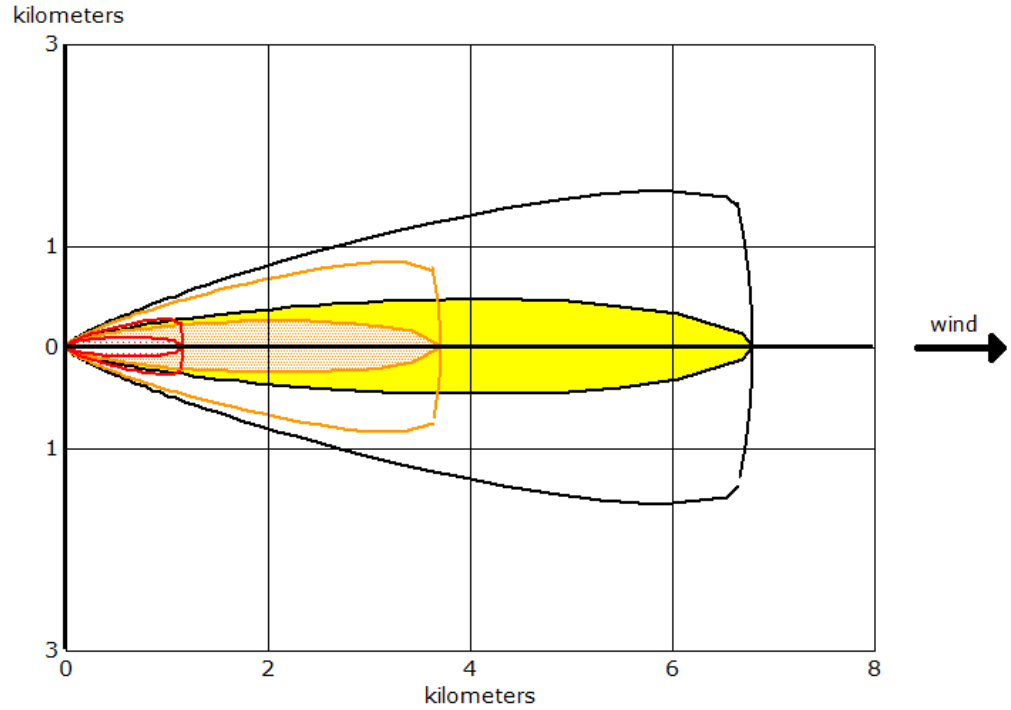
Yellow: 6800 meters --- (0.5 ppm = AEGL-1 [60 min])

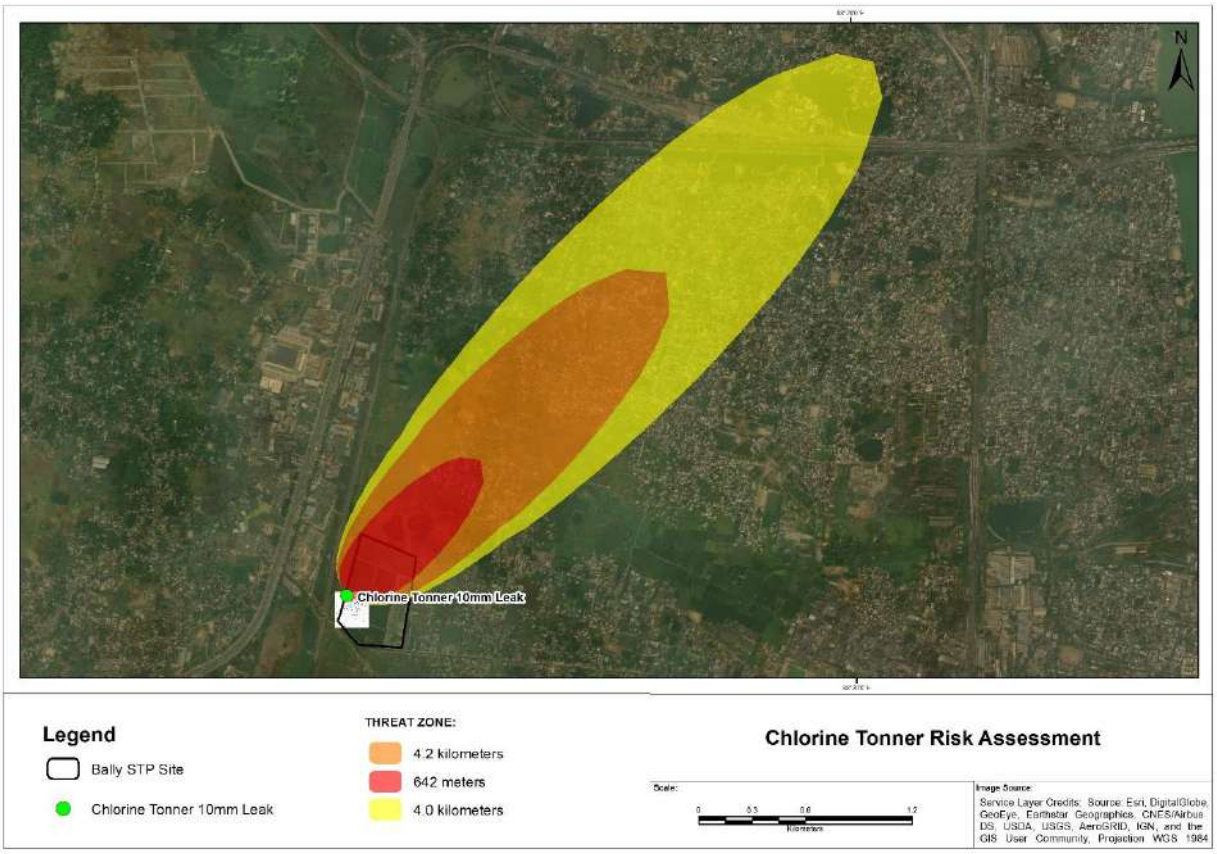
The maximum effect resulting from failure of chlorine tonner (5mm leak) will be experienced within a maximum radial distance of 1200m from the source with potential lethal effects within 1 hour.

Scenario 2: Chlorine Tonner – 10 mm leak (Worst Case)

The toxic vapour threat zone plot for chlorine tonner leak of 10mm (worst case) is represented in **Figure 1.4** below.

Figure 1.4: Threat Zone Plot – Chlorine Tonner (10mm leak – Worst Case)





Source: ALOHA

THREAT ZONE:

Threat Modelled: Toxic Level of Concern

Model Run: Gaussian

Red : 1200 meters --- (20 ppm = AEGL-3 [60 min])

Orange: 3700 meters --- (2 ppm = AEGL-2 [60 min])

Yellow: 6800 meters --- (0.5 ppm = AEGL-1 [60 min])

The maximum effect resulting from catastrophic failure of chlorine tonner (10mm leak) will be experienced within a maximum radial distance of 1200m from the source with potential lethal effects within 1 hour.

1.5. Quantitative Risk Assessment (QRA)

A QRA has been undertaken using a standard procedure in order to estimate a numerical value for risk to people, by combining the frequency of accident occurence with the consequence of damage, leading to loss of life. For quantitative estimation of risk, 3 potential release scenario's – Catastrophic, 13 mm Hole and 6 mm Hole was considered with corresponding failure rates being 4×10^{-6}, 1×10^{-5} and 4×10^{-5} respectively, as per UK HSE database (refer Table 1.4 above). To account for event probability, the assumption was made that wind direction in any given quadrant of 45^{o} is equal with 12.5% chance of the plume to fall in any given quadrant.

The severity of accident scenarious have been re-estimated in terms of fatalities that may be caused by exposure to toxic Chlorine gas, with the reference damage assuming the deat of a normal non-protected person. The following Probit equation has been used to estimate the likelihood of fatality due to exposure to Chlorine: **$Pr = - 6.35 + 0.5 \ln (C^{2.75} t)$**, where t = 30 mins. Using this probit relationship, the concentration thresholds for Chlorine has been calculated for 3 different probability of fatality – Lethal Dose 50, Lethal Dose 20 and Lethal Dose 05 in **Table 1.5**, as follows:

Table 1.5 – Probit Values for Chlorine

Hazardous Chemical	Probability of Fatality (Probit)	Concentration (mg/m3)
Chlorine	0.5 (LD50)	870
	0.2 (LD20)	470
	0.05 (LD05)	260

As a next step, using toxic as dispersion model (in heavy gas mode) in ALOHA consequence modelling tool, the endpoint distances to respective probit values have been estimated for the 3 release scenarious, as is presented in Table 1.6.

Table 1.6 – Chlorine Toxic Effect Relationship & Endpoint Distances

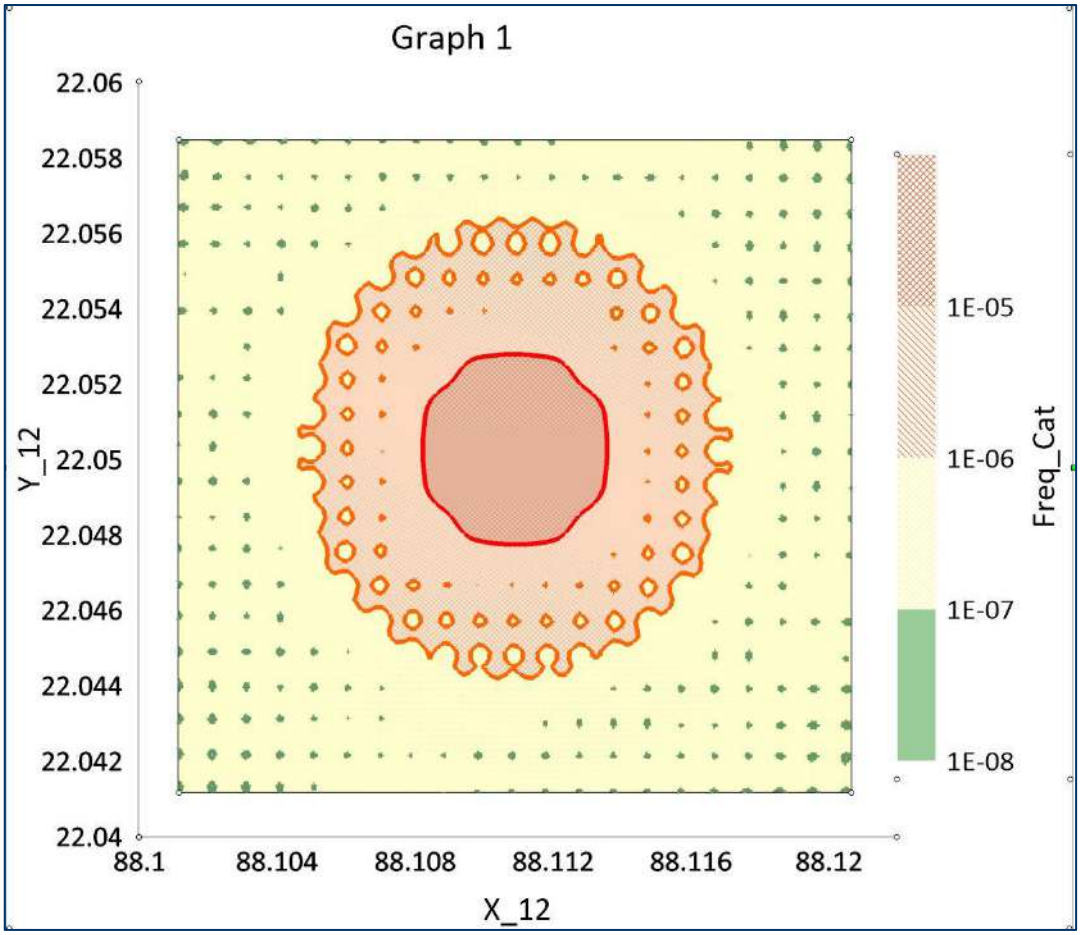
Release Scenario	Probability of Fatality (Probit)	Endpoint Distance (m)
Catastrophic (Cas)	0.5	543
	0.2	684
	0.05	858
Leak 13mm Hole (L13)	0.5	300

Release Scenario	Probability of Fatality (Probit)	Endpoint Distance (m)
	0.2	408
	0.05	545
Leak 6 mm Hole (L6)	0.5	150
	0.2	222
	0.05	328

Individual Risk is estimated as as the probability at which an individual may be expected to sustain a level of harm from specified hazards by combining the level of consequences with their frequency of occurrence. Graphically the IR is represented by a spatial risk summation of all the 3 scenarious across the 3 probit endpoint distance of damage to calculate the resulting Individual Risk at a particular x,y location from the source (the location of the Tonner).

