Initial Environmental Examination

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NEP: Kathmandu Valley Wastewater Management Project − Dhobighat

Package No: KUKL/WW/TP-03

Prepared by the Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited, Ministry of Water Supply, Government of Nepal for the Asian Development Bank.

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CURRENCY EQUIVALENTS

(as of December 2017)

Currency unit	-	Nepalese rupee (NRs/NRe)
NRs1.00	=	$ 0.0097
$1.00	=	NRs 103.33

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

ABBREVIATIONS

ADB	Asian Development Bank
BAP	Bagmati Action Plan
CBP Team	Capacity Building and Public-Private Partnership Support Team
CBS	Central Bureau of Statistics
CITES	Convention of International Trade in Endangered Species of Wild Fauna and Flora
CASSC	Community Awareness and Social Safeguard Consultants
CEMP	Construction Environmental Management Plan
DBO	Design Build and Operate
DCC	District Coordination Committee
DWEC	District Wage Evaluation Committee
DNI	Distribution Network Improvement
DSC	Design and Supervision Consultant
EA	Executing Agency
EARF	Environmental Assessment and Review Framework
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ENPHO	Environmental and Public Health Organisation
EPA	Environment Protection Act
EPR	Environment Protection Rules
ERP	Emergency Response Plan
HACCPP	Hazard Analysis and Critical Control Point Plan
HH	Household
HPCIDBC	High Powered Committee for Integrated Development of Bagmati Civilization
IEC	Information, education and communication
IFC	International Finance Corporation
Lpcd	Liters per capita per day
LPG	liquefied petroleum gas
ICIMOD	International Centre for Integrated Mountain Development
IDA	International Development Assistance
IEE	Initial Environmental Examination
INGO	International Nongovernment Organization
ICSU	Income Consumer Support Unit
IUCN	International Union for Conservation of Nature
JICA	Japanese International Cooperation Agency
JBIC	Japanese Bank for International Cooperation
KUKL	Kathmandu Upatyaka Khanepani Limited Kathmandu
MoFE	Ministry of Forest and Environment
MoWS	Ministry of Water Supply
VWMPK	Valley Wastewater Management Project Kathmandu
VWSMB	Valley Water Supply Management Board
MSDS	Material Safety Data Sheets
MWSDB	Melamchi Water Supply Development Board
MWSP	Melamchi Water Supply Project

NEWAH	Nepal Water for Health
NGO	Nongovernment organization
NTFP	Non-timber forest product
NTNC	Nepal Trust for Nature Conservation
NWSC	Nepal Water Supply Corporation
OHS	Occupational Health and Safety
PD	Project Director
PID	Project Implementation Directorate
PIU	Project Implementation Unit
PLC	Programmable Logic Controllers
PPE	personal protective equipment
PPP	public-private partnership
PPTA	Project Preparatory Technical Assistance
REA	Rapid Environmental Assessment
RoW	Right of Way
RP	Resettlement Plan
SAPI	Special assistance for project implementation
SPAF	Severely project affected family
SPS	Safeguards Policy Statement
SWC	Social Welfare Council
SWNCC	Social Welfare National Coordination Council
UDLE	Urban development through local efforts
UN	United Nations
UNEP	United Nations Environment Programme
VDC	Village Development Committee
WWTP	Wastewater treatment plant

WEIGHTS AND MEASURES

cm	- centimetre
db	- decibels
ha	- hectare
kg	- kilogram
km	- kilometre
km^2	- square kilometre
l	- litre
m	- meter
$_m2$	- square meter
m^3	- cubic meter
mg/l	- milligrams per litre
ml	- millilitre
MLD	- million litres per day, mega litres per day (1 mega litre = 1000m3)
mm	- millimetre
ljg/m^3	- micrograms per cubic meter

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Executive Summary

1. The proposed Kathmandu Valley Wastewater Management Project (KVWMP) will support the ongoing efforts of the Government of Nepal towards improving the wastewater services in Kathmandu Valley. The project will invest in modernization and new construction of wastewater treatment plants, and improvement of wastewater management in Kathmandu Valley, which will complement the past and ongoing Asian Development Bank (ADB) projects.[1] The project is expected to increase operational efficiency, improve service delivery, and result in positive impact on health and quality of life for inhabitants of Kathmandu Valley. ADB requires the consideration of environmental issues in all aspects of its operations as per its Safeguard Policy Statement (SPS 2009). This initial environmental examination (IEE) has been prepared for the proposed modernization and expansion of wastewater treatment plants. This IEE is updated for Dhobighat wastewater treatment plant under TP-03.

2. **Categorization.** The project is considered Category B as per the SPS 2009 as no significant impacts are envisioned. This IEE assesses the environmental impacts and provides mitigation and monitoring measures to ensure no significant impacts as a result of the project.

3. **Scope.** The projects expected impact will be sustainable wastewater services for the residents of Kathmandu Valley. The expected outcome will be an improved wastewater collection and treatment system and increased access of wastewater services to the residents of Kathmandu Valley including poor women and men. The project will further consolidate the continuing efforts of the government and ADB in institutional development and improvement of governance in the wastewater sector.

4. **Implementation Arrangements.** The Ministry of Water Supply (MoWS) will be the executing agency responsible for overall strategic planning, guidance, and management of the project, and for ensuring compliance with loan covenants. Kathmandu Upatyaka Khanepani Limited (KUKL) will be the implementing agency, and the existing Project Implementation Directorate (PID) in KUKL will be responsible for (i) project planning, implementation, monitoring, and supervision; (ii) reporting to KUKL Board of Directors, MoWS, and ADB; and (iii) coordination of all activities in the project. PID has already established a safeguards unit staffed with environmental, social, and legal specialists. The PID, KUKL will recruit two consulting firms, design, supervision and management consultant (DSC) and community awareness and safeguard support consultant (CASSC) firm. The DSC will have an environmental and social safeguard specialist to facilitate PID in implementation and supervision of safeguards-related works.

5. **Description of the Environment.** The project is located in ward no 4, Dhobighat Lalitpur Metropolitan City which is densely populated. The project site is located in government-owned land. There are no protected areas, wetlands, or estuaries in or near the subproject location. Trees, vegetation, and animals are those which are commonly found in urban areas.

6. **Environmental Management.** An Environmental Management Plan (EMP) is included as part of this IEE. It will guide all stakeholders including PID, KUKL, DSC and contractors in the environmentally sound design, construction and operation of infrastructure under this project. In particular the EMP (i) recommends the measures and means of testing to be implemented to reduce the likelihood of potential environmental impacts during the design, construction and operation phase of the project; (ii) provides the necessary tools to carry out onsite environmental performance monitoring; (iii) ensures compliance with recommended standards and safety measures; (iv) recommends the public consultation and disclosure procedures; and (v) provides a grievance redress mechanism. The EMP will be included in the civil work bidding and

[1] Melamchi Water Supply Project (ADB 1820-NEP); Kathmandu Valley Water Supply Improvement Project (ADB 2776-NEP); Bagmati River Basin Improvement Project (ADB PPTA -43448).

contract documents.

7. The construction and rehabilitation of WWTPs will be on existing treatment plant sites which are in residential areas. Mitigation measures during the design phase of the WWTP have been included to ensure minimum nuisance to residents pertaining to odour and noise. Establishment of tree screens to maintain an appropriate green zone buffer and fencing to restrict public access will support to minimize the odour and noise.

8. Operational and maintenance efficiency of the WWTPs were considered to ensure minimum impact to aquatic and public health. These include (i) WWTP processes designed to meet the prescribed BOD_5 reductions prior to discharge; (ii) operation of the WWTP using a risk-based approach through the development and implementation of WWTP water safety plans; and (iii) incorporating a long-term operational and maintenance component embedded in the design, build and operate (DBO) contract.

9. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. Mitigation will be assured by a program of environmental monitoring to be conducted during design, construction and operation phases. The environmental monitoring program will ensure that all measures are implemented and will determine whether the environment is protected as intended. It will include observations on- and off-site, document checks, photographs, monitoring of key parameters and interviews with workers and beneficiaries. Any requirements for corrective action will be reported to the ADB.

10. The stakeholders were involved in developing the IEE through discussions on-site and public consultation, after which views expressed were incorporated into the IEE and in the planning and development of the subproject. Several meetings, workshops, and focus group discussions were held with local residents, stakeholders and technical persons to keep them informed of the project and to get their feedback for the project design, as required. To provide for more transparency in planning, and for further active involvement of key stakeholders including the general public, the project information will be disseminated through disclosure of the translated versions of the IEE. The information will be made available at public places, including the offices of PID, KUKL main office and branch offices. A copy of the IEE will be disclosed on the ADB and project-related websites and will also be available from PID upon request.

11. The most noticeable long-term benefit of the project will be the improved wastewater management system in Kathmandu Valley especially within the Dhobighat area which will in turn improve the water quality maintain the ecological flow of the rivers overtime and safeguard public health.

12. **Consultation, Disclosure and Grievance Redress.** Public consultations and disclosures will be continuous in the future during the design, construction and operation phases. The CASSC with the help of the Safeguard unit of PID will be responsible for the public consultations and information disclosures. Grievances will be addressed by the grievance redress mechanism, which incorporates a clear and grassroots process for addressing public complaints quickly.

13. **Monitoring and Reporting.** The safeguards staff within the PID will monitor the implementation of the EMP with support from the DSC and CASSC. The DSC Environmental Safeguards Officer will prepare quarterly progress reports and submit to PID and PID will prepare semi-annual monitoring reports and submit to ADB. ADB will post the environmental monitoring reports on its website. These reports will describe the progress of the implementation of the EMP, any compliance issues and corrective actions.