The result of the summation show IR contours as in **Figure 1.5** with the Iso-risk contour of 1X 10^{-5} (per year), an IR level higher to which is considered unacceptable as per Dutch VROM Directives, at within 300 m from the source of where the Chlorine tonner is located with the STP site and would mostly be lying within the boundary of the STP premises. The iso-pleth level of 1X 10^{-6} (per year) is at around 600 m radial distance beyond which the risk is to be considered acceptable. In the zone between 300 m – 600 m, the risk level can be considered as As Low As Reasonably Achievable (ALARA) which would mean that reasonable mitigation and adaptive measures need to be taken to try and bring down the risk to acceptale level at below 1X 10^{-6} (per year).

Figure 1.5: IR Contours after Risk Summation



A second metric for risk estimation, as a part of QRA, is Societal Risk (SR) and provides the relationship between frequency and the number of people that may suffer from a specified level of harm in a given population from the relaization of specific hazards (here, a Chlorine relase). This metric will be dependant on the population present in the vicinity of the Baranagar STP.

Out of the several measures to estimate SR, the Potential Loss of Life (PLL) measure has been chosen because it allows for a spatial display of the risk to the society by combining the damage potential with population desnity estimates and therefor can be used as a basis for discussion with the administration for drawing up risk resduction measures for the area. It is important to take note that SR is a conservative risk metric as it always considers all people to be unsheltered and always present at their residences. The PLL has been estimated using the following expression:

$$\mathbf{PLL}_{(x,y)} = \left[\mathbf{IR}_{(x,y)} \times \mathbf{NP}_{(x,y)} \right]$$

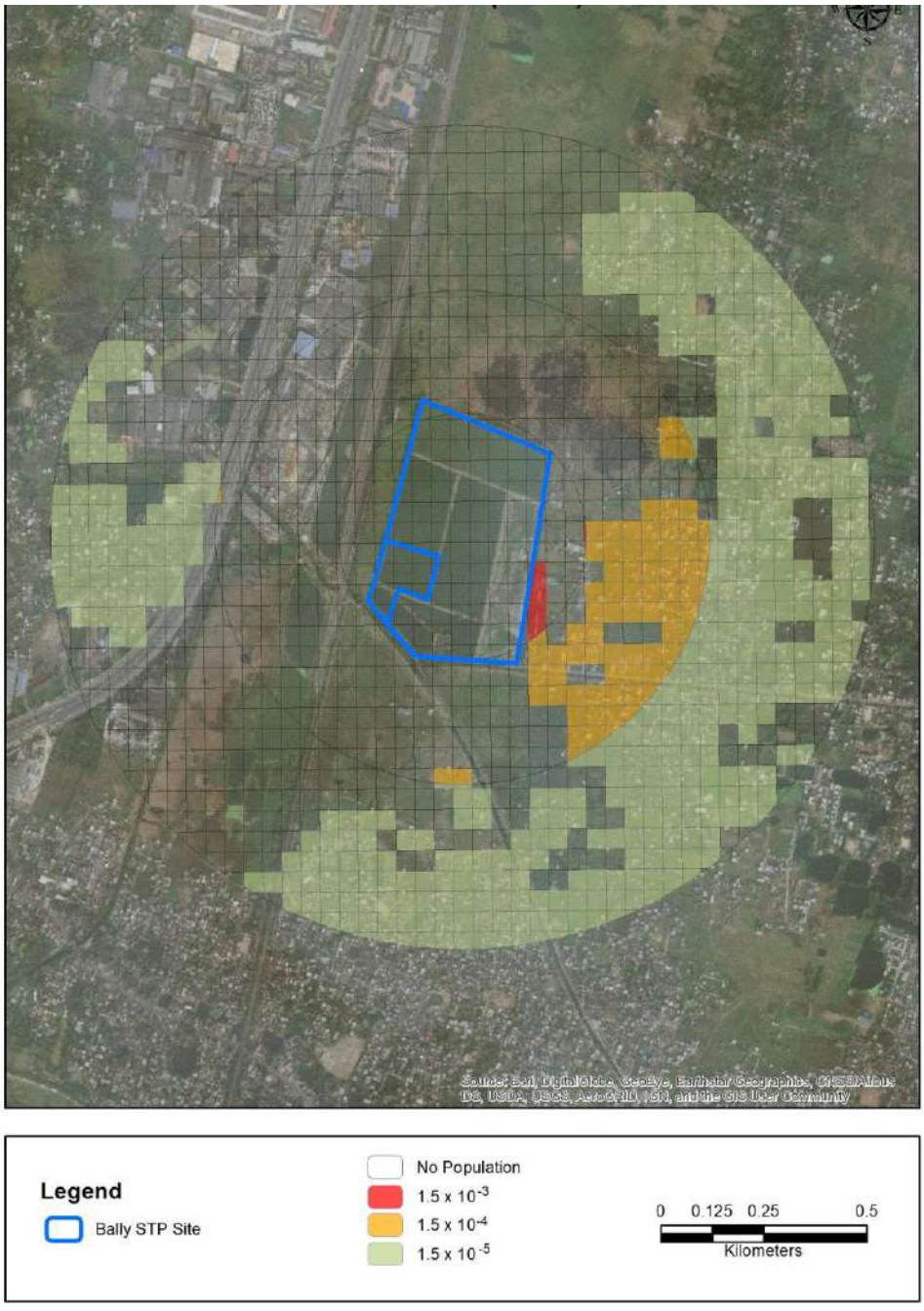
- $PLL_{(x,y)}$ is the Potential Loss of Life at a geographical location (x, y);
- $IR_{(x,y)}$ is the individual risk at location (x, y); and
- $NP_{(x,y)}$ is the number of people at a geographical location (x, y).

To allow for PLL to be spatially calculated across a spatial grid, an interpolated population database taking into account an area of 1 kms radius around the facility has been developed on a 50 m X 50 m grid, accounting for residential areas and with average population calculated based on Ward level population as per 2011 Census. The spatial PLL map shown in **Figure 1.6** shows the number of people in the grid affected by risk levels 1.5 X 10^{-3} (red), 1.5 X 10^{-4} (amber), 1.5 X

10^{-5} (green) / year respectively. The total estimated population who would be exposed to the specific SR levels are presented in **Table 1.6**.

Societal Risk Level	Population at Risk
1.5 X 10^{-3} (red)	300
1.5 X 10^{-4} (amber)	4100
1.5 X 10^{-5} (green)	22650

Figure 1.6: Societal Risk as Potential Loss of Life (PLL)



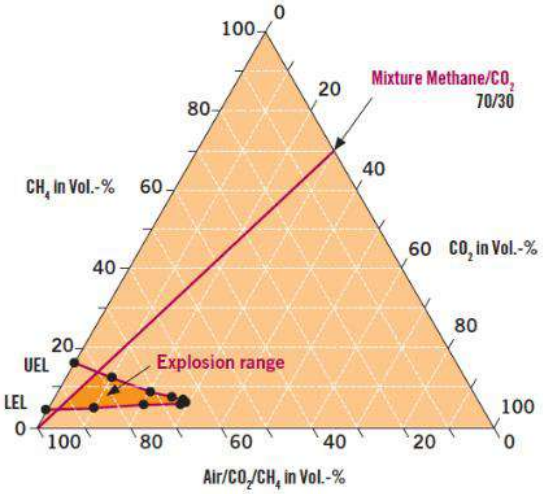
1.6. RA Discussion - Biogas

Biogas produced by an anaerobic digestion plant is composed of combustible gases methane (50-75%), carbon dioxide (25-50%), water (H2O), nitrogen (N2), oxygen (O2), hydrogen sulfide (H2S), ammonia (NH3), and trace elements (organo-halogenated, siloxanes, etc.), with the composition varying depending on the nature of the substrates being used and the operating conditions.

The hazards arising out of biogas production, storage and transportation system (using pipelines) potentially include fire and explosion, risk of gas poisoning or asphyxiations through creation of oxygen deficient atmosphere, hazards associated with pathogens and due to confined space

entry. For the purposes of this risk assessment, the fire and explosion risk that may be caused by the leakage of Bio-gas has been considered.

The fire and explosion risk for biogas, often in combination with air, depends on several factors like presence of sufficient amount of combustible gas (methane), presence of oxygen from air and that of an ignition source, and will be particularly high close to the digesters and the gas storage. The explosion regions of the methane – air mixtures are represented by triangular explosion diagrams as one below drawn up by the German Biogas Association.



In the case of a leakage resuting in an accidental release of biogas into the surrounding mixture, an explosive mixture can be formed if concentration for the Lower Explosive Limit (LEL) of methane is exceeded and the level is below the Upper Explosive Limit (UEL). Given that the plant building and associated infrastructure are well spread out, it is very unlikely that any leaked out gas would find an enclosed space in which such explosive gas mixture can develop. Also, because the gas would not be stored under pressure, the possibility of a jet fire would also be very remote. However, on modelling for probable jet fire or vapour cloud explosion scenario for biogas using ALOHA consequence assessment model, the tool did not result in any hazard footprints to recognised end-points or levels of concern (both for fire radiation and explosion overpressure).

1.7. Risk Mitigation & Emergency Management Plan

In order that the risk posed by the the hazardous substances stored within the STP site (Chlorine & Biogas), a risk management framework which comprising of risk mitigation measures and an emergency prevention and response plan has been formulated and is presented in the following sections.

Risk Mitigation Measures – Chlorine

The STP site would conform to the following safeguards/risk mitigations as per Indian Standard IS 10553, Part I – General Guidelines for Chlorination Plants including handling, storage and safety of Chlorine drums:

- ***Chlorine Leak Absorption System:*** An air extraction system connected to a Leak Absorption System will be provided for the tonner room and chlorinator room to remove chlorine in contaminated air, in case of Chlorine leak in these rooms**.** The extraction system will consist of extractor fans 2 Nos**.** (1W**+**1S) withdrawing air from these areas separately by a system of low level ducts through a chlorine absorber and discharging chlorine free air to the atmosphere**.** The ductwork will be arranged to extract from the rooms and provided at floor level connected to the absorber**.** The scrubber exhaust rate will be designed to maintain

negative pressure in the tonner room and Chlorinator building during a leak. In the chlorine scrubber tower, the chlorine gas will be neutralized with absorbent (Caustic) solution. The pH of the spent absorbent (caustic) will be checked at the outlet of the scrubber. If the pH is found to be high, then absorbent will be neutralised with water in a neutralisation pit. This activity would be triggered only in case of an accidental release of Chlorine which has a probability of less than 1 event in less than 100 years. If such an instance occurs, the neutralised water from the pit would be recycled back to the Clarifier and will be treated through the STP system, before being discharged along with treated sewage water.

- ***Absorbent Tank:*** The absorbent to be used for Chlorine would be Caustic (NaOH) solution. The concentration of caustic used in the absorber will be selected such that it can limit the temperature rise during the absorption process to 10^{o}C. One (1) no, Caustic solution cum recirculation tank adequate to neutralize the content of One (1) Chlorine drum will be provided for this purpose. The tank will also be provided with dilution water supply.
- ***Caustic Solution Recirculation Pump:*** Two (2) Nos. Horizontal Centrifugal Type Caustic Solution Pumps (1W+1S) will be provided to transfer the NaOH solution required for neutralizing the contents of one chlorine drum (1000 kg), from the storage tank to the scrubber. These pumps will also be used for loading the Absorbent Holding / Recirculation tank with fresh caustic solution.
- ***Chlorine Leak Blower***: Extraction fans will be mounted on the downstream side of the absorber to induce an upward draft of contaminated air through the absorber. Two Centrifugal Blowers (1W+1S) each of capacity adequate to provide the required number of air changes per hour will be provided.
- ***Chlorine Leak Response:*** If an extensive Chlorine leak is identified, an effort should be made by the Chlorination Plant operator should warn all persons in the path of the gas, notify the STP plant manager and consider intimating the chemical emergency coordinator, fore brigade or the police. Water shall not be sprayed on the Chlorine leak as it tends to make the leak worse because of corrosive effect. If the leak occurs in an equipment where Chlorine gas is being used, the controlling valves at the Chlorination Toners should be immediately closed. Leaks around valve stems would be stopped immediately after detection by tightening the packing nut or the gland.
- ***Storage Area Restrictions:*** It should be ensured that no other compressed gas containers, inflammable materials, turpentine, ether, anhydrous ammonia or finely divided metal should be stored in the Chlorination Plant. The storage

Emergency Management Plan

Emergency Management is a process or strategy that is implemented when any type of catastrophic event takes place. The Emergency Management Plan envisages the need for providing appropriate action so as to minimize loss of life/property and for restoration of normalcy within the minimum time in event of any emergency. Adequate manpower, training and infrastructure are required to achieve this.