14. **Conclusion and Recommendations.** Overall the potential impacts of the project will be very positive, benefitting both the environment and the people. Some negative impacts are anticipated during implementation, but in specific areas and for a short

duration (e.g., dust, noise, traffic problems, erosion, sedimentation, etc.). It is expected that these environmental impacts of the project will in general not be significant and can be reduced and/ or prevented through adequate mitigation measures and regular monitoring during the design, construction, and operation phases of the project. Based on the findings of the IEE, there are no significant environmental impacts, and the classification of the project as category B is confirmed, and no further special study or detailed environmental impact assessment (EIA) needs to be undertaken to comply with ADB SPS (2009).

I. INTRODUCTION

Purpose of the Report

1. The proposed Kathmandu Valley Wastewater Management Project (KVWMP) will support the ongoing efforts of the Government of Nepal towards improving the wastewater services in Kathmandu Valley. The project will invest in rehabilitation and expansion of sewerage network, modernization and new construction of wastewater treatment plants, and improvement of wastewater management in Kathmandu Valley, which will complement the past and ongoing Asian Development Bank (ADB) projects. The project is expected to increase operational efficiency, improve service delivery, and result in positive impact on health and quality of life for inhabitants of Kathmandu Valley.

The project has the ultimate objectives of:

(i) rehabilitating and expanding connecting to wastewater treatment plants (WWTPs); and
(ii) Supporting operational and financial improvements and capacity building.

2. The purpose of this initial environmental examination (IEE) is (i) to provide information on existing geographic, ecological, social and temporal context including associated facilities with the package (TP-03) area of influence, (ii) to find out the likely positive and negative direct and indirect impacts to physical, biological, socioeconomic and physical cultural resources in the package area of influence, (iii) identify mitigation measures and any negative impacts that should be mitigated during planning, implementation and operation, (iv) to establish Grievance Redress Mechanism for resolving environmental issues, (v) to describe the monitoring measures and reporting procedures to ensure early detection conditions that require particular mitigation measures, (vi) to describe the process undertaking during project design to engage stakeholders and affected persons and the planned information disclosure measures and the process of carrying out consultation with affected people and facilitating their participation during project implementation, (vii) to identify who is responsible for carrying out the mitigation and monitoring measures.

3. The mitigation measures are then carried forward into the Environmental Management Plan (EMP). The EMP assigns responsibilities, time frames, and performance indicators or standards for each mitigation measure to make sure that it is implemented. An environmental monitoring plan is also prepared. This monitoring plan identifies methods and responsibilities for checking the operation of the project against a range of relevant and agreed performance indicators.

Both Nepal's law and the ADB policy require that the environmental impacts of development projects are identified and assessed as part of the planning and design processes, and that action is taken to reduce adverse impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of project development and implementation worldwide. This IEE is updated for Dhobighat Wastewater Treatment facilities as TP 03 at bank of Bagmati River.

Project Rationale

4. Improvement of wastewater systems are urgently needed in Kathmandu Valley because it is currently suffering from the lack of properly functioning sewerage systems. This project has been designed to raise the quality of the infrastructure and services of selected areas of Kathmandu Valley, thereby increasing the quality of life of the people.

5. Kathmandu Valley has gone through a phase of rapid and unplanned urbanization and

industrialization without adequate infrastructure development. To improve the present conditions of the wastewater services in Kathmandu Valley, the Government, with the assistance of ADB, has embarked on a two-pronged improvement strategy that includes capital investments for infrastructure development, i.e. supply augmentation and system improvement, and institutional reforms.

6. The rapid urbanization of Kathmandu Valley has brought negative impacts to its overall development. Water has become scarce as demand exceeds supply. Lack of operational wastewater system facilities has converted the holy Bagmati River into a highly polluted watercourse. Congested and crowded roads have brought hardship to travellers and road junctions have become garbage dumping sites. Despite these negative impacts, the urbanization of the valley has continued at a similar rate over the past 10 years. According to urban planners, from urban basic service management and disaster relief management aspects, Kathmandu Valley has a carrying capacity of only 5 million people.

7. WWTPs will be constructed and rehabilitated at the existing site of Dhobighat. Septage from individual septic tanks for 30% of the households not having access to the sewerage system will be pumped out, transported, and treated together with the sludge from the WWTPs for the production of energy.

8. Rehabilitation and expansion of wastewater treatment plant at Dhobighat will i) improve quality of life with elimination of bad smell in open drains and ease of disposal of waste water from the household, ii) have positive impact on the environment as it will arrest pollution of air and ground water. The water bodies and drains will become cleaner and iii) the quality of water in Bagmati River will become better.

9. Integrated planning and development of Dhobighat WWTP sites to include (i) planning for holistic development of the WWTP sites and surrounding areas, (ii) landscaping, plantation and gardens, (iii) river front development, (iii) solid waste management, (iv) development of water bodies, (v) information centre and recreational activities such as water sports, walk-ways, restaurants, etc.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

10. The Safeguard Policy Statement (SPS, 2009) of ADB stipulates addressing environmental concerns, if any, of a proposed activity in the initial stages of project preparation. For this, ADB categorizes the proposed components into categories (A, B, or C) to determine the level of environmental assessment required to address the potential impacts. The project has been categorized as B. This IEE has been prepared to address the potential impacts, in line with the recommended IEE content and structure for category B projects. Stakeholder consultation was an integral part of the IEE. An EMP outlining the environmental measures to be adhered to during implementation of the project has also been prepared. The EMP will form part of the bidding and contract documents for civil work.

ADB's environmental safeguards policy principles are defined in SPS, 2009, Safeguard Requirements 1 and the IEE is intended to meet these requirements Table II-1:

Table II-1: ADB SPS, 2009 Safeguard Requirements

SPS 2009 - Safeguard Requirements	Remarks
Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment (EA) so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.	REA has been undertaken (Annex A), indicating that subproject is NOT: (i) environmentally critical; and (ii) adjacent to or within environmentally sensitive/critical area.
SPS 2009 - Safeguard Requirements	Secondary influence areas. Significant adverse impacts during construction will be temporary and short-term, can be mitigated without difficulty. There is no adverse impact during operation. Hence, IEE is sufficient. The IEE including specific description of the environment and corridor of impact will be updated as necessary based on the final design and alignments.
Conduct EA to identify potential direct, indirect, cumulative, & induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential trans boundary global impacts, including climate change.	IEE has been undertaken to meet this requirement. (Section VI). No transboundary & global impacts, including climate change.
Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.	Analysis of "with-subproject "or "without subproject" is presented in Section III.
Avoid, and where avoidance is not possible, minimize, mitigate, &/or offset adverse impacts and enhance positive impacts by means of environmental planning & management. Prepare an EMP that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.	An EMP has been prepared to address this requirement. Section IX
Carry out meaningful consultation with affected people & facilitate their informed participation. Ensure women's participation. Involve stakeholders, including affected people & concerned NGOs, early in the	Key informant and random interviews have been conducted (Annex C). A grievance redress mechanism for the resolution of valid project- related social and environmental issues/concerns is

SPS 2009 - Safeguard Requirements	Remarks
project preparation process & ensure that their views & concerns are made known to & understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to EA. Establish a GRM to receive & facilitate resolution of affected people's concerns & grievances on project's environmental performance.	presented in Section VIII.
Disclose a draft IEE (including the EMP) in a timely manner, before project appraisal, in an accessible place & in a form & language(s) understandable to affected people & other stakeholders. Disclose the final EA, & its updates if any, to affected people & other stakeholders.	The draft IEE will be disclosed on ADB's website prior to project appraisal. Copies of both SPS- compliant IEE and Government of Nepal- approved IEE will be made available at the offices of the PMO, Project Implementation Support Unit (PISU) and Water Users' and Sanitation Committee (WUSC)for public consultation. For the benefit of the community, the summary of the IEE will be translated in the local language and made available at (i) offices of executing and implementing agencies, (ii) area offices, (iii) consultant teams' offices; and (iv) contractor's campsites. It will be ensured that the hard copies of IEE are kept at places which are conveniently accessible to people, as a means to disclose the document and at the same time creating wider public awareness. An electronic version of the IEE will be placed in the official website of executing and implementing agencies and the ADB website after approval of the IEE by ADB.
Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.	EMP implementation, reporting and disclosure of monitoring reports are in this IEE.
Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.	The subproject does not encroach into areas of critical habitats.
Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage	This requirement is only minimally applicable to the subproject in the aspect of waste generation, e.g., effluent from septic tanks and generated sludge and sludge disposal from water supply and sanitation structures. The subproject will not involve hazardous materials subject to international bans/phase outs.

SPS 2009 - Safeguard Requirements	Remarks
pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.	
Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.	EMP provides measures to mitigate health and safety hazards during construction and operation.
Conserve physical cultural resources and avoid destroying or damaging them by using field- based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.	The subproject will not affect any physical cultural resource. The EMP recommends the measure/s to mitigate adverse impact on physical cultural resources (PCRs) in case of chance find.

B. National Law and Rules

11. The requirement for environmental assessment in Nepal is established by the National Environment Protection Act (1997). The procedures are defined in the Environment Protection Rules, as amended. These rules require IEE for sewerage projects costing more than NRs. 50 lakhs. The Government's Urban Environmental Management Directive (2011) sets the standards for wastewater effluents (Annex 3).