The objectives of the site's Emergency Management Plan will be as follows:

- Rapid control and containment of the hazardous situation;
- Minimising the risk and impact of occurrence and its catastrophic effects;
- Effective rehabilitation of affected persons and prevention of damage to Property and environment;
- To render assistance to outside the factory.

The following important elements in the Emergency Management Plan (EMP) are recommended to effectively achieve the objectives of emergency planning:

Command, Co-ordination and Response Team

One of the most important objectives of emergency planning is to create a response organisation structure capable of being developed in the shortest time possible during an emergency.

Command and control of an emergency condition, will cover the key management functions necessary to ensure the least impact on environment, health and safety of employees, as well as the public living in the vicinity. These primary functions to be commanded are as follows:

- Detection of the emergency conditions;
- Assessment of the conditions;
- Classification of emergency;
- Mitigation of the emergency conditions;
- Notification to management personnel;
- Notification to local, state, and government agencies;
- Activation and response of the necessary on-site and off-site support personnel;
- Continuous assessment and reclassifications, as necessary;
- Initiation of proactive actions;
- Aid to affected personnel;
- Recovery and re-entry.

Training Program

Training is one of the basic components of disaster management. In principle, anyone who occupies a position within the disaster management plant organisation undergoes some kind of training, followed by refresher courses at periodical intervals.

The main goal of training for emergencies is to enable the participants to understand their roles in the response organisation, the tasks associated with each position, and the procedures for maintaining effective communications with the other response functions and individuals. An in-house team will be appointed for the development of such training programme. This team is composed of the same people in-charge of developing and reviewing the response plan.

Mock Drill

In spite of detailed training, it may be necessary to try out whether, the emergency plan works out and will there be any difficulties in execution of such plan. In order to evaluate the plan and see whether the plan meets the objectives of the emergency plan, periodical mock drills are contemplated. Before undertaking the drill, it would be very much necessary to give adequate training to all staff members and also information about possible mock drill. After few pre-informed mock drills, few un-informed mock drills would be taken. All this is to familiarize the employees with the concept and procedures and to see their response. These scheduled and unscheduled mock drills would be conducted during shift change, public holidays, in night shift etc. To improve preparedness once in 6 months, ateleast one mock drill will be conducted.

PPEs

In certain circumstances, personal protection of the staff maybe required as a supplement to other preventive action. It should not be regarded as a substitute for other control measures and must only be used in conjunction with substitution and elimination measures. PPEs must be appropriately selected individually fitted and workers trained in their correct use and

maintenance. PPEs must be regularly checked and maintained to ensure that the worker is being protected.

Internal Emergency Communication

The plant will install a Local Audio Alarm System, PA system, & Emergency siren with siren code to make the emergency known both inside and outside of the facility, and co-ordinating among the various groups involved in response operations. A protocol for operating the siren should be worked out and to be informed to all employees of teh STP.

Personal Protective Equipment

This equipment is used mainly for three reasons:

- To protect personnel from a hazard while performing rescue/accident control operations,
- To do maintenance and repair work under hazardous conditions, and
- For escape purposes.

Security and Access Control Equipment

In case of an emergency the incoming response teams and resources will be directed to assembly place. Admission to contaminated area / effected area will be restricted. The response team and resources coming from outside will reach to event place after permission from STP Manager. Assembly point will be a predesignated location, where, persons not-connected with emergency operations would proceed at assembly point and await for rescue operation.

APPENDIX K STAKEHOLDER CONSULTATION & PARTICIPANT LIST

STAKEHOLDER CONSULTATION WITH WORKERS IN LS-3

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*
B	*Stakeholder Title:*	Belur LS -2

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C *Basic details:*

Location: Belur Math	Village/Urban: Howrah Corporation
Date: 21/06/2019	Ward no: 52 Union:

D *Attended By*

Sr.	Name	Designation
1.	Mr. Manindra Nath Das	Operator
2.	Mr. Dilip Singh	Operator
3.	Mr. Debobrato Das	Operator

E *Purpose of Consultation*

To learn about the pump operators opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.

F *Key Points Discussed:*

.

What do you know about this project? Tell us your opinion regarding this project in details: The pump operators heard about the proposed work but they don't have any clear idea about the work to be done. They are waiting for the repair/replacement of the pipelines to improve the services .

Advantages/ disadvantages of the project and Suggestions on the advantages/ disadvantages: According to them if the proposed work to be implemented the peoples of the area to be benefitted but this LS have no blockage found. There have no commercial jobs done there as well. Most of the area is being maintained by the Belur Math authorities.

The workers Lifting station is operated and maintained by Associated Co-operative .Society, a contracting agency engaged by KMDA for the operation of the STP. According to the pump operators there are two outlet point Jagannath Ghat and Rashbihari Ghat if the pipe lines repaired/replace there will be no problem . The Condition of the pump building and the capacity of machine is normal position. No leakage, water logged and blockage in the sewer line is reported in the LS-2
This LS-2 is also operated and maintained by Associated Cooperative Society.

Photo Evidence:

STAKEHOLDER CONSULTATION WITH WORKERS IN GOLABARI

A	*Project Title:*	
B	*Stakeholder Title:*	Golabari LS-6

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C *Basic details:*

Location: Golabar Ghat	Village/Urban: Golabari , Howrah Corporation
Date: 21st June 2019	Ward no: 13 Union:

D *Attended By*

Sr.	Name	Designation
1.	Mr. Subhendu Mukherjee	Operator
2.	Mr. Bijay Ghosh	Operator
3.	Mr. Pratap Ghosh	Operator
4.	Mr. Nitai Dhole	Operator
5.		
6.		
7.		
8.		

E *Purpose of Consultation*Focus group Discussion,

To learn about the pump operators opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.

F *Key Points Discussed:*

.

1. **What do you know about this project? Tell us your opinion regarding this project in details:** The pump operators heard about the proposed work but they don't have any clear idea about the work to be done . They are waiting for the repair/replacement of the pipelines to improve the services .
2. **Advantages/ disadvantages of the project and Suggestions on the advantages/ disadvantages::** According to them if the proposed work to be implemented the peoples of the area to be benefitted but one thing should remember the area is very congested and Golabari lounch Ghat is there**.**
3. According to the pump operators there is a water logging point in front of the LS and if the pipe lines repaired**/**replace there will be no problem**.**
4. Condition of the pump building is poor and the capacity of machine also**.**
5. This LS**-**6 is also operated and maintained by Associated Cooperative Society**.**

.

Photo Evidence:

STAKEHOLDER CONSULTATION WITH WORKERS IN BALLY KHAL

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*
B	*Stakeholder Title:*	Bally Khal LS -3

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C	*Basic details:*	
	Location: Bally	Village/Urban: N.K.Pal Lane, Howrah Corporation
	Date: 21/06/2019	Ward no: 51 Union:

D *Attended By*

Sr.	Name	Designation
1.	Mr. Aloke Kumar Das	Operator
2.	Mr. Shyamal Dutta	Operator
3.	Mr. Shailen Dutta	Operator
4.	Mr. Partha Banerjee	Operator

E *Purpose of Consultation*Focus group Discussion,

To learn about the pump operator's opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.

F *Key Points Discussed:*

.

What do you know about this project? Tell us your opinion regarding this project in details: The pump operators heard about the proposed work but they don't have any clear idea about the work to be done . They are waiting for the repair/replacement of the pipelines to improve the services .

Advantages/ disadvantages of the project and Suggestions on the advantages/ disadvantages: ***According*** to them if the proposed work to be implemented the peoples of the area to be benefitted but one thing should remember one road side hotel and one garage over the pipe line. Leakage have been found in the pipes of Chaital Para near Bally Jute Mill area over and a blockage was also found. N.K.Pal Lane manhole usually blocked and during rainy season water overflow the road.

According to the pump operators there is a water logging point Chaital Para near Bally Jut and N.K.Pal Lane manhole beside meat shop if the pipe lines repaired/replace there will be no problem .
The Condition of the pump building is poor and the capacity of machine as well. The workerd engaged in LS-3 is also operated and maintained by Associated Cooperative Society .

Photo Evidence:

STAKEHOLDER CONSULTATION WITH WORKERS IN LS-1

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*	
B	*Stakeholder Title:*	Ghusuri LS-1	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location: Ghusuri G.T.Road	Village/Urban: Ghusuri, Howrah Corporation	
	Date: 21st June 2019	Ward no: 3 Union:	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Mr. Juran Kumar Das	Operator
	2.	Mr. Amar Saha	Operator
	3.	Mr.Kamal Kumar Acharjee	Operator
	4.	Mr. Sanjib Mukherjee	Operator
	5.	Mr. Sadhan Kumar Pal	Operator
	6.	Mr. Gopal Prasad Kisori	Operator
E	*Purpose of Consultation*Focus group Discussion,		
	To learn about the pump operators opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.		
F	*Key Points Discussed:*		
	• The pump operators heard about the proposed work but they don't have any clear idea about the work to be done. • They are waiting for the repair/replacement of the pipelines to improve the services . • According to them if the proposed work to be implemented the peoples of the area to be benefitted but one thing should remember the area of Naskar Para Road, Kali Majumder Road are very congested. • According to the pump operators there is no water logging point of the LS-1 and if the pipelines or machines repaired/replace there will be no problem. • The Condition of the pump building is poor and the capacity of machine non-functional. The workers in LS-1 are worker under the Associated Cooperative Society. • In Golabari, the area near to the LS is highly congested and accordingly a Golabari Ghat is located near to the LS. Therefore, safe access for passengers should be provided during the construction period. • According to the pump operators in both the LS, there is water logging point in front of the LS. **NOTE: The respondent has denied to provide their personal details and signature**		
Photo Evinence:			
			

STAKEHOLDER CONSULTATION WITH WORKERS IN SALT GOLA

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*
B	*Stakeholder Title:*	Salt Gola LS-5

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C	*Basic details:*	
	Location: Salt Gola	Village/Urban: Salt Gola, Howrah Corporation
	Date: 5th July 2019	Ward no: 23 Union:

D *Attended By*

Sr.	Name	Designation
1.	Mr.Mahesh Prasad Kesari	Operator
2.	Mr.Subhendu Ganguly	Operator
3.	Mr. Goutam Mukherjee	Operator
4.	Mr. Sujit Daw	Operator

E *Purpose of Consultation*Focus group Discussion,

To learn about the pump operators opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.

F *Key Points Discussed:*

- The pump operators heard about the proposed work but they don't have any clear idea about the work to be done .
- They are waiting for the repair/replacement of the pipelines to improve the services .
- According to them if the proposed work to be implemented the peoples of the area to be benefitted but one thing should remember the area is very congested and Railway Godown are there. Proper meaures to be kept in place during construction to avoid congestion and inconveniences during construction.
- According to the pump operators there is no water logging point of the LS and if the pipe lines repaired/replace there will be no problem.
- Condition of the pump building is poor and the capacity of machine also.
- This LS-5 is also operated and maintained by Associated Cooperative Society.

Photo Evidence:

STAKEHOLDER CONSULTATION TEMPLE AUTHORITY

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*
B	*Stakeholder Title:*	BELUR PANCHANAN TALA JAGANNATH TEMPLE
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.		
C	*Basic details:*	
	Location:	Village: Ward number: 58 & 59
		Municipal: BELUR MUNICIPALITY (HMC)
	Date	17/7/2019
D	*Attended By (List attached)*	
	Sr.	Name / Designation
E	*Purpose of Consultation*	
	Proposed work of KMDA for repairing/desilting/replacement of underground Pipe both Intake and Outlet Point/	
F	*Key Points Discussed:*	
	1) Proposed work to be done 2) The Authority 3) The inconvenience may be caused during implementation Period 4) Miscellaneous .	
	Key concern and suggestion expressed by Community:	
	• According to the Members, presented during the consultation, The Temple is a years old Temple . At the time of Ganga Action Plan Project the Structure of the Temple was affected partially and the Implementing Authority reconstructed the affected Portion . • The Members objected about the out fall that behind the LS. They told that “first you stop that out fall through which the sludge water polluted the river Ganges “ . • They will cooperate at the time of implementation . • The clearly expressed that if any damage done during the work the Authority will have to reconstruct the affected portion of the Temple . • They made us cautious about the traffic of that portion and the water pipe lines	

Photo Evidence:

ESIA Study for Three STP Locations
Stakeholder Consultation Participant List

Venue: Panchanantala Jagannath Temple Date: 17/7/19

Sl. No.	Name	Designation	Contact No.	Signature
1.	Mr. Tarun Roy.	Member.	9903039691	Tarun Roy
2.	Mr. Supriay Bhowmik	"	9883535405	
3.	Mr. Paritosh Saha.	"	9163828376.	Paritosh Saha
4.	Mr. Nimai Halder	"	93308875 02	Nimai Halder
5.	Mr. Kanu Das	"	9051965892	Kanu Das

STAKEHOLDER CONSULTATION WITH COMMUNITY IN KONA

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*	
B	*Stakeholder Title:*	Local People	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location: Kona MPS	Villag: Ananda Nagar and Bhatta Nagar, GP: Chakpara Ananda Nagar,Block : Jogacha ,District : Howrah	
	Date: 22nd June 2019	Ward no: Union:	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Mr.Hare Ram Pandey	Cityzen
	2.	Mr.Sunil Mondal	Cityzen
E	*Purpose of Consultation*		
	To learn about the local people opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.		
F	*Key Points Discussed:*		
	.		
	• The local people don't have any clear idea about the work to be done. They are waiting for the repair/replacement of the machine or pipe line to improve the services . • According to them if the proposed work to be implemented the fisherman of the area to be benefitted. The last 3 months MPS has stopped. • The water which falls in this bheri resulted difficulty in the cultivation of fish so the fishermen requested the pumping to start again. there is no water logging point and if the pipe lines repaired/replace there will be no problem. • This area was under Bhatta Jamindar and later it was declared demesne land. • There were about 108 families farming in that low land. When a waste treatment plant project came in this area, its main purpose was to filter the waste waters. The people who were dependable on that land, rehabitation and resettlement were organized. • Every farmer was given 2 katha land in good locationsand their livelihood was changed from farming to fishing. • A co-operative was also created there. Every year a token money was also given to them. After 2014 this co-operative was closed and At present, every year through lease that fish cerate is working till date.		

STAKEHOLDER CONSULTATION WITH LOCAL MARKET IN BELUR

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts*
B	*Stakeholder Title:*	Morning Market at Belur Panchanan Tala (B. K. Pal market)

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C *Basic details:*

Location: Belur	Village:
Date: 27/8/2019	Ward no: 59 Union:

D *Attended By*

Sr.	Name	Designation
1.	Md . Dulhara Ahmed	Azam Chicken centre
2.	Sri.Shyamal Ghosh	Vegetable Vendor
8.		

E *Purpose of Consultation*

To learn about the affected community's opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.

F *Key Points Discussed:*

Brief History of the Market :

- The market vendors use to seat regularly both side of B. K. Pal Road of Belur Panchanan Tala . Vegetables , Fish and meat are sold here . Per day income approx ranging from 200 to 500
- The said market starts on regular basis in the morning around from 6am to 1pm. The vendors comes from surrounding areas , most of them are from poor family and as the people who comes for marketing also are from lower income group so the per day income of the vendors is low.
- As the vendors use to seat in open area they are facing problem in rainy season .
- Talked with the vendors Dulhara Ahmed, Subha Bar, Gopal Mandal Shyamal Ghosh and others regarding the project of KMDA, they told us that they will cooperate at the time of implementation ,

Suggestion: The local people requested to minimize the impact and the road should be repair in proper manner immediate after the implementation work completed.

Photo Evidence:

STAKEHOLDER CONSULTATION WITH TEMPLE AUTHORITY

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts*
B	*Stakeholder Title:*	Temple at Bimal Ghat (Jaya Bibi Road)

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C *Basic details:*

Location: Belur	Village:
Date: 24/8/2019	Ward no: 38/39 Union:

D *Attended By*

Sr.	Name	Designation
1.	Sri . Shyam Chandra Jha	PUJARI
2.	Sri. Paras choudhury	Member of the Temple committee.
8.		

E *Purpose of Consultation*

To learn about the affected community's opinion on the project, advantages/ disadvantages of the project, their opinion on minimizing the adverse situations.

F *Key Points Discussed:*

- *The Temple estd in the year 1969 by one of Sri. Gopal Singh and from that time Shyam Chandra Jha is serving as Pujari and now He is all in all .*
- *This is a Shib Temple and Idol of Hanumanji is also there. The Property of the Temple other than the main temple/temples three rooms are there used for rent .*
- *The Pujari Cattle shed almost over the Out fall and has gavin it to a Person on Rent .*
- The Pujari and others are not aware of this Project but they wants to improve the condition of the Pipe lines so that the wter of river Ganga to be clean in future.
- According to them this Project will protect the water of river Ganga**.**

Photo Evidence:

STAKEHOLDER CONSULTATION WITH FISHERMEN

A	*Project Title:*	*Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.*
B	*Stakeholder Title:*	Consultation with Fishermen Groups at WSP Kona

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C	*Basic details:*		
	Location:	Village: Kona Waste Stabilization Pond, North Howrah, Bally Jagacha	
		Howrah Municipal Corporation	
	Date	9th and 14th September 2019	
D	*Attended By (List attached)*		
	Sr.	Name *(List attached)*	Designation
E	*Purpose of Consultation*		

- To establish a baseline on the fishing activity carried out in the WSP pond.
- The consultation also aimed to understand the agreement between the Fishing Cooperatives and the Gram Panchayat/ BDO over the land leased out for fishing activities.
- The consultation was carried out with the presence of representatives of Maa Ganga Fishing, Ma Tara Fishing, Jivan Jivika Fishing and Maa Kali Fishing.

Points discussed:

- The WSP falls under the Chakpara Anandanagar Gram Panchayat. The WSP land was previously being overseen by the Block Development Office (BDO), Bally Jagacha and it was revealed that the tender for fishing activities at the WSP was floated by the Panchayat Samiti, under Bally Jagacha Block.
- Present at the meeting were representatives from Maa Ganga Fishing, Jivan Jivika Fishing, Maa Kali Fishing, and Maa Tara Fishing. It was revealed that the lease agreement of these cooperative groups comprises of three cycles i.e from 2017-2018, 2018-2019 and 2019-2020. The main type of fish cultivated is rohi, katla, chingri, japani Puti, hybrid koi as well as other few hybrid fishes.
- As per discussion with Maa Ganga Fisheries representative, Mr. Indrojeet Debroy, the group has 11 members who made an initial investment of Rs. 2 Lakhs each. This group utilises Pond 1 (Maturation Pond) and they indicated that they harvest 4 times a year, with approximately 500 kgs for the first 3 cycles. They indicated that they yield 7-8 tonnes during the last cycle and that they sell their produce to the local market. They also indicated that they they made the full payment of 3 lakhs during the first cycle i.e. the 2016-2017 cycle. During the second cycle, i.e. the 2017-2018 cycle, they made a payment in two installments i.e. 60% and then 40%. During the present cycle i.e 2019-2020, they have already made 40% of the payment i.e. Rs. 1,20,000 in cash, for which a receipt was also produced.
- As per discussion with Jivan Jeevika Fishing representative, Mr. Sanjoy Mondal, the group has 12 members and they have been functioning since 2017. They utilise pond Pond 6 (Anaerobic Pond) and Pond 2 (Facultative Pond).
- As per discussion with Maa Kali Fishing representative Mr. Amit Roy, the group has 14 members and utilise Pond 4 (Maturation Pond) and Pond 5 (Anaerobic Pond). They mostly cultivate small fish. Reportedly, they have already made 40% payment for the 2019-2020 cycle. They also indicated the fish cultivated at pond 5 which is the anaerobic pond, is mostly affected in terms of yield.
- As per discussion with Maa Tara Fishing representative, Mr. Amit Mondal and Mr. Babusona Patip, the group has 10 members and they utilise Pond 3 Facultative Pond. For the cycles, 2017-2018 and 2018-2019, they have made the full payment of 3 lakhs each cycle, to the Gram Panchayat but have not yet made the payment for the present cycle 2019-2020. It may be noted that since the group leader for Maa Tara fisheries, Mr. Babusona Patip was not able to physically attend the meeting, the ERM team was able to discuss with him over the phone. In addition, a representative was present on his behalf i.e. Mr. Amit Mondal.

- It was communicated to the fishermen groups that the construction of the STP will mainly take place at the location of Pond 5 and 6, which are both anaerobic ponds, therefore the other ponds will not be affected by the project activities.
- It was also reported that the pump house has not been working for the last 7 months and according to them, the water has become very unclear since then.
- They indicated that they have been facing a loss in the previous cycles and that they have also been utilizing their own funds for the cleaning of the chemicals present in the ponds. These chemicals were used by the previous group utilising the ponds, to increase the fish yield.
- Taking into consideration their already incurred losses, the groups thus shared their concerns about the current cycle, and particularly about not having received any intimation from either the Block Development Office or the Gram Panchayat authorities about the jurisdiction of the ponds being handed over to KMDA, and about the project as a whole.
- They therefore requested for immediate communication from the respective authorities about this new development.

Fishing Group	**No. of Members**	**Ponds Used for Fishing**
Maa Ganga Fishing	11 Members	Pond 1 Maturation Pond
Jivan Jivika Fishing	12 Members	Pond 6 Anaerobic Pond Pond 2 Facultative Pond
Maa Kali Fishing	14 Members	Pond 4 Maturation Pond Pond 5 Anaerobic Pond
Maa Tara Fishing	10 Members	Pond 3 Facultative Pond

Photo Evidence:

PROJECT NAME: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY FOR UPGRADATION OF SEWAGE TREATMENT PLANT (STP) IN BALLY
PROGRAMME: CONSULATION WITH FISHERMEN UTILISING KONA WSP
VENUE: KONA WASTE STABILIZATION POND (WSP) BASED SEWAGE TREATMENT PLANT (STP), NORTH HOWRAH, BALLY JAGACHA, WEST BENGAL
DATE: MONDAY, 9th SEPTEMBER 2019

Sl No	Name	Occupation/Designation	Address and Contact No.	Signature
	Krishna Biswas.	Jeen Jantu Matsa Jagti	Paschim Bagupara, Bhata nagar, Liluah Howrah. 988 32100 82	K. Biswas
	Indrajit deb Roy	Ma. Ganga Fisheries	Paschim Bagupara, Bhata Nagar, Liluah 91233 46858	I deb Roy

PROJECT NAME: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY FOR UPGRADATION OF SEWAGE TREATMENT PLANT (STP) IN BALLY
PROGRAMME: CONSULATION WITH FISHERMEN UTILISING KONA WSP
VENUE: KONA WASTE STABILIZATION POND (WSP) BASED SEWAGE TREATMENT PLANT (STP), NORTH HOWRAH, BALLY JAGACHA, WEST BENG
DATE: SATURDAY, 14th SEPTEMBER 2019

Sl No	Name	Occupation/Designation	Address and Contact No.	Signature
1	SANJAY MONDAL		VILL & PO - Amandanagar P.S - Liluah, Dist - Howrah Pin - 711227	S Mondal 14/9/19
2	ASHOK MONDAL	"	Do	Ashok Mondal 14/9/19.
3	INDRAJIT DEB ROY		DO	I deb Roy
4	Amit Roy		DO	Amit Roy 8443872625
5.	Amit Mondal.	Far-3 No Pond.		Amit Mondal. 8617782344
6	Biroj Singha Roy	DO	DO	Biroj Singha Roy 9051019197

STAKEHOLDER CONSULTATION WITH EXISTING WORKERS STP, MPS AND LS

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.	
B	*Stakeholder Title:*	Consultation with Workers at Arupara and Bally STP and Associated Facilities	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Chittaranjan Bayam Samiti, 16 Naskapara Byelane, Howrah	
		Howrah Municipal Corporation, West Bengal	
	Date	17th of September 2019	
D	*Attended By (List attached)*		
	Sr.	Name *(Key attendees)*	Organization/ Individual
	1	Parthapratim Bandyapadhyay	Executive Engineer (E/M) KMDA
	2	Debashish Ganguly	Executive Engineer (GAP), KMDA
	3	Anjan Kumar Bhuniya	Executive Engineer (Civil), KMDA
	4	Sushanta Kumar Banerjee	Assistant Engineer (Civil), KMDA
	5	Sibu Chandra Dey	Assistant Engineer (E/M), KMDA
	6	There was no representation from NMCG	
	7	Amar Saha	Chairman, M/s. Associated Cooperative Labour Contractor and Construction Society Ltd & Operator at LS 1 Ghusri
	8	Jibon Majumdar	Secretary, M/s. Associated Cooperative Labour Contractor and Construction Society Ltd
	9	Amalesh Ch. Jana	Director, M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd
	10	Pradip K. Chandra	Chairman, M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd
	11	Ananta Sinha	VA Tech Wabag
	12	Sunil Kumar Ganguly	VA Tech Wabag
	13	Shantanu Roy	VA Tech Wabag
	14	Arindam Talukdar	VA Tech Wabag
	15	Workers from Arupara STP and associated sewerage puming facilities	Individuals
	16	Workers from associated sewerage pumping infrastructure of Bally WSP	Individuals
	17	Durjoy Mallick, Mayanka Singh	ERM
E	*Purpose of Consultation:*		
	■ To obtain understanding on the existing contract arrangement between KMDA the Contracting (O&M) Agency engaged at the Arupara and Bally STP and their associated facilities. ■ To physically verify to the extent possible the deployed manpower at the project facilities at Arupara and Bally, in presence of the workers themselves or by their nominated representatives. ■ To understand from KMDA, the modalities and thought process for re-engagement of the existing workers.		
	Points discussed: ■ The programme began with a briefing on the purpose of the consultation along with a round of introduction by all the members present i.e. KMDA, VA Tech Wabag, ERM and the workers		

and/or representatives from the O&M agencies engaged at the Arupara and Bally STP sites and associated facilities.