12. The legal provisions for environmental protection in Nepal are found in different laws and regulations (Annex 4). Nepal is also a signatory to many international agreements and conventions related to environmental conservation such as

(i) Plant Protection Agreement for Asia and the Pacific Region, 1956
(ii) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973
(iii) Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), 1972
(iv) International Tropical Timber Agreement, 1983
(v) Convention on Biological Diversity, 1992

C. Policies and Legal Framework of KUKL

13. The Government of Nepal remains fully committed to providing safe drinking water and sanitation services--considered as a fundamental human need and a basic human right--for all of its citizens. The Government is committed to providing improved water supply and sanitation services of medium and higher levels commensurate to the capacity to pay of the served populations. In the 1990s, political liberalization and a focus on decentralization saw important new actors in the sector emerge, namely the community groups, local governments, and the private sector, including nongovernment organizations (NGOs). However, the ever-growing urban population and increasing water demand has been placing a strain on the existing urban water supply and sanitation services. There have been a number of efforts to streamline planning and investment in the sector. Some of the major efforts are examined below.

14. The National Urban Policy (2007) highlights the historical imbalances and haphazard nature of urban development in Nepal. It views urban centres as catalysts of economic development linked to north-south and east-west access corridors. The policy also flags poor sanitation, environmental degradation, and lack of services by the urban poor as requiring urgent attention. It proposes the building of capacity of municipalities to plan and manage integrated local development activities, including the preparation of urban master plans to be

moderated by central and regional authorities. Private sector involvement and investment in infrastructure development is specifically sought.

15. The National Urban Water Supply and Sanitation Sector Policy (2009) was formulated to provide the overall policy support and guidance toward achieving equity in service delivery by ensuring that the financially marginalized households within the service areas are mainstreamed as valid customers through the design and implementation of financial incentives, where required.

16. The Nepal Water Supply Corporation Act (2007), as amended, Water Supply Management Board Act (2006), and Water Supply Tariff Fixation Commission Act (2006) have facilitated the improved management of Kathmandu Valley's water and sanitation services. They established the legal basis for private sector management of water supply and independent tariff setting and regulations that are applicable to all urban areas.

17. The Ancient Monuments Protection Act (1991) states the rights and duties of the Government to make arrangements for the protection of historically and archaeologically important areas and monuments by preventing any misappropriation and misuse.

18. Nepal's procedures for environmental assessment of development projects are described in the Environment Protection Act (1997) and the Environment Protection Rules (1997), as amended). Projects that need EIA and IEE are identified in the rules. Accordingly, the responsibility for undertaking an IEE for this proposed project lies with the Kathmandu Upatyaka Khanepani Limited (KUKL/Project Implementation Directorate (PID) as the project proponent, on behalf of the Kathmandu Valley Water Supply Management Board (KVWSMB). Public involvement, including notification of stakeholders, dissemination of information, and consultation, is a requirement, particularly during the review and approval of the IEE report.

III. DESCRIPTION OF THE SUB PROJECT

19. The project is located at Dhobighat, Lalitpur Metropolitan City ward 4. The project location is situated close to the left bank of Bagmati River. The coordinate of proposed project is situated at the latitude of 27° 40' 18.72" N and longitude of 85° 17' 44.06" east at the elevation of 4194 ft. (1278.3 meter). The capacity of proposed wastewater treatment plant after expansion will be 74 MLD.

20. Rehabilitation and expansion of wastewater treatment plant at Dhobighat will i) improve quality of life with elimination of bad smell in open drains and ease of disposal of waste water from the household, ii) have positive impact on the environment as it will arrest pollution of air and ground water. The water bodies and drains will become cleaner and iii) the quality of water in Bagmati River will become better.

A. Existing Situation

21. The project zone of influence is defined on the basis of perceived direct and indirect impacts due to the project activities. The area where the WWTP will be implemented and the area adjacent to it is defined as the direct impact area. The peripheral areas of the WWTP where the construction and operation activities will have direct impact upon the surroundings will be considered. The project is perceived to have no direct significant impact beyond the 150-meter perimeters. Hence, the impact area is defined as:

Zone of Influence:	Dhobighat area, Bagmati River bank, LMC Ward 4.
Direct Impact Area:	Proposed project location and 150-meter perimeters
Indirect Impact Area:	Area beyond direct impact area that might inadvertently affected by the project activities and due to transportation of heavy loaded construction vehicles and surrounding settlement area.

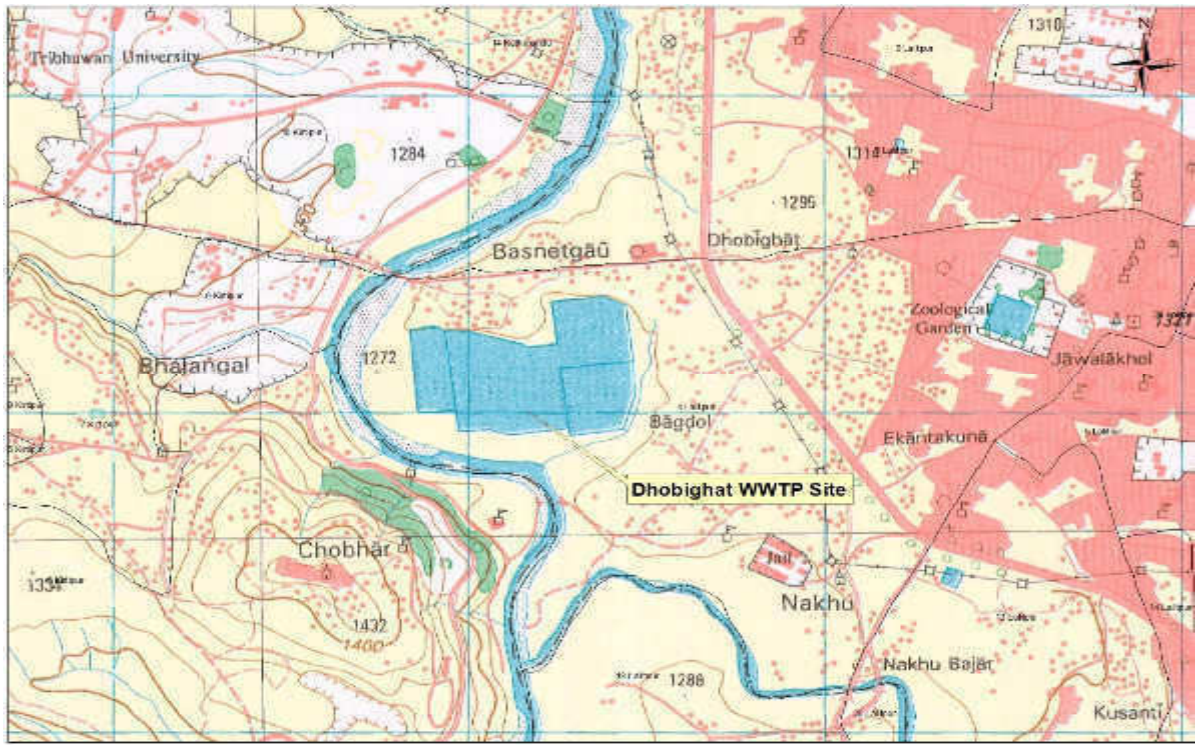

Figure III-1 Dhobighat WWTP project site

Table III-1 Snapshot of Existing Centralized WWTPs

Parameter	Dhobighat WWTP
Year established	1982
Reported nominal capacity (MLD)	15.4
Original supporting agency	IDA, Engineering Science/ USA
Operator	KUKL
Type of plant originally installed	Waste stabilization pond
Catchment served	Kathmandu and Lalitpur
Existing operation status	Not operational since 1982

22. The total area of Dhobighat WWTP is 30.4 ha consisting originally of four stabilization ponds (area totally 19.4 ha). However, the plant has had no influent flow and load since the 1980s because of total non- operation of the Sundarighat pumping station.

B. Component of subproject

23. The purpose of this document is to present the conceptual design of Dhobighat WWTP (2nd stage) to treat additional 37 MLD.At the Dhobighat WWTP, flow rate is planned at the one-third (37) of 110 MLD considering for landscape and non-useable land (surrounding load and photovoltaic power plant, etc). Peak flow is calculated from the 1.8 times of average flow.

24. The WWTP will be located at Dhobighat WWTP site. The WWTP will be planned by considering aspects of favorable maintenance and management including future expansion and operation. Also, application of sustainable facility plan will allow the facility to provide place for relaxation by applying odor removal and eco-friendly landscaping design.

25. Collected wastewater from interceptor on Bagmati River that High Powered Committee for Integrated Development of Bagmati Civilization (HPCIDBC) and interceptor on Manohara and Hanumante which collects wastewater from mid-stream of Bagmati river, Bhaktapur, Madhyapur Timi, Lalitpur, municipality and VDCs districts will be treated in three wastewater treatment plant in Dhobighat,

Table III-2 Wastewater Treatment Scenario for WWTP in 2020 and 2030

Wastewater Treatment Plants	**Wastewater to be Treated** (MLD)		**WWTP Area Available** (hectare)	**Effluent Standards** (BOD mg/l)	
	Year 2020	**Year 2030**		**Year 2020**	**Year 2030**
Dhobighat	39.2	81.6	30	50	50
Total	**90.5**	**382.1**	**84.33**	**-**	**-**

MLD = million litres per day, WWTP = wastewater treatment plant. *Land still to be acquired.

26. The site for Dhobighat WWTP can be accessed from road at left bank of Bagmati River where Chakra path 1 on Ring road and the distance from Charkra path 1 to access road is approximately 2 km.