- The discussion revealed that the contractors at these facilities are engaged by three different O&M agencies i.e. M/s. Associated Cooperative Labour Contractor and Construction Society Ltd; M/s. M.C.E Construction, and M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd since 2009, 2008 and 2006 respectively.
- The list of workers shared by KMDA (hereinafter stated as "KMDA list") mentions M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd. as the only O&M agency engaged at these facilities. The table below thus highlights the names of the agencies and the time period of engagement. Futher details on the manpower engagement at each site are mentioned in the subsequent tables.

O&M Agency	Contract Time Period
Associated Cooperative Labour Contractor and Construction Society Ltd	2009 to present
M.C.E Construction	2008 to present
Ganga Action Plan Contract Workers Co-operative Society Ltd.	2006 to present

- The workers of M/s. Associated Cooperative Labour Contractor and Construction Society Ltd and M/s. Ganga Action Plan Contract Workers Co-operative Society Ltd. present during the consultation indicated that they have been receiving their salary, ESI, PF, Bonuses as well as some increase in their salary proportionate to Dearness Allowance (DA) increase, during the government pay scale change. However, the workers under M/s. M.C.E Construction do not avail this D.A benefit.
- As reported by the workers engaged at Arupara STP, the STP was commissioned in 1970 and has not been functioning since March 2019.
- It was also reported during previous consultations that the Kona MPS in Bally has not been functioning for the last 7 months.
- Furthermore, the names mentioned in the KMDA list were verified against the names of the workers present during the consultation. Those who could not attend the consultation, were verified by the representatives of their respective agencies as well as their co-workers at their respective locations. This exercise thus revealed the following facts:
  - The name of Mr. Achinta Roy who was recently engaged at Arupara MPS, (as confirmed by his co-workers) was not included in the KMDA list. Therefore there are a total of nine (9) workers at the Arupara MPS, not eight (8) workers, as reported in the KMDA list.
  - Mr. Dip Adhikari has been engaged at the Itchapur MPS in place of his recently demised father Mr. Samir Adhikary. This engagement has been recommended by the KMDA as per their letter sent to the Secretary of M/s. Associated Cooperative Labour Contractor and Construction Society Ltd, dated 26th of June, 2019. Therefore, there are a total of eight (8) workers at the Itchapur MPS, not seven (7) workers, as reported in the KMDA list.
  - The name Mr. Pratap Karmakar, who is engaged as an operator at Arupara MPS is incorrect as per the KMDA list. His actual name is Mr. Pratip Karmakar.
  - As stated earlier, the KMDA list only mentions the name of one O&M agency i.e. M/s. Ganga Action Plan Contract Workers Co-operative Society, for both Bally and Arupara sites. The verification however revealed that M/s. Associated Cooperative Labour Contractor and Construction Society Ltd and M/s. M.C.E Construction are also engaged as O&M agencies at these two locations.
  - Therefore as per the verification, there are a total of sixty-three (63) workers at the Arupara STP and associated facilties and a total of thirty-two (32) workers at the Bally site and associated facilities.
  - Reportedly, the security guards working at the Arupara facilities are engaged directly by KMDA, and KMDA has its own plan to relocate the guards, as per their requirement.
  - The tables below highlights the updated names of the agencies including the updated numbers of workers at each facility, in the respective sites:

Arupara STP & Associated Facilities

STP & Facilities	Project Components	Location	Contractor	Manpower Involvement

Arupara	STP-Arupara	Arupara Sewage Treatment Plant, South Howrah Zone	Associated Cooperative Labour Contractor and Construction Society Ltd	24
	MPS-Arupara	Arupara Main Pumping Station		9
	MPS- Itchapur	Itchapur Main Pumping Station		8
	LS-3	Round Tank Road		6
	LS-2	CPT Land, Foreshore Road		5
	LS-1	BESU, B.E College	M.C.E Construction	5
	Security Personnel		Reportedly, they are directly engaged by KMDA	6
	Total			**63**

Bally STP & Associated Facilities

STP & Facilties	Project Components	Location	Contractor	Manpower Involvement
Bally	LS-1	Ghusuri, Hanuman Jute Mill	Associated Cooperative Labour Contractor and Construction Society Ltd	6
	LS-3	Bally Khal		4
	LS-4	Liluah, Panchanantala		4
	LS-5	Salt Gola		4
	LS-6	Golabari		4
	MPS-Kona	Kona		7
	LS-2	Belur Math	Ganga Action Plan Contract Workers Co-operative Society Ltd.	3
	Total			**32**

- It is understood from the consultation that O&M agency Associated Cooperative Labour Contractor and Construction Society Ltd is formed as a consortium of existing workers, out of which some workers are holding designated posts. For instance, Mr. Amar Saha who is working as an operator at LS 1-Ghusri (Hanuman Jute Mill) also holds the post of Chairman, Associated Cooperative Labour Contractor and Construction Society Ltd.
- Representative from KMDA indicated that the correct list of workers' names should be shared by the respective O&M agencies along with their personal details, duration of service and documentary evidence in support of their work, under the specified contractor at the site, to the Executive Engineer at KMDA Head Office.
- The workers shared the following opinions on the project:
  - They strongly expressed their apprehension of losing their jobs due to the onset of this project.
  - They also requested the authorities for their reasonable consideration to protect their livelihood and current earnings.

F

Action Points and Documents Required:

- Actual O&M contract agreements made between KMDA and O& M agencies namingly Associated Cooperative Labour Contractor and Construction Society Ltd; M.C.E Construction, and Ganga Action Plan Contract Workers Co-operative Society, related to the concerned project components for Arupara and Bally.
- Latest three months Wage Slips of the contract workers engaged at Arupara and Bally project location;
- Latest three months ESI and PF challans of the Contract Workers engaged at Arupara and Bally project location;

	■ Updated and verified list of workers from KMDA respectively for each facility at Arupara and Bally; ■ List of existing contract workers including date of birth (as per Govt. Photo ID) and the total time period of work/ service period under the agency engaged by KMDA (as applicable), from the workers at the respective facilities at Arupara and Bally project locations; ■ Information on KMDA's approach for settlement, voluntary retirement for the existing workers and/ or engagement of workers in KMDA's other facilities during 24 months project construction period and post construction O&M phase. This will require a separate meeting with KMDA, NMCG and VA Tech Wabag.
Photo Evidence:	
	

ROJECT NAME: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY FOR UPGRADATION OF SEWAGE TREATMENT PLANT (STP) AT ARUPARA AND BALLY, HOWRAH MUNICIPAL CORPORATION, HOWRAH, WEST BENGAL
PROGRAMME: CONSULTATION WITH WORKERS AT SEWAGE TREATMENT PLANT AND ASSOCIATED FACILITIES AT ARUPARA AND BALLY
VENUE: CHITTARANJAN BAYAM SAMITI, HOWRAH, WEST BENGAL
DATE: TUESDAY, 17th OF SEPTEMBER 2019

Sl No	Name	Occupation/Designation	Address and Contact No.	Signature
1.	Satyajit Chanda	Operator M.C.E Contactor	Uttar Podrah, Howrah - 9801770883	[signature]
2	Kartick Mondal	Do	B.E. College Pump House, Howrah - 3	K Mondal 9433868507
3	Partha Pramanik	J.E., KMDA	DIV. O&M-I/GAP-II Dasnagar, Howrah	[signature]
4.	Tapas Kr. Sarkar	A.E. KMDA	- Do -	[signature]
5	Parthapratim Bandyopadhyay	EE (E/M) KMDA	GAP-II (E/M)	[signature]
6	Debashis ganguly	EE/GAP/WB-I	GAP (WB-I), KMDA	[signature]
7	Anjan Kumar Bhunya	A.E (Civil) KMDA	Div. - O&M-I/GAP-II Dasnagar Howrah	ABhunya
8.	Sushanta Kumar Banerjee	AE(C) KMDA	GAP (WB-I) KMDA	[signature]
9.	Sibu Chandra Dey	A.E (E/M) KMDA	GAP(E/M)-I, KMDA	[signature]
10	Sanjay Bhattacharya	Arupara Pump House (Sr. Manager)	Accounts Emporium 8296528278	[signature]

Sl no	Name	Occupation Designation	Address & Contact No	Signature
11.	Sibangshu RN. Mukherjee	Incharge/Operator	Arupara Associated co-op. 9831065521	Sraboji
12	Sujit Roy.	Incharge/Operator	Arupara Associated co-op 6290746068	S. Roy.
13.	Sailen Das	Incharge/Operator	Arupara Associated co-op 8019975709	[signature]
14.	Jiban Mojumdar	Secretary Associated Co-op.	9903392445	[signature] 17.09.19
15	Samarnath Chaurasia	Operator -	Ichhapur Pump house 9830363665	Snehasis 17.09.19
16	Amar Saha	Chairman Associated Co-op.	Ekesmi Pump 9836578829	Amar Saha
17	Amalesh Ch. Jana -	Director Gangaactivan Co-op	9478751976	[signature]
18	Banwari Lal Das	Vice chairman Ganga Action Plan contract workers Co-op Sv. Ltd	968 8777590633	B Das
19	Pradip Kr. Chandra	Chairman Ganga Action Plan Contract Workers Co-op Society Ltd	9681274101	[signature]
20	ANANTA SINHA	VA TECH WABAG Chief Manager (O&M)	9330481521	[signature]
21	S. K. Ganguly	VA TECH WABAG Chief Mgr - Project	8260741804	[signature]
22	SANTANU ROY	VATECH WABAG Chief Manager	9383504323	[signature] 17.09.19

Sl No	Name	Occupation/Designation	Address & Contact No	Signature
23	Arindam Talukda	Va Tech Wabag Ltd	8100833340	Arindam Talukda
24	Mayanka Singh Negeiw	ERM India Pvt. Ltd	8451058225	Mayanka Singh.
25	Dr. Dipjoy Mallick	ERM India Pvt Ltd.	9820029865	

STAKEHOLDER CONSULTATION WITH BLOCK DEVELOPMENT OFFICER

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.	
B	*Stakeholder Title:*	Consultation with Block Development Officer (BDO) of Bally	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village: Block Development Office, Madhyapara, Ghosipara, Bally	
		Howrah Municipality	
	Date	28th August 2019	
D	*Attended By (List attached)*		
	Sr.	Name *(List attached)*	Designation
E	*Purpose of Consultation*		
	• To establish a baseline on the fishing activity carried out in the WSP pond. • The consultation also aimed to understand the agreement between KMDA and BDO office for over the land leased out for fishing activity. The consultation was carried out with the presence of the BDO, KMDA officials and Wabag Team.		
	Points discussed: ■ The WSP ponds fall under the Chokpara Anandanagar Gram Panchayat. The land of the WSP falls under KMDA but it has been handed over to Block Development Office under the order of the Ministry for promotion of pisciculture activity in the ponds. However under the administrative order, in future in case of any development/infrastructure work, the land will be handover back to KMDA by BDO. ■ In all the 6 ponds (2 Anaerobic, 2 facultative and 2 Maturation), fishing activity is allowed only in 4 ponds (maturation and facultative). Reportedly, no fishing activity is permitted inside the Anaerobic ponds due to the high content of BOD & COD thus the product is not safe for public consumption. ■ In the WSP ponds, fishing activity had been carried out for the last 20 years by the local from nearby the WSP location on a lease basis issued by the BDO. The WSP ponds have been lease out for fishing activity on a yearly basis. The lease was last renewed on the 31st March 2018 and since then the lease has not been renewed. Currently, the WSP pond is vacant and no fishing activity is undertaken inside the 6 WSP ponds. As a result, there will be no person to be affected on account of the proposed project. ■ In the future, if required, the lease will be renewed and fishing activity will resume only after the construction activities will be completed. ■ Fishing is reported to be carried out by the local as secondary livelihood activity and mainly for self-consumption, fishermen are not dependent on the ponds for their day-to-day earnings. Reportedly, as of the last lease record (document evidence will be shared by KMDA to ERM), the WSP has been leased out to 8-9 people to carry out fishing in the WSP ponds. ■ KMDA officials reported that lease has not been renewed and evident for the same will be provided as proof so that the project execution agency does not face any issues/problems in the future. ■ Note: During the consultation, no representative from fishermen was present during the consultation.		

PROJECT NAME: ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT STUDY FOR UPGRADATION OF SEWAGE TREATMENT PLANT IN BALLY

VENUE: BLOCK DEVELOPMENT OFFICE, BALLY JAGACHA, MADHYAPARA, GHOSHPARA, HOWRAH, WEST BENGAL 711227

DATE: 28th AUGUST 2019

Participant List

Sl. No.	Name	Designation	Contact No.	Signature
	Tapas Aine	Saha Sabhapati	9830802788	[signature]
	TAPAS MAITY	Representative MIC	9830817792	
	Udayan Mandal	S.E/KMDA	84205-99408	[signature]
	Debashis Ganguly	EE/GAP/KMDA	9830725693	[signature]
	Sushanta Kumar Banerjee	EE/GAP(WB-1) KMDA	8900108893	[signature]
	SUNIL KUMAR GANGULY	PM - WABAG	8260749804	[signature]
	SANTANU ROY	PM - WABAG	9333504323	[signature] 28/08/19
	Shri Asit Baran Ghosh	BDO - Bally.	9335879105	[signature] 28/8/19
	Asit Baran Ghosh			
	Subhas Roy	Karmadhakha	9830030386	[signature] 28/8/19

	Mr. ASIT BARAN GHOSH	BDO - Bally.		

STAKEHOLDER CONSULTATION WITH LOCAL COMMUNITY

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.	
B	*Stakeholder Title:*	Consultation with Local Community at Panchanantala	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location: Bally	Village:	
	Date: 13th of February, 2020	Ward no: Union:	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Participant List could not be obtained since the community resist to give their names and signature	
E	*Purpose of Consultation:*		
	To provide awareness about the proposed upgradation works and gather their inputs and suggestions on the project.		
F	*Key Points Discussed:*		

- A consultation was conducted with the local community residing at Panchnantola Road. This road stretch will require replacement of sewer lines. The ERM team was accompanied by the Wabag team and the purpose of the consultation was to provide an awareness about the proposed upgradation works, the implementation timeline and as well as to gather their suggestions and inputs. The team gave a detailed briefing about the duration of work, which will be approximately three days, as well as the nature of disruption.
- The name of the locality is B.K Pal Road comprising of 4 wards with 2000 households. The community reported that about 80% of the households belong to BPL community.
- The major occupation of the community is daily wages. Majority of the resident are from West Bengal followed by migrants from Bihar and Jharkhand.
- The areas around the BK Pal road faces frequent flooding especially during the rainy season. The major reason is the clogged drain connecting to the high drain. As a result the water from the low drain overflows and causes waterlogged in the areas. The community reported that as a result of this, many of the local resident were suffering from Dengue.
- The road stretches along the BK Pal road is very busy and heavy vehicle coming from Ghusuri more are passing through this road stretches. The road stretches is busy from 7 am to 1 pm and from 4 pm to 10 pm.

Concern about the Project:

- The community perceived that the proposed project will improve the drainage system in the area and hopeful the issues of water logging will be resolved. They expressed cooperation for the project during construction period.
- The community, however raised their concern that in the earlier construction work have causes damage to public utilities such as the drinking water pipelines. Therefore they urge that during replacement work, measure should be taken to avoid damage to public utilities.
- The local community were told of the grievance mechanism and a toll numbers was shared with the community members in case of any grievances.

Photo Evidence

STAKEHOLDER CONSULTATION WITH LOCAL COMMUNITY

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.	
B	*Stakeholder Title:*	Consultation with Local Community at Jayabibi Road	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location: Bally	Village:	
	Date: 13th of February, 2020	Ward no: 38/39 Jayabibi Road	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Participant List could not be obtained since the community resist to give their names and signature	
E	*Purpose of Consultation:*		
	To provide awareness about the proposed upgradation works and gather their inputs and suggestions on the project.		
F	*Key Points Discussed:*		
	• A consultation was conducted with the local community residing at Jayabibi Road. This road stretch will require replacement of sewer lines. The ERM team was accompanied by the Wabag team and the purpose of the consultation was to provide an awareness about the proposed upgradation works, the implementation timeline and as well as to gather their suggestions and inputs. The team gave a detailed briefing about the duration of work, which will be approximately three days, as well as the nature of disruption. • The name of the locality is 38/39 Jayabibi Road. In this road stretches about 11 households are residing along the road stretches. They are mainly engaged in daily labour. Women are also engaged in labour work and their monthly income is between 2000-2500 per month. • The areas around the Jayabibi road comprises of small narrow lane with small scale industry some of which are metal and engineering works. • Heavy vehicles of approximately 10-6 tyre are frequently using the road stretches. • The community reported no water logged issues in the areas. • The community perceived that the proposed project will improve the drainage system in the area and hopeful the issues of water logging will be resolved. They expressed cooperation for the project during construction period. • The community requested for advance notice prior to construction since they are utilising a portion of the road for keeping their scrap items. They however, extend their support for the project and that during construction, they will accommodate their belongings/scrap items to a nearby areas. • There is no time limit for carryout construction, however requested that during construction, they should be given a safe access path to access their homes. • The local community were told of the grievance mechanism and a toll numbers was shared with the community members in case of any grievances.		
Photo Evidence			

STAKEHOLDER CONSULTATION WITH LOCAL COMMUNITY

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Paraganas (North) and Howrah Districts.	
B	*Stakeholder Title:*	Consultation with Local Community at Paschim Ghughupara	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location: Kona	Village: Paschim Ghughupara	
	Date: 13th of February, 2020	Ward no: N/A	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Participant List could not be obtained since the community resist to give their names and signature	
E	*Purpose of Consultation:*		
	To provide awareness about the proposed upgradation works and gather their inputs and suggestions on the project.		
F	*Key Points Discussed:*		
	• A consultation was conducted with the local community residing at Paschim Ghughupara. This locality is located just outside the WSP ponds. The ERM team was accompanied by the Wabag team and the purpose of the consultation was to provide an awareness about the proposed upgradation works, the implementation timeline and as well as to gather their suggestions and inputs. The team gave a detailed briefing about the duration of work, which will be approximately three days, as well as the nature of disruption. • The name of the locality is Paschim Ghughupara under Bally Jagacha Block. The locality has approximately 1000 HHs. • The locality has 4 schools comprises of English, Hindi and Bengali medium. These schools operate between 8 AM to 3 PM in the afternoon. • Though no impacts is identified along this area, however the road for transporting construction materials during construction period will passes through this locality. Therefore the community were made aware of the vehicular movement during the construction period. The community reported no objection for the proposed project and willing to cooperate during the entire period. However they requested that in case of any damage to the existing road stretches, the project concessionaire should repair the road in order to avoid any inconvenience to the local community. • No issues of water logging is reported in the areas. • The local community were told of the grievance mechanism and a toll numbers was shared with the community members in case of any grievances.		

APPENDIX L INFORMATION DISCLOSURE

INFORMATION DISCLOSURE WITH ULBS

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Parganas (North) and Howrah Districts.
B	*Stakeholder Title:*	Howrah Municipal Corporation- Urban Local Body (ULB)
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.		
C	*Basic details:*	
	Location: Howrah Municipal Corporation (HMC)	Village: N/A
	Date: 12/11/2019	Ward no: N/A

D *Attended By*

Sr.	Name	Designation
1	Sri. Mr. Pijush Bhanja	Executive Engineer
2	Mr. Arup Roy	Executive Engineer (PWD)
3	Smt. Sabita Santra	Councillor Ward No. 39

E *Purpose of Consultation:*

Disclose about the Bally STP Project implemented by KMDA under one of the Namami Gange Program at 24th Parganas (North).

F *Key Points Discussed:*

- A meeting was conducted with the officials of Howrah Municipal Corporation to disclose about the KMDA project on the upgradation of the STP and sewerage system at Bally and Arupara STP project, both of which fall within the Howrah Municipal Corporation (HMC). Present during the meeting were the Executive Engineer, HMC; Executive Engineer, PWD and Councillor of Ward 39.
- The ERM team apprised the HMC members about the purpose of the meeting including the potential environmental and social impacts, which include impacts on air quality, noise as well as community health and safety during the construction phase. Other potential social impacts include temporary livelihood loss and access disruption, during the laying or replacement of the sewer pipelines in the project area.
- The ERM team also informed about the potential short-term disturbance in the neighbourhoods near the Arupara and Bally STP, during the construction phase. However, it was highlighted that these impacts are temporary and will be addressed through proper mitigation measures.
- It was also informed to the HMC members present that the survey would be conducted to identify the potentially affected persons at both the Arupara and Bally STP project locations. The information on the affected persons will be further updated on finalisation of the design and detailed measurement survey. If any person/s is/are assessed to be impacted, he/she will be compensated for the loss as per the Livelihood Restoration Framework (LRP) document. The members present have requested for the final project design including the timeline of the project implementation.
- The HMC members thus indicated that they understand the purpose and value of the project and mentioned that since the project is in the public interest of the community, they have agreed to offer their full cooperation during the project implementation phase.
- After the discussion, the Executive Engineer, HMC; Executive Engineer, PWD and Councillor of Ward 39, conducted a joint visit to the project area, to understand the potential areas for disruption.

INFORMATION DISCLOSURE WITH COMMUNITY

A	*Project Title:*	Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Parganas (North) and Howrah Districts.
B	*Stakeholder Title:*	Community at B.K. Pal Temple Road, Kalachand Bazar

Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.

C *Basic details:* Community at B.K. Pal Temple Road, Kalachand Bazar

Location: Howrah Municipal Corporation locality	Village: N/A
Date: 07.11.2019	Ward no: 57

D *Attended By*

Sr.	Name	Designation
1	Sri. Somnath Pal	Local People
2	Sri Debasis Chakraborty	Local People
3	Sri Ashok Shaw	Local People
4	Sri Nirmal Ghosh	Local People
5	Sri Upendra Paswan	Local People
6	Asim Das	Local People
7	Sri Paresh Nath Shaw	Local People
8	Sri Rina Roy	Local People
9	Jyoti Das	ERM
10	Subhasis Chakrabarti	ERM

E *Purpose of Consultation:*

Disclose about the Bally STP Project implemented by KMDA under one of the Namami Gange Program at 24th Parganas (North).

F *Key Points Discussed:*

- A meeting was conducted with the community at Panchanantala, Bally, to disclose about the KMDA project on the upgradation of the STP and sewerage system in an around Balli STP.
- The ERM team explained to the community about the purpose of the disclosure meeting and explained about the proposed upgradation works.
- The team highlighted that there will be potential temporary impacts particularly related to access disruption and temporary livelihood loss during the laying or replacement of the sewer pipelines.
- The team further highlighted that there will traffic disruption during the period where the proposed work will be undertaken.
- The community members have expressed their support for the project as they view it as beneficial to the community. They however requested that they be informed in advance when the work starts.
- Some members reported that due to previous experience there was a excavation work undertaken, post which the road was not repaired. Thus, the community suggested that once the roadwork has completed, the roads should be repaired accordingly.
- They also suggested that proposed works be conducted in the evenings/ night, to prevent access disruption to the in habitants.
- The members mentioned that since the project is in the public interest, they support the project activities.

Photographic Evidence

INFORMATION DISCLOSURE WITH COMMUNITY

A	*Project Title:*	Updating/Revalidation and Preparation of Safeguard Documents for Sewerage Projects implemented by Kolkata Metropolitan Development Authority(KMDA) Under one of the Namami Gange Program at North 24 Paraganas and Howrah Districts of West Bengal .
B	*Stakeholder Title:*	Fishermen of Kona WSP

Note: This document provides a working summary of the main facts captured during the consultation/key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/feedback and not intended for official review or approval.