Figure III-2 Google image of proposed site

Design Detail

27. The process design concepts are based on providing a treated effluent to specified quality standards that will be suitable for irrigational reuse or river discharge. The WWTP concept design includes sufficient redundancy and robustness to treat peak hour flow of 1.8 times of average daily flows for up to the effluent quality required. The conceptual design for solids handling in this design concept includes waste sludge thickening, digestion, dewatering, and disposal of the sludge as landfill

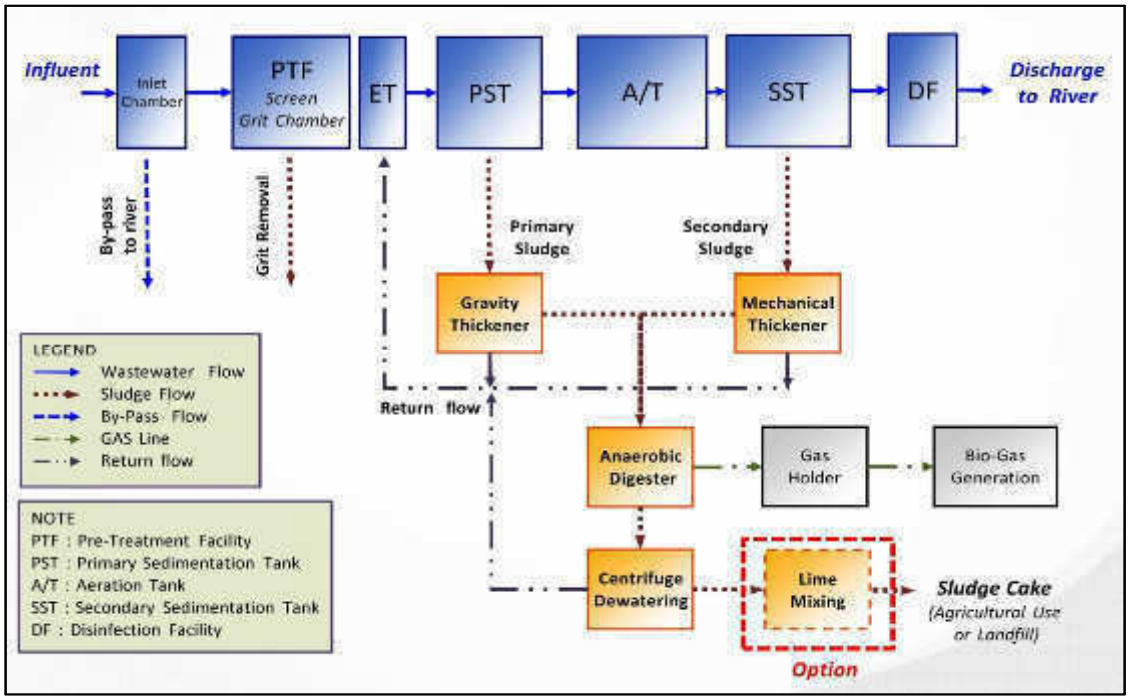

Figure III-3 Process Flow Diagram of Dhobighat WWTP

C. Salient Feature of the project

Table III-3 WWTP Components and Salient features of the project TP-03

Sn.	Particulars	Description
1.	Project location	Dhobighat.
2.	District	Lalitpur.
3.	Available Land Area	30.4 Hectare approximately.
4.	Municipality/Ward	Lalitpur Metropolitan City ward 4
5.	Project Works	Construction of Wastewater Treatment Plant
6.	Employer	Project Implementation Directorate (PID)
7.	Executing Agency	Kathmandu Upatyaka Khanepani Limited (KUKL)
8.	Funding Agency	Asian Development Bank and Government of Nepal
9.	Capacity of existing WWTP	Average flow of MLD
10.	Trees Cut	No trees in the proposed site
11.	Estimated capacity after rehabilitation and expansion	Average flow 37.0 MLD in first stage and additional 37.0 MLD in second stage with total of 74.0 MLD
12.	WWTP process type	Activated Sludge
13.	Effluent Standard	50.0 mg/l in Year 2020
14.	Design Life	Structures-minimum 60 years Mechanical and equipment- minimum 15 years
15.	Served population	954,860 by 2030 (Source: DPR)
16.	Contract Award Date	02 Feb,2018
17.	Contract Completion Date	02 Feb, 2020
18.	WWTP Components	Screening and Grit chambers, Primary Sedimentation Tanks, Activated Sludge Tanks, Secondary Sedimentation Tanks, Tertiary Treatment Facility, Disinfection Facility, Sludge Thickening Facility, Anaerobic Sludge Digester, Bio-Gas Generation Facilities, Sludge Dewatering machine etc.

D. **Implementation Schedule**

28. Detailed design of WWTP packages was started in the mid of 2017, Construction is scheduled to commence in the end of 2019..

29. The project implementation schedule is for a period of 3 years. Most of the activities have been scheduled on a continuous basis.

30. Before construction, KUKL/PID will develop detailed responsibilities and requirements for contractors and will provide detailed cost estimates of mitigation measures and environmental monitoring in the construction contracts. KUKL/PID will also detail the responsibilities of their environmental management offices and prepare their work schedules.

31. Before operation, KUKL/PID will develop detailed work plans for environmental management and monitoring during operation based on the EMP. These work plans will be submitted to the concerned persons to help them supervise implementation.

Table III-4 Proposed Implementation schedule for TP-03

S. No.	Activity	2017				2018				2019				2020
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
1	Finalize Bidding Document													
2	ADB Review													
3	Final Revisions as Necessary													
4	Advertise Invitation For bids in Newspaper/ADBBO													
5	Preparation of Bids													
6	Submission of Bids/Public Opening													
7	Evaluate Technical Envelop (Qual./Technical)													
8	Review by Procurement Committee													
9	ADB Review													
10	Public Opening of Financial Envelop													
11	Evaluate Financial Bid													
12	Bid Evaluation Report & Recommend Award													
13	Review by Procurement Committee													
14	ADB Review and No Objection													
15	Issue Notice of Award													
16	Contract Sign and Notice to Proceed													
17	Completion of work													

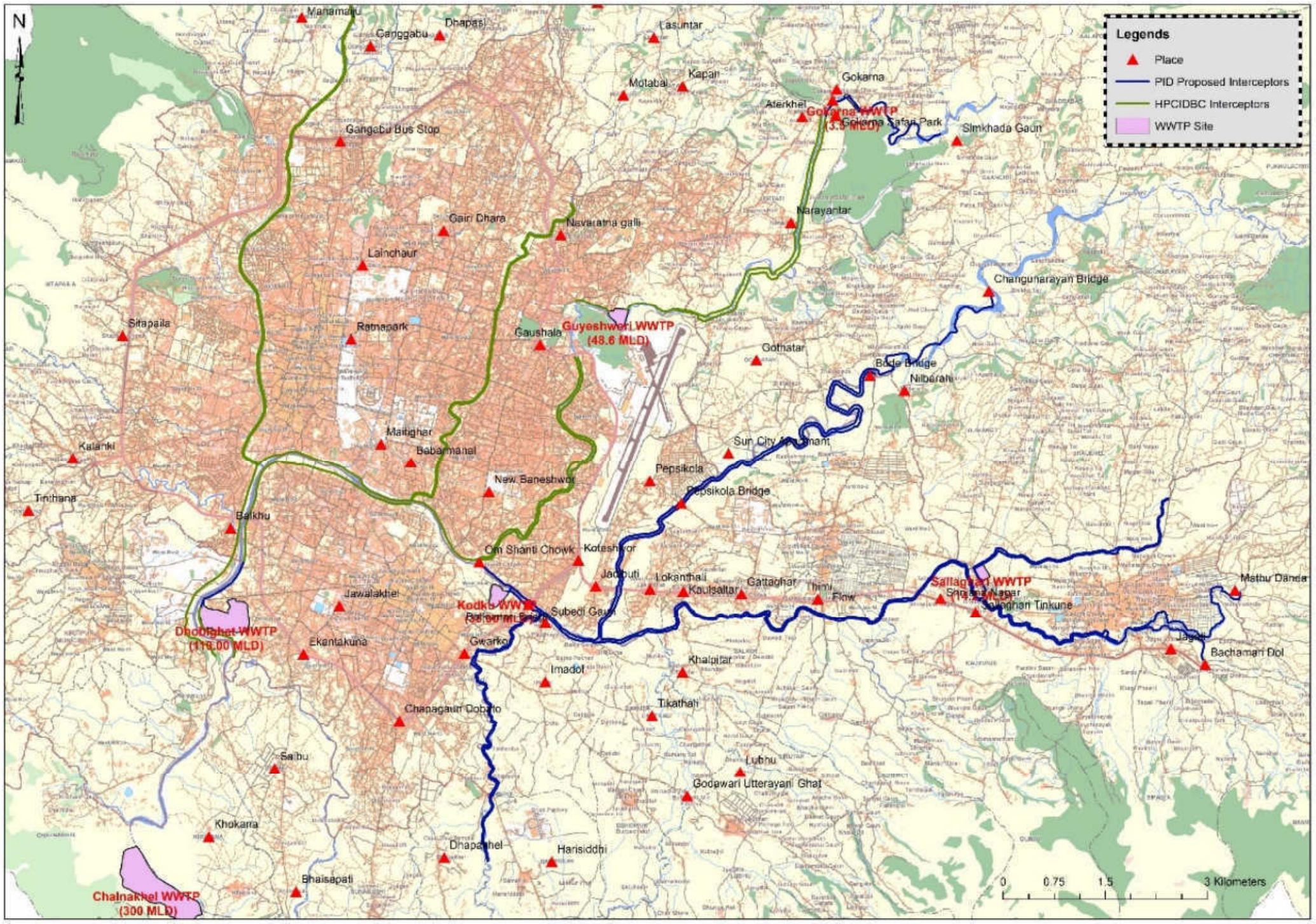

Figure III-4: Project components and schematic layout of Kathmandu Valley with proposed Treatment plants

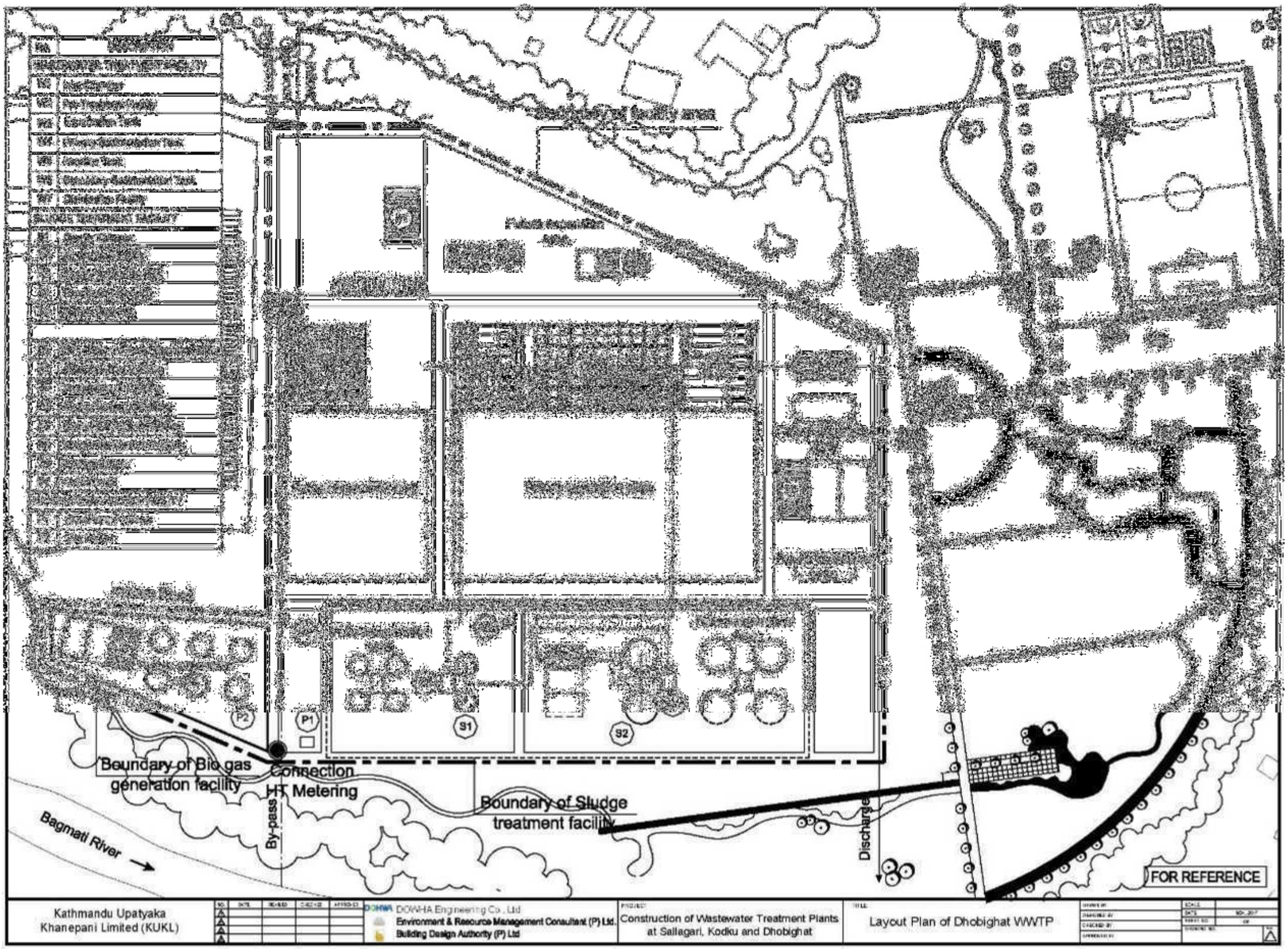

Figure III-5: Layout of WWTP Dhobighat (TP-02)

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Topography

32. Kathmandu Valley (Figure IV-1) lies between latitudes 27035' to 27°48'N and longitudes 85012' to 85°33'E. The altitude of the district ranges between 1, 372 m and 2,732 m above mean sea level. The major rivers flowing in the district are the Bagmati River, Bishnumati River, and Manohara River. The length of Bagmati River within Kathmandu Valley is 28 km. The Bishnumati, Manohara, Dhobikhola, Nagmati, and Balkhu rivers are the main tributaries of the Bagmati River. The Bagmati River is important both for water consumption and for religious purposes. One of the most famous temples of the Hindus (the Pashupati Nath Temple) is located in the banks of the Bagmati River.

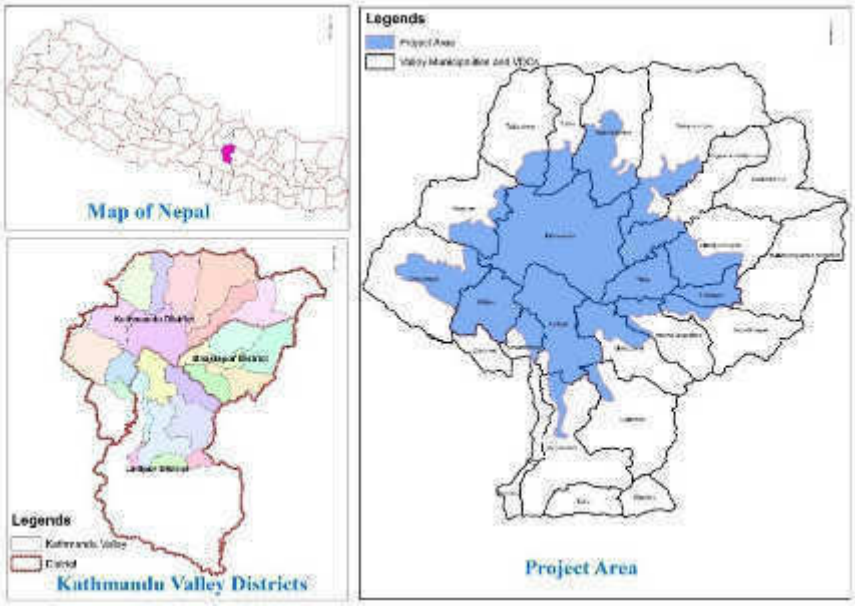

Figure IV-1: Kathmandu Valley and project area.

33. Lalitpur is another adjoining city of Kathmandu and is located between latitudes 27° 22 to 28°50'N and longitudes 85°14' to 85°26'E. It is bounded by Kavrepalanchowk in the east, Makwanpur in the west and south, and Bhaktapur and Kathmandu in the north. Bagmati River serves as boundary between Lalitpur and Kathmandu. The major tributary of the Bagmati River in the Lalitpur district is the Nakkhu Khola.

34. The Lalitpur sub-metropolitan city, popularly known as Patan, is located about 5 kilometers southeast of Kathmandu. Lalitpur is extremely rich in arts and architecture and boasts of the largest community of artisans, especially metal and wood workers. It has a large number of sacred buildings, temples, pagodas, Stupas and Shikharas, monasteries, maaths and Chaityas. UNESCO has enlisted the conglomerate of the buildings in Patan Durbar Square as a world heritage site, one of the seven heritage sites in Kathmandu Valley.

a. Geology and Soil

35. Kathmandu Valley is a synclinal tectonic basin consisting of fluvio-lacustrine deposits from the Pleistocene age resting on top of Precambrian metamorphic bedrock. In Kathmandu Municipality, the Gokarna (to the northeast) and Kalimati (to the southwest) formations are predominant. The Gokarna formation typically consists of light to brownish-grey fine laminated and poorly graded silt sand with intercalation of clay of variable thickness. Shallow SP sandy soils, which are highly prone to liquefaction even under small to moderate intensity earthquakes (MMI = VII-VIII), are often found within the Gokarna formation.

36. The Kalimati formation is grey-to-dark silt clay and clayey silt. Organic clay, fine sand beds, and peat layers are commonly found. SM silty-sand soil layers intercalated with silt or clay layers are often found from 5 to 15 meters down. Such layers are prone to liquefaction under moderate to high intensity earthquakes (MMI = VIII-IX).

37. Generally, apart from soils located at the foot of mountains, those soils in the Kathmandu Valley located above 1,300 m are expected to be either non liquefiable or to have a low liquefaction potential.

b. Climate

38. Nepal, in a year, receives about 1,500 millimetres (mm) of rainfall in a good monsoon regime (Department of Hydrology and Meteorology Records). The climate of Kathmandu Valley is sub-tropical cool temperate with maximum of 35.6°C in April and minimum of –3°C in January. The annual average humidity is 75%. The temperature in general is 19°C to 27°C in summer and 2°C to 20°C in winter. The monthly average maximum temperature is 28.9 °C and monthly minimum temperature is 13.8 °C. The average rainfall is 1465 millimetres, most of which falls during June to September. Rainfall is concentrated, and more than 75% of the annual rainfall occurs during the monsoon months beginning June through September. The months between October and May are dry and rainfall is sporadic. In winter, rainfall is caused by the weather system originating from the Mediterranean region. The winter rain reaches Nepal and causes significant precipitation in the western part.