C *Basic details:*

Location Kona WSP	Village: Chakpara, Anandanagar Gram Panchayat
Date: 12/11/2019	

D *Attended By*

Sr.	Name	Designation
1.	Babusoa Patit	Group Leader of “Ma Tara Fishing Group”.
2.	Indrajit Deb Roy	Group Leader of Ma Ganga Fishery".
3.	Shyayamal Sarkar	Group Leader of “Ma Kali Fishery".
4.	Sanjib Mandal	Group Leader of Jiban Jibika Gosthi

E *Purpose of the Meeting :*

Disclose about the Bally STP Project implemented by KMDA under one of the Namami Gange Program at 24th Parganas (North). The specific purpose of the meeting is to make the fishermen is to disclose the impacts and the proposed mitigation measures.

F *Key Points Discussed:*

- The team informed the affected cooperative societies that 2 pnds will be affected on account of the construction of the STP facility. About 30% of each of the affected ponds will be taked for the proposed work.
- The group’s members informed to have carried out fishing inside the WSP ponds from 2017 and that yearly payment for leasing out the pond is paid to the respective BDO. The group members are aware about the project. They further expressed that the work to be undertaken for the improvement of these Ponds and the modification of MPS is in the interest of the community.
- The group reported that they had been undertaken fishing in the WSP ponds from 2017 on lease basis. The lease amount is paid to the Jagacha BDO.
- No of Group members and workers involved in these groups:
- Ma Tara Fishery : 10 nos of group member including the group Leader and workers are 2 in number.
- Ma Ganga Fishery : 9 no of group member and the worker is One .
- Ma kali Fishery : 16 nos of group member and the workers are 8 in number .
- Jiban Jibika Gosthi: 12 number of group member and workers are in 4 in number.

- The Fishermen reported that currently, the MPS is not functioning and the water in the existing WSP is not sufficient therefore they are drawing water from the nearby khal through submercial pump. The Fishermen usually collect the fish usually 5 to 8 times in a year. In each harvest they got 500 kg per catch per season and the selling price is 200-210 kg from each pond. The income from sales is divided equally among the group members.

- The fishermen requested to inform them at least 2 to 3 months before the work to be implemented as they collect the Fishes every after 3months . They agreed to cooperate at the time, However, they demanded Rs. 25,000 to Rs.30, 000 per member per month during the construction period and secondly to consider the amount they have deposited for the whole year .

- The team disclose that there will be impact on the fishing activity carried out inside the WSP, particularly in two ponds where the proposed STP facility will be constructed. The team further highlighted that there will be potential temporary impacts particularly related to access disruption and temporary livelihood loss during the laying or replacement of the sewer pipelines.
- The community were also informed that a compensation is being considered, for the impact casued by the project. The compensation amount for the affected fishermen will be considered based on their income from the fishing activity etc.
- The community members have expressed their support for the project as they view it as beneficial to the community. They however requested that they be informed in advance when the work starts.

Participant's List

Project Name: Updating /Revalidation and Preparation of Safeguard documents for Sewerage Projects Implemented by KMDA under one of the Namami Gange Program at 24th Parganas (North) and Howrah Districts

Venue: Kona MPS
Date: 12/11/2019.

Sl. No.	Name	Designation	Contact No.	Signature
1.	Sri Babusona Pandit.		9804440055	[signature] 12-11-19
2.	Indrajit deb roy		9123346858	[signature]
3.	Shyamal Sarkar (Tinku)		6289199026	Shyamal Sarkar
4.	Sanjib Mondal	Absent on that day		

APPENDIX M NMCG MINUTES OF 2ND REVIEW MEETING DATED 22ND OCTOBER, 2019

Pr-12013/15/2018/PPP/NMCG

National Mission for Clean Ganga

Ministry of Jal Shakti

1st Floor, Major Dhyan Chand National Stadium,
India Gate, New Delhi-110 002.
Dated: November 7, 2019

Subject: Minutes of 2nd Review Meeting of progress of achievement of conditions Precedent by the stakeholders of Howrah, Bally and Baranagar & Kamarhati STP Projects under HAM held on 22nd October 2019 under the chairmanship of Director General, NMCG

Please find the attached MoM of 2nd Review Meeting of progress of achievement of conditions Precedent by the stakeholders of Howrah, Bally and Baranagar & Kamarhati STP Projects under HAM, held on 22nd October 2019 at NMCG, for your perusal and necessary action.

Madhava Kumar R
Sr. Economic Financial Analysis expert
National Mission for Clean Ganga

Enclosures: As above

To,

1. Chief Executive Officer, KMDA
2. Mr. Swadhin Samantaray, VA Tech Wabag

Copy to:

1. Office of the DG, NMCG
2. Office of the ED(Projects), NMCG
3. Director (T-III), NMCG

Minutes of 2nd Review Meeting of progress of achievement of conditions Precedent by the stakeholders of Howrah, Bally and Baranagar & Kamarhati STP Projects under HAM held on 22nd October 2019 under the chairmanship of Director General, NMCG

List of participants is enclosed in Annexure-I.

Ganga Amantran – River Rafting Expedition

1. The meeting was started with discussion on '*Ganga Amantran-River Rafting Expedition*'. It was informed that the rafting team will reach West Bengal on 6th November 2019 at '*Farakka*' and ends with '*Bakkhali Sea Beach*' on 12th November 2019. DG, NMCG instructed the SPMG/KMDA to provide support on logistics, boarding within the budget of Rs.2,00,000/- and IEC activities in the tentative budget ofRs.50,000/-.Further, SPMG/EA was asked to depute Nodal Officer for coordination in this regard.

Howrah, Bally and Baranagar

1. The Concession Agreement for the project was signed on 5th June 2019and 120 days for achievement of conditions precedent lapsed on 3rd October 2019.The Basic Engineering Package (BEP) submitted by the concessionaire has been submitted to IIT, Kharagpur by KMDA the approval is still awaited. It was directed to expedite the approval process.

2. In connection to the employability of people deployed by KMDA for operating existing facilities, it was decided in the last meeting that KMDA and concessionaire shall conduct a consultative meeting with the existing employees within 2 weeks and submit the necessary action plan to the lender (IFC, ADB). However, till date it is not been concluded. Further, concessionaire stated that in order to prepare and finalise the Resettlement Action Plan (RAP), inputs from KMDA is pending. It was instructed to complete the assessment and submit the necessary EISA report to IFC within two (2) weeks.

3. Representative from ADB informed that the concessionaire shall be indemnified from the existing STP site contaminations and shall be insulated from any Liquidated Damages (LDs) due to that. It was informed that the existing site conditions/contaminations shall not be a constraint on assessing the non-performance of the STPs. In any ways concessionaire was requested to prepare a report on site contaminations and submit the same to KMDA for scrutiny.

4. KMDA and Concessionaire informed that application for Consent to Establish (CTE) for new STPs at Howrah, Baranagar & Kamarhati have been submitted to WBPCB and the approval is expected on 8th November 2019.

5. Concessionaire has requested to extend timeline for achievement of conditions precedent till 1st February 2020 stating the delay in approval on basic engineering packages and finalization of ESIA. DG, NMCG expressed his concerns about lack of coordination between KMDA and the concessionaire in obtaining approval on Basic Engineering Package (BEP) and instructed that achievement of conditions precedent is the joint responsibility of all parties. However, it was decided that based on the progress by the concessionaire in coming days, extension of time 2to3 months beyond the initial 4 months' period will be decided for achievement of conditions precedent in due course.

6. The meeting ended with vote of thanks to the chair.

Annexure 1: List of participants

1. Director General -NMCG
2. Executive Director (Finance)- NMCG
3. Dr. Pravin Kumar, Director (T-III) –NMCG
4. Sh. Madhava Kumar, SEFAE – NMCG
5. Sh. B. Sengupta, CE/GAP –KMDA
6. Sh. S. Mukherjee, KMDA
7. Sh. Udayan Mandal – KMDA
8. Sh. Swadhin Samantaray, VA Tech Wabag
9. Sh. S. Varadarajan, VA TECH Wabag
10. Sh. Manjay Verma, VA TECH Wabag
11. Sh. K. N. Apaual, ADB
12. Sh. Senthil Kumar , NMCG
13. Sh. Sherya Sharda, PwC

APPENDIX N CONCESSIONAIRE'S LETTER TO KMDA DATED 27TH NOVEMBER, 2019

KMDA-NMCG/Proj/016/19-20 27th Nov 2019

The Chief Executive Officer,
Kolkata Metropolitan Development Authority,
3rd Floor, Unnayan Bhavan,
Salt Lake City, Kolkata – 700 091

Kind Attn: Smt. Antara Acharya, IAS

Subject : Regarding pending CP Issues of KMDA Baranagar, Aurupara and Bali STP Project on HAM model under Namami Gange Program.

Reference : LoA Ref. no: 165/SE(N)/GAP/W&S/KMDA/W-29 Dated: 06th March 2019 Concession Agreement signed on 5th June 2019

Dear Madam,

We thank you so much for your valuable time in meeting us on the subject matter during our visit to your office on 27th November 2019. Wabag is equally keen to achieve the financial closure of the KMDA STP Project sooner and we are grateful to you and the senior officers of KMDA for the support assured to us in this regard.

We discussed on the following pending obligations/issues which are related to achievement of "Financial Closure" of project which are more in nature of CPs of KMDA :

1) **Article 3.8** ***Handover of existing facilities free of all encumbrances*** **as CP :**
   a. **Sub-clause (a)** : In line with discussion in NMCG review meeting held on 22.10.2019 in New Delhi, we shall facilitate re-engagement of around 25 nos of existing workers. KMDA to identify alternate sites for rest of them from the list of workers provided by KMDA. KMDA may kindly advice concerned person to provide age/identity proof for the ones chosen.
   b. **Sub Clause (b)(ii)** : *The Concessionaire to complete survey of the existing facilities and notify structures that it would want the KMDA to remove from the relevant Site (Baranagar) prior to the respective Effective Date :*
      Wabag would like to mention:
      - KMDA may retain few identified structures based on survey and discussion viz Admin Building, Centrifuge Shed and Sludge Storage Shed because these 3 building are neither to be used in our system nor these are obstructing our STP layout in Baranagar. This can save cost of demolition & transportation.
      - Wabag would explore possibility of retaining part of base raft of "Secondary Clarifier" & "Digester" so that saving on demolition & transportation to that extent is feasible. This will be discussed in detail with KMDA team to come to a conclusion.
      - All other existing structures and buildings can be demolished including disposal of debris and hazardous waste generated during demolition.

WABAG
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CIN : L45205TN1995PLC030231
"WABAG HOUSE"
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: +91-44-4223 2323
Fax : +91-44-6123 2324
Email : wabag@wabag.in
Web : www.wabag.com

KMDA's support with copy of drawings of existing structure or more specific narration of structure to be removed / retained would be greatly appreciated.

*Please refer to **Annexure-II** for extract of relevant portion of Article 3.8*

c. Permits / Approvals from WBPCB, Railway, NHAI & Local Municipality Authority at appropriate time and ROW, free of encumbrances during construction is requested.
*Please refer to **Annexure-III** for extract of relevant portion of Article 3.3*

2) **Article 11.1 Sub-clause (d)** ***Indemnity and Limitation of Liability:*** ***Indemnity is provided for any environmental pollution or health hazard caused by the quality of raw sewage in Article 11.1.*** Inclusion of spillage of potential contamination of soil and underground water in Baranagar STP site due to surficial intrusion of MSW leachate, requested. This was also discussed in NMCG's meeting on 22.10.2019 in the presence of lender. Copy of MOM extract is enclosed. Please find attached report on contamination of water as discussed.
*Please refer to **Annexure I** for extract of relevant portion of **Article 11.1***

3) MSW site adjacent to Baranagar STP premises - construction of high boundary wall requested. This was agreed in meeting held on 4th June 2019 in KMDA and during our yesterday's meeting.

4) Approach Road for "Bally STP" - Some broadening & strengthening of existing road requested. This was agreed in meeting held on 4th June 2019 in KMDA and during our yesterday's meeting.

5) **Vetting/approval of Design & Drawings by IIT Kharagpur :** Wabag submitted the drawings to KMDA on 5th of July as per CA. KMDA approved the same on 10th August. These drawings were to be approved by IIT in 30 days. Considering the delay, we request support in facilitating the approval by IIT. Wabag has deployed its design engineers in Kolkata for this purpose and they shall meet the Professor concerned in Kharagpur or Kolkata as required.

6) **Appointment of Project Engineer by NMCG for Project :** This would be required soon on achieving Financial closure.

As advised by you, we would seek your appointment for review of progress in the above matters after two weeks time.