39. The climatic condition of the Bagmati watershed is quite variable because of the intricate topography. Temperature generally decreases with elevation; it is low in winter and increases with the advent of spring. Climatically, the Bagmati watershed region can be classified into three regions:

- Tropical climate of the southern Terai, Bhabar, Chure (Shiwalik), and the Inner Terai with mild and dry winter
- Warm temperate climate of the Mahabharat region above the elevation of 2,000 m with warm summers and cool winters
- Cool temperate climate of the high Mahabharata region above the altitude of 3,000 m with cool summers and cold winters; snow falls in the winter months and persists on the high slopes throughout the winter.

40. Rainfall occurs from the months of June through September due to the southeast monsoon. The humid monsoon air stream blowing from the Bay of Bengal is forced to rise as it meets the Himalayas. As a result, heavy rainfall occurs in some sections of the southern Himalayan slopes. Rainfall is also high along the Chure range. Regions close to the Indian border receive about 1,500 mm rain in a year, while at the foothills of Chure the annual rainfall reaches 2,000 mm. In the northern side of Chure, the rainfall diminishes again. In the lee-ward side, rainfall is reduced due to rain shadow effects. Orographic effect is pronounced and governs the rainfall pattern.

B. Ecological Resources

1. Surface Water

41. Nepal has many small to large size rivers, which flow from north to south. It has over 6,000 rivers with a combined length that exceeds 45,000 km. About 1,000 of these rivers are more than 10 km long and 100 are more than 160 km long. The surface water available is estimated to be around 224.7 billion cubic meters (m3) per annum. The flow rate is around 7,125 cusecs. Nepal receives a yearly average precipitation of more than 1,500 mm.

42. The Bagmati River forms a medium-sized river basin with a catchment area of 3,700 km2 at the Nepal-India border. It extends from latitudes 200 42' to 270 50'N and longitudes 850 02' to 850 58'E. It originates from the Shivapuri hills in the Mahabharat range of mountains and flows down south into the Terai plains before crossing the Indo-Nepal border. The major tributaries of the Bagmati River are Manohara, Bishnumati, Kulekhani, Kokhajor, Marin, Chandi, Jhanjh, and Manusmara. Kathmandu Valley comprises 15% of the basin area in Nepal. The basin as a whole can be divided into three parts:

(i) Upper Bagmati basin comprising Kathmandu Valley plus the upper part of the Nakhkhu Khola and Dakshinkali area,

(ii) middle Bagmati basin comprising the remainder of the basin in the hills including the Kulekhani Khola, and

(iii) Lower Bagmati basin comprising the basin in the Terai, plus some tributaries which originate in the Shiwaliks.

43. Rainfall occurs from the months of June through September due to the southeast monsoon. The humid monsoon air stream blowing from the Bay of Bengal is forced to rise as it meets the Himalayas. As a result, heavy rainfall occurs in some sections of the southern Himalayan slopes. Rainfall is also high along the Chure range. Regions close to the Indian border receive about 1,500 mm of rain in a year, while at the foothills of Chure the annual rainfall reaches 2,000 mm. On the northern side of the Chure the rainfall diminishes again. In the lee-ward side, rainfall is reduced due to rain shadow effects. Orographic effect is pronounced and governs the rainfall pattern.

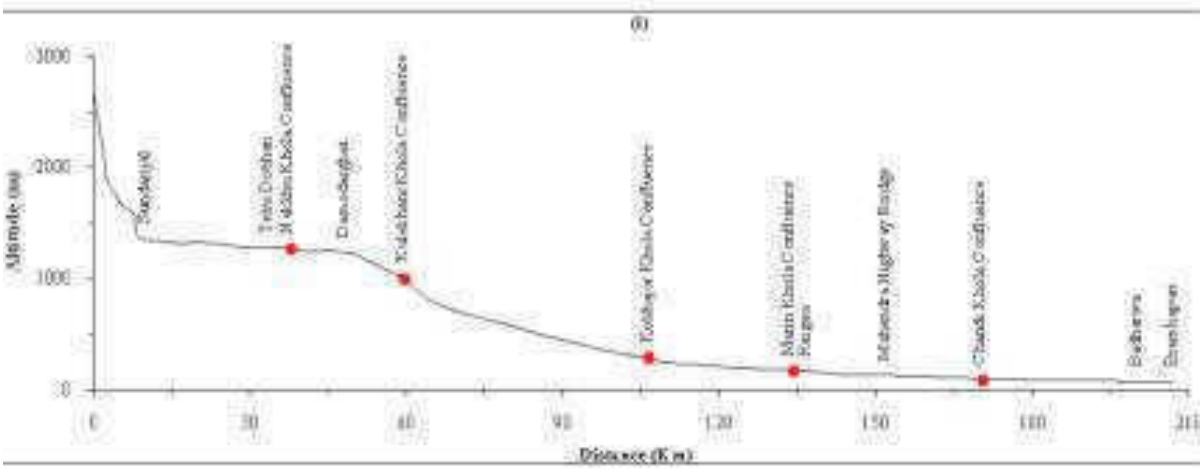

Figure IV-2: Longitudinal Profile of the Bagmati River Basin

Source: DWIDP/SILT/ERMC/TECHDA. 2005. Preparation of Water-Induced Hazard Maps of Bagmati River Basin.

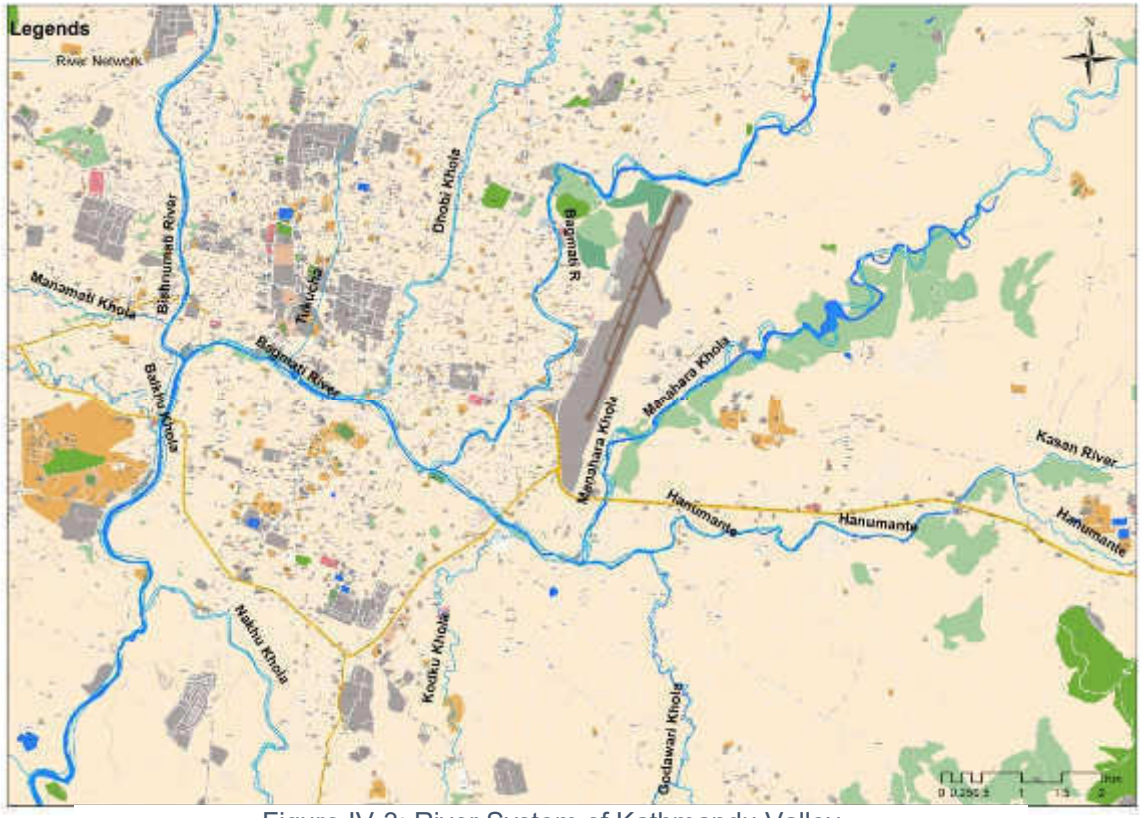

Figure IV-3: River System of Kathmandu Valley

44. Themajor tributaries of the Bagmati River inside the Kathmandu Valley are Bishnumati, Balkhu, Tukucha, Dhobi Khola, Manohara, Kodku, and Nakhu Khola. These tributaries are highly polluted. The municipal wastes and industrial effluents are directly discharged into these rivers and have made the water unusable for human and ecological needs along most

of the course. In addition, Kathmandu Valley is facing a severe shortage of water due to rapid urbanization. The annual groundwater use for domestic and industrial purposes in the valley is almost two times the annual rechargeable groundwater available. The Bagmati River has a high religious value. It also adds to the aesthetics of the valley as it passes through, along with its tributaries, the major three cities of the valley.

2. Surface Water Quantity

45. Kathmandu Valley has a chronic water shortage. The sole water utility operator, Kathmandu Upatyaka Khanepani Limited (KUKL) has not been able to meet water demand of rapidly growing population of urban and semi urban areas of KV within its service area. The present water demand is estimated to be 350 MLD by KUKL in 2012 while the supply is limited to about 150 MLD in wet season and about 90 MLD in dry season. There is thus a large disparity between demand and the supply. KUKL is adapting intermittent supply to cope with this shortage and customers are sometimes supplied with drinking water for only about an hour once every six days during wet season, and as little as 1-2 hours once every eight days during dry season in some locations. The demand for drinking water is increasing by about 6% annually.

46. The existing system taps water from 35 surface water sources and 59 deep tube wells located in different parts of the valley. The total production of water from all these sources is about 150 MLD in wet season and 90 MLD in dry season with an average production of about 120 MLD throughout the year. During the wet season, surface water constitutes about 90% of water production while this drops down to about 70% during dry season. The groundwater is a major source of water during dry season and constitutes about 30% of water supplied by KUKL.

47. As the water utility has not been able to meet water demand, many private and government institutions and industries have constructed their own deep tube-wells to use groundwater directly. KVWSMB estimates that the total quantity of groundwater being extracted in 2011 is 81.6 MLD, out of which 31.6 MLD is being used by KUKL for municipal supply and the balance (50 MLD) is extracted by private sector for uses in hotels, industries, bottled water manufacturing, tanker supplies and new housing colonies.

48. Tanker water supply is a flourishing business in Kathmandu Valley and is complementing the meagre supply of water by the utility. Their supply areas are mainly urban core and newly developed semi-urban areas where there is high density of hotels, hospitals and other institutions. There are 700-800 water tankers in operation being operated by about 216 water tanker entrepreneurs. Most tanker companies have their own water sources and use both surface as well as groundwater source, but predominantly groundwater source. The combined production of these companies is about 12.58 MLD (11.10 MLD groundwater and 1.48 MLD surface water) in the dry season and about 6.36MLD (5.44 MLD groundwater and 0.92 MLD surface water) during the wet season. Research conducted in 2012 indicated that the total amount of water supplied through tankers is about 25.58 MLD in dry season and 15.36 MLD in wet season. This supply constitutes about 8% of water demand or about 44% of water reaching consumers from KUKL supplies.

49. The shallow wells are a common source of water used to supplement inadequate public supply for domestic use. Most houses in Kathmandu Metropolitan City have either dug well or shallow tube-well (Rower pump). In 2009, the number of houses possessing a private well was about 74.3 % in Kathmandu Metropolitan City.

50. The other sources commonly used are bottled water, stone spouts, rain water harvesting arrangement and other springs and rivers.

51. The present consumption of water in Kathmandu Valley varies between municipalities and the availability of water. The population of KMC has higher water demand than other smaller municipalities. The population with private tube-wells has significantly higher consumption than people without them. The consumer survey carried out in 2009 showed that every house in Kathmandu with a private tube-well consumed 98 lpcd in average whereas a house without private well consumed only 47 lpcd. The analysis of data from the baseline survey showed that the total water consumed for domestic purposes (from all sources) in Kathmandu valley is about 107.43 MLD.

52. The unconstrained water demand in the five municipalities and the VDCs is estimated by

the baseline survey study to be in the range of 100-120 lpcd for fully plumbed connections, 50 lpcd for yard taps and 25 lpcd for public stand post. These demand values have been used for forecasting post-Melamchi water demand (year 2020 water demand) while preparing the Capital Investment and Asset Management Program for Kathmandu Valley. The CIAMP has assumed the water demand to grow with economic growth and availability of water. The water consumption in the year 2025 in Metropolitan Kathmandu is expected to be 135 lpcd for fully plumbed, 70 lpcd for yard tap and 45 lpcd for public stand post. The total water demand within the service area in Kathmandu Valley is estimated in CIAMP to be 445 MLD and 685 MLD in the year 2020 and 2025 respectively.

Table IV-I: Water Consumption by consumers in Kathmandu from all sources

Municipality Name	Population (Year 2011)	Population Served by KUKL	Population Served	Population with Private Well in the Compound			Population with Private Tubewell in the Compound			Total Water Consumption
				Percentage	Per Capita Consumption	Total Consumption	Percentage	Per Capita Consumption	Total Consumption	
		(%)	(No.)	(%)	(lpcd)	(MLD)	(%)	(lpcd)	(MLD)	(MLD)
Kathmandu	1,006,658	84.9	854,651	74.3	97.7	62.04	25.7	46.9	10.30	72.34
Lalitpur	223,285	87.9	196,268	59.4	86.2	10.05	40.6	49.6	3.95	14.00

Source: Consumer Survey, 2009

3. Surface Water Quality

53. The BOD5 level in different stretches of the Bagmati River at different seasons provides a clear indication of high level of pollution at all seasons of the year (BOD5 levels range from 1.7 to 239.4 mg/l in the pre-monsoon, 2.1 to 84.7 mg/l in the monsoon, and 2.3 to 119.4 mg/l in the post-monsoon seasons). The main reason for the deteriorating water quality of the Valley's rivers is discharge of untreated sewage in the urban areas of Kathmandu, although solid waste dumping along the river is also a contributing factor.

54. Water treatment plants were installed from the very beginning of system development in order to improve the raw water quality and make it safe for drinking purpose. Balaju water treatment was built as a component of Tri Bhim Dhara system and Maharajgunj water treatment plant as a component of Bir Dhara system. With the expansion of the networks, more water treatment plants were built. There are 21 water treatment plants (5 major and 16 smaller) in Kathmandu Valley water supply system with a total treatment capacity of about 85 MLD. Most of WTPs are capable of treating surface water and groundwater containing a high content of suspended solids, iron and ammonia. Most of water treatment plants are in poor state of maintenance and have not been consistent in producing acceptable water quality.

55. Bacteriological water quality deterioration during transmission is a significant problem due to ingression of polluted water into water supply pipe from leaking sewers during intermittent water supply. Pollution of drinking water is now very frequent and KUKL receives many complaints about it. Almost every report on drinking water quality of Kathmandu reveals that most of water supply is contaminated with bacteria. The chemical quality of most of the water is within WHO guidelines.

Table IV-II: Comparative Analysis and Projection of BOD and DO at different locations in Kathmandu Valley along the Bagmati River in 2014, 2020 and 2030.

Location	BOD (mg/L)			DO (mg/L)		
	2014	2020	2030	2014	2020	2030
Gokarna	15.07	16.72	20.10	6.01	6.01	5.85
Gaurighat	33.06	9.29	42.32	5.38	5.19	4.72
Minbhavan	86.46	97.05	109.03	2.49	2.36	2.18
Teku	117.61	131.4	148.04	1.31	1.17	1.05

Dhobighat	118.0	131.98	148.93		1.013	0.92	0.82

Source: Mishra, B.K., et al. Assessment of Bagmati river pollution in Kathmandu Valley: Scenario-based modelling and analysis for sustainable urban development. Sustain. Water Qual. Ecol (2017)

56. Table IV-II showed the comparative plots of monthly DO and BOD values at five locations on the Bagmati River from upstream to downstream areas. In general, there are consistent seasonal variations in DO and BOD levels strongly associated with river discharge as DO and BOD approach 0 mg/l and 200 mg/l during the dry months of the year. The higher concentrations of DO and BOD in the dry months are also associated with the lower capacity for natural self-purification and dilution of pollutants due to reduced flows. Although it was believed that the river water pollution will be largely sorted out after the establishment of the new/rehabilitated WWTPs, plots of 2020 and 2030 show that DO and BOD values will remain far beyond acceptable limits.

57. These data demonstrate that the current, as well as new/rehabilitated wastewater treatment plants are largely inadequate to alleviate the Bagmati river pollution. By 2030, river water pollution will be much worse. There will be an increase of wastewater generation due to the greater population and socio-economic development despite rehabilitation, up-gradation and new wastewater management systems. Therefore, the new/rehabilitated wastewater infrastructures need to be expanded further with the increase of population, lifestyle and other socio-economic development activities resulting in a significant increase of wastewater. The quantity of wastewater generation is closely connected with management or pattern of water consumption. Thus, the simulation results of the WEAP model with adaptation scenarios can contribute to the improvement of water consumption pattern. One of the alternative measures for reducing water consumption and wastewater generation could be changes in the water utility pricing system. Alternative pricing such as an increase in water utility service fee (sum of water supply and sanitary service charges) can help in optimal use (reduction) of water consumption and also increase revenue for sustainable operation and management of water infrastructures. Water quality simulation in this study was based on the mean behaviour of the system.

58. However, the wastewater generation rate, as well as water quality parameters, may be significantly different depending on the location, community, catchment, daily variation in stream flow in the rainy season and various others. Obviously, in 2020 and 2030, if there are no drastic measures to control pollution sources, Bagmati River water quality will be no longer eligible to supply for any practical purposes. Therefore, to ensure the water quality in future eligible for different uses, it is required now to have timely solutions to solve this problem (Mishra, B.K., et al.).

4. Groundwater

59. The groundwater aquifers of Kathmandu Valley are divided into three districts: Northern (157 km2 with 59 km2 recharge area), Central (114 km2 with about 6 km2 recharge area), and Southern (55 km2 with about 21 km2 recharge area) (Dixit and Upadhya 2005). The heavy extraction of groundwater to meet the domestic as well as commercial demands is alarming because it depletes the groundwater level. There is haphazard extraction of water from both shallow and deep aquifers in Kathmandu Valley at present. According to the hydro-geological conditions of Kathmandu Valley and the recharge rate of the basin, only 15 MLD of groundwater can be safely extracted in a day (JICA 1990). This rate is being exceeded by more than 70% by the Nepal Water Supply Corporation (NWSC) tube wells alone. Due to the increase of built-up areas, groundwater recharge is reduced with the rerouting of the natural drainage. The unsustainable extraction of groundwater causes land subsidence, which is already evident in many cities in Asia (e.g., Bangkok).