Yours truly
For **VA TECH WABAG LTD.**

(SWADHIN SAMANTARAY)
Head-Capital Projects

VA TECH WABAG LIMITED

Copy to:-

1. **Executive Director – Projects**
   National Mission for Clean Ganga
   1st floor, Major Dhyanchand National Stadium, India Gate, New Delhi – 110002
2. Sh. Bhaskar Sengupta CE/ GAP -KMDA
3. Sh. Udayan Mandal SE / GAP - KMDA

Encls: 1) Annexure 1-3
2) Baranagar Soil & Ground Water Contamination Test Report
3) MOM dtd. 22nd Oct'2019 with NMCG

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Web : www.wabag.com

APPENDIX O IBAT SCREENING

Proximity Report

BALLY 2

Country: India

Location: [22.6, 88.3]

Date of analysis: 25 February 2020

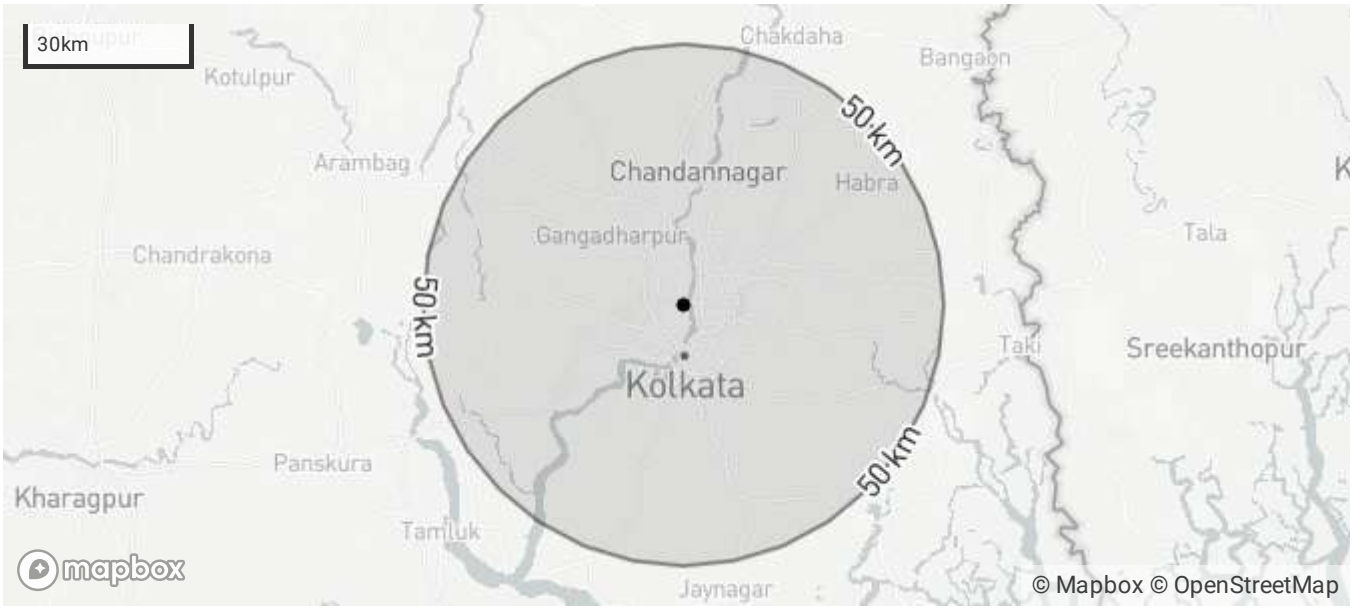
Buffers applied: 50.0 km

Generated by: Abhishek Roy Goswani

Company/Subscriber: Environmental Resources Management

Overlaps with:

Protected Areas	2
Key Biodiversity Areas	0
IUCN Red List	111



Displaying project location and buffers: 50.0 km

About this report

This report presents the results of [3296-7207] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 50.0 km.

This report is one part of a package generated by IBAT on 25 February 2020 that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

Data used to generate this report

- UNEP-WCMC and IUCN, 2020. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - February 2020.
- BirdLife International (on behalf of the KBA Partnership), 2019. Key Biodiversity Areas - October 2019.
- IUCN, 2020. IUCN Red List of Threatened Species - January 2020.

Protected Areas

The following protected areas are found within 50.0 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Within buffer of
East Calcutta Wetlands	50.0 km
Narendrapur	50.0 km

Key Biodiversity Areas

The following key biodiversity areas are found within 50.0 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

No KBAs within buffer distance

IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

Species name	Common name	IUCN Category	Taxonomic Class
Acropora rudis		EN	Anthozoa
Aetobatus flagellum	Longhead eagle ray	EN	Chondrichthyes
Aetobatus ocellatus	Spotted eagle ray	VU	Chondrichthyes
Aetomylaeus maculatus	Mottled eagle ray	EN	Chondrichthyes
Aetomylaeus nichofii	Banded eagle ray	VU	Chondrichthyes
Alopias pelagicus	Pelagic thresher	EN	Chondrichthyes

Species name	Common name	IUCN Category	Taxonomic Class
Alopias superciliosus	Bigeye thresher	VU	Chondrichthyes
Alopias vulpinus	Common thresher	VU	Chondrichthyes
Anacyclus pyrethrum	Atlas daisy	VU	Magnoliopsida
Anoxypristis cuspidata	Narrow sawfish	EN	Chondrichthyes
Aquila heliaca	Eastern imperial eagle	VU	Aves
Aquila nipalensis	Steppe eagle	EN	Aves
Aythya baeri	Baer's pochard	CR	Aves
Aythya ferina	Common pochard	VU	Aves
Balaenoptera musculus	Blue whale	EN	Mammalia
Batagur baska	Northern river terrapin	CR	Reptilia
Batagur dhongoka	Three-striped roofed turtle	CR	Reptilia
Batagur kachuga	Red-crowned roofed turtle	CR	Reptilia
Calidris pygmaea	Spoon-billed sandpiper	CR	Aves
Calidris tenuirostris	Great knot	EN	Aves
Carcharhinus albimarginatus	Silvertip shark	VU	Chondrichthyes
Carcharhinus falciformis	Silky shark	VU	Chondrichthyes
Carcharhinus hemiodon	Pondicherry shark	CR	Chondrichthyes

Species name	Common name	IUCN Category	Taxonomic Class
Carcharhinus longimanus	Oceanic whitetip shark	CR	Chondrichthyes
Carcharias taurus	Sand tiger shark	VU	Chondrichthyes
Carcharodon carcharias	White shark	VU	Chondrichthyes
Chaenogaleus macrostoma	Hooktooth shark	VU	Chondrichthyes
Chaetornis striata	Bristled grassbird	VU	Aves
Clanga clanga	Greater spotted eagle	VU	Aves
Clanga hastata	Indian spotted eagle	VU	Aves
Crocodylus palustris	Mugger	VU	Reptilia
Dermochelys coriacea	Leatherback	VU	Reptilia
Eretmochelys imbricata	Hawksbill turtle	CR	Reptilia
Eusphyra blochii	Winghead shark	EN	Chondrichthyes
Francolinus gularis	Swamp francolin	VU	Aves
Geoclemys hamiltonii	Spotted pond turtle	EN	Reptilia
Glaucostegus typus	Giant guitarfish	CR	Chondrichthyes
Glyphis gangeticus	Ganges shark	CR	Chondrichthyes
Gymnura zonura		VU	Chondrichthyes
Gyps bengalensis	White-rumped vulture	CR	Aves

Species name	Common name	IUCN Category	Taxonomic Class
Gyps indicus	Indian vulture	CR	Aves
Gyps tenuirostris	Slender-billed vulture	CR	Aves
Haliaeetus leucoryphus	Pallas's fish-eagle	EN	Aves
Halophila beccarii	Ocean turf grass	VU	Liliopsida
Heliopora coerulea		VU	Anthozoa
Hemipristis elongata	Snaggletooth shark	VU	Chondrichthyes
Heritiera fomes		EN	Magnoliopsida
Himantura uarnak	Reticulate whipray	VU	Chondrichthyes
Hippocampus histrix	Thorny seahorse	VU	Actinopterygii
Hippocampus kelloggi	Great seahorse	VU	Actinopterygii
Hippocampus spinosissimus	Hedgehog seahorse	VU	Actinopterygii
Hippocampus trimaculatus	Three-spot seahorse	VU	Actinopterygii
Holothuria fuscogilva		VU	Holothuroidea
Holothuria lessoni		EN	Holothuroidea
Holothuria scabra		EN	Holothuroidea
Isurus oxyrinchus	Shortfin mako	EN	Chondrichthyes
Isurus paucus	Longfin mako	EN	Chondrichthyes

Species name	Common name	IUCN Category	Taxonomic Class
Lamiopsis temminckii	Broadfin shark	EN	Chondrichthyes
Lepidochelys olivacea	Olive ridley	VU	Reptilia
Leptoptilos dubius	Greater adjutant	EN	Aves
Leptoptilos javanicus	Lesser adjutant	VU	Aves
Lonchura oryzivora	Java sparrow	EN	Aves
Lutrogale perspicillata	Smooth-coated otter	VU	Mammalia
Maculabatis gerrardi	Whitespotted whipray	VU	Chondrichthyes
Manis crassicaudata	Indian pangolin	EN	Mammalia
Melursus ursinus	Sloth bear	VU	Mammalia
Mobula alfredi	Reef manta ray	VU	Chondrichthyes
Mobula birostris	Giant manta ray	VU	Chondrichthyes
Mobula mobular	Giant devilray	EN	Chondrichthyes
Mobula tarapacana	Sicklefin devilray	EN	Chondrichthyes
Mobula thurstoni	Bentfin devilray	EN	Chondrichthyes
Mola mola	Ocean sunfish	VU	Actinopterygii
Nebrius ferrugineus	Tawny nurse shark	VU	Chondrichthyes
Negaprion acutidens	Sharptooth lemon shark	VU	Chondrichthyes

Species name	Common name	IUCN Category	Taxonomic Class
Neophocaena phocaenoides	Indo-pacific finless porpoise	VU	Mammalia
Neophron percnopterus	Egyptian vulture	EN	Aves
Omobranchus smithi		VU	Actinopterygii
Ophiophagus hannah	King cobra	VU	Reptilia
Orcaella brevirostris	Irrawaddy dolphin	EN	Mammalia
Oryza malampuzhaensis		VU	Liliopsida
Panthera pardus	Leopard	VU	Mammalia
Panthera tigris	Tiger	EN	Mammalia
Pateobatis jenkinsii	Jenkins' whipray	VU	Chondrichthyes
Pateobatis uarnacoides	Bleeker's whipray	VU	Chondrichthyes
Physeter macrocephalus	Sperm whale	VU	Mammalia
Platanista gangetica	South asian river dolphin	EN	Mammalia
Prionailurus viverrinus	Fishing cat	VU	Mammalia
Pristis clavata	Dwarf sawfish	EN	Chondrichthyes
Pristis pristis	Largetooth sawfish	CR	Chondrichthyes
Pristis zijsron	Green sawfish	CR	Chondrichthyes
Python bivittatus	Burmese python	VU	Reptilia

Species name	Common name	IUCN Category	Taxonomic Class
Rhina ancylostoma	Bowmouth guitarfish	CR	Chondrichthyes
Rhincodon typus	Whale shark	EN	Chondrichthyes
Rhinoceros unicornis	Greater one-horned rhino	VU	Mammalia
Rhynchobatus australiae	Bottlenose wedgefish	CR	Chondrichthyes
Rhynchobatus laevis	Smoothnose wedgefish	CR	Chondrichthyes
Rusa unicolor	Sambar	VU	Mammalia
Sarcogyps calvus	Red-headed vulture	CR	Aves
Sonneratia griffithii		CR	Magnoliopsida
Sousa chinensis	Indo-pacific humpback dolphin	VU	Mammalia
Sphyrna lewini	Scalloped hammerhead	CR	Chondrichthyes
Sphyrna mokarran	Great hammerhead	CR	Chondrichthyes
Stegostoma tigrinum	Zebra shark	EN	Chondrichthyes
Sterna acuticauda	Black-bellied tern	EN	Aves
Stichopus herrmanni		VU	Holothuroidea
Taeniurops meyeni	Blotched fantail ray	VU	Chondrichthyes
Thelenota ananas		EN	Holothuroidea
Tringa guttifer	Spotted greenshank	EN	Aves

Species name	Common name	IUCN Category	Taxonomic Class
Urogymnus asperrimus	Porcupine ray	VU	Chondrichthyes
Urogymnus polylepis		EN	Chondrichthyes
Wallago attu		VU	Actinopterygii

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How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a “first-step”, providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

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