60. It is estimated that the groundwater of Kathmandu Valley is decreasing at an average rate of 2.5 meters per year. The depletion varies by location as the geological structure within the Kathmandu Valley is diverse. If the current rate of groundwater extraction continues, water will be sufficient for the next 90 years only (http://guthi.net).

61. Many households have installed rower pumps to extract groundwater from the shallow

aquifer when NWSC could not meet their demand, but the bacteriological quality of the water poses some concern and has to be looked into. Due to the necessity of stopping groundwater mining, it is urgent to enact a law and formulate rules and regulations on the extraction of groundwater in Kathmandu Valley.

5. Groundwater Quality

62. Of the 57 deep tube wells tested, many have exceeded the country's standards for color, turbidity, ammonia, iron, and manganese. Two of the wells exceeded the arsenic standard. In some wells, ammonia concentration was found to be extremely high (50 fold above the threshold value of 1.5 mg/l). Twenty of the 57 wells showed bacterial contamination (ENPHO, 2009).

6. Melamchi and Other Water Supply Projects

63. Major infrastructural development works are on-going in Kathmandu Valley for augmentation of water supply, and expansion and rehabilitation of distribution network. Melamchi Water Supply Project (Melamchi Water Diversion Subproject 1), which will bring in170 MLD water from Melamchi River to Kathmandu Valley in the first phase, is under implementation. The subsequent phases of Melamchi project would bring in 170 MLD water from Yangri Khola in the second phase and 170 MLD water from Larke Khola in the third phase. The Melamchi water diversion project involves construction of about 27.5 km tunnel, river intake and a de-silting basin. The water treatment plant proposed at Sundarijal is under construction. The construction work of the project has been on-going since April 2009. Although the originally scheduled completion date of tunnel construction is September2013, it is now expected that the project will be completed by April 2016.

64. KUKL is currently implementing Kathmandu Valley Subproject 2 of Melamchi Project (Loan 1820). It has completed some works for immediate improvement of water supply service in Kathmandu Valley. KUKL PID is now implementing distribution network improvement works and other related activities.

D. Existing Wastewater System

65. This section provides an overview of the wastewater services. It covers issues relating to the wastewater collection network and conveyance system. It includes the neighborhood system, main collectors and interceptors which ultimately convey wastewater to the treatment plants. The issues concerning the wastewater treatment systems have been dealt in the separate reports under different packages.

66. Kathmandu Upatyaka Khanepani Limited (KUKL), a public company, established in February 2008, estimated that by February 2014 all existing wastewater treatment plants are to be functional and run each plant to at least 90% of its hydraulic capacity. Also, KUKL stated that by the beginning of the fifth year after the commissioning of Melamchi Project, wastewater services in the form of sewer or on-site sanitation should be made accessible to 90% of the population in the service area. KUKL is not currently responsible for the operation and maintenance of Guheshwori WWTP (commissioned in November 2006). This is under the control of the High-Powered Committee for Integrated Development of Bagmati Civilization (HPCIDBC).

E. National Parks

67. The Shivapuri Nagarjun National Park is the only national park near Kathmandu Valley. Shivapuri is the second highest peak among the hills surrounding the valley. It is 2,732 m high with numerous sharp ridges radiating to all sides. Due to its strategic location and convenience, being situated toward the north of Kathmandu Valley, Shivapuri was proclaimed as a watershed area supplying more than 1 million liters of natural spring water to the city. After Shivapuri had experienced several problems concerning soil erosion as a result of deforestation, over-grazing, cultivation on steep slopes, etc., which reduces the quality and quantity of the water, the Government initiated a program to protect Shivapuri and its adjoining areas as a watershed and wildlife reserve in 1975. In 2002 Shivapuri Watershed and Wildlife Reserve was officially given the national park status. In 2009,

Nagarjun was annexed to the Shivapuri National Park and renamed the Shivapuri Nagarjun National Park.

1. Forests

68. The valley has 20,945 ha of forests, which constitutes 32.7% of its total area. The natural vegetation, except in a few conservation areas, has been under intense pressure. The area under natural forest cover, excluding shrubs, is 9,580 ha (45.7% of the total forest land), of which only about 22% has good forest cover with more than 50% of crown coverage. Mature hardwood forests are now confined to parks and sacred areas such as Nagarjun (Raniban), Gokarna, Shivapuri National Park, and Bajrabarahi forest. Shrubland occupies nearly 34% of the total forest area.

69. The Nagarjun National Park (area: 15 km2) was annexed in 2009 to the Shivapuri National Park (area: 144 km2) and called the Shivapri Nagarjun National Park. The intension was "to provide extended habitat for the wildlife population and as a representation of intact midhill forest ecosystems whose representation is comparatively low in the protected area system. The Shivapuri Nagajun National Park is one of the primary sources of freshwater for Kathmandu Valley, providing about 40% of the drinking water to the Valley" (Department of National Parks and Wildlife Conservation 2009).

70. However, no any forests, national parks and protected area is existed within the proposed project locations.

2. Flora

71. Since Shivapuri lies in the transition zone between a subtropical and a temperate climate, the vegetation consists of a variety of natural forest types, depending on altitude and aspects. Most of the areas below 1,800 m are covered with *Schima castanopsis* forest in which pines *(Pinus roxburghii)* appear on the southern dry ridges, with utis *(Alnus nepalensis)* along the streams. A forest of oak species such as *Quercus semicarpifolia* and *Quercus lamelosa* mixed with rhododendron and a variety of orchids flourish in the northern slopes. There are more than 2,122 species of flora; 16 of them are endemic flowering plants found in the Shivapuri Nagarjun National Park. A variety of medicinal herbs are found at higher altitudes. About 130 species of mushrooms have been so far identified and catalogued from the Shivapuri National Park.

3. Fauna

72. The Shivapuri National Park is home to 311 species of birds, 21 species of mammals, and more than 102 species of butterflies, some of which are endemic and rare. This is out of the 800 species of birds, 130 species of mammals *(of which 11 are* threatened species), and *600 species of* butterflies found in Nepal, thus making the National *Park a paradise* for flora and fauna. The threatened wildlife found *are wild boar (Sus scrofa), barking deer (Muntiacus muntijak),* rhesus monkey *(Macaca mulata),* porcupine *(Hystrix indica),* goral *(Naemorhedus goral),* Himalayan black bear *(Ursus thibetanus),* leopard *(Panthera pardus),* pangolin *(Manis spp.), cloded leopard* (Pardofelis nebulosa), *leopard cat* (Primailurus bengalensis), *and jungle cat* (Felischaus).

C. Economic Development

73. The economy of Kathmandu Valley is based on trade, commerce, and manufacturing industries (e.g., carpets and garments). Other important sectors are agriculture, education, transport, and hotels and restaurants. Tourism is also a key component of the Valley's economy. However, in the rural areas, the economy is still based on agriculture.

74. Kathmandu Valley has developed as a center of trade links with India and Tibet (People's Republic of China). According to the Economic Survey 2010-2011, Nepal in fiscal year 2009-2010 exported 71% of its goods to India and 29% to countries such as the United States, United Kingdom, Italy, Germany, Canada, and Japan. The main export commodities are ready-made garments, woolen carpets, woolen and pashmina goods, and handicrafts of which most are manufactured in Kathmandu Valley. Nepal imported 68% of goods from India and the rest, from other countries. The major import items are petroleum products, medicines, electronic goods, gold, transport equipment, and fertilizers. A significant share of imported goods is consumed in the valley. Kathmandu Valley is the entry point for the

majority of tourists. In 2009, a total of 602,867 tourists arrived in Nepal, of which, more than 80% entered through the Kathmandu international airport.

75. About 53% of the total population aged 10 years and above in the valley are economically active (Census 2001). They are engaged in agriculture and forestry (36%), manufacturing (17%), commerce (16%), construction (4%), and transportation/ communication (3%).

Table IV-III: Household in Non-farm Economic Activities in Kathmandu Valley

Municipalities	Share of Households Engaged in Non-farm Activities (%)	Type of Activities				
		Manufacturing	Trade/ Business	Transport	Services	Others
Lalitpur	50.18	13.25	33.22	4.29	42.37	6.86
Kathmandu	31.57	6.86	49.49	3.49	30.26	9.9

Source: CBS, 2003

76. According to the 2001 Census and the Nepal Human Development Report 2004, the poverty status and human development index of Kathmandu Valley was lower than the national level (Table IV-IV).

Table IV-IV: Kathmandu Valley Development Indicators

District	Human Development Index (HDI)	Human Poverty Index (HPI)	Gender-related Development Index (GDI)
All Nepal	0.471	39.6	0.452
Kathmandu	0.652	25.8	0.635
Lalitpur	0.588	25	0.569

Source: Census 2001; UNDP. 2004. Nepal Human Development Report.

1. Economic Development and Prospects for Growth

77. Compared to the rest of Nepal, Kathmandu Valley fares better because it has basic facilities such as water supply, sanitation, electricity, bottled gas, telecommunications, roads, education, security, and transportation. The valley is also the center for several major industries such as textile, food & beverage, non-metallic mineral products, publishing, and printing. Such facilities and opportunities are a huge attraction to the rural poor resulting in high migration rates into the Valley; hence the rapid population growth and demand for urban services, especially water supply, within the Valley.

78. The valley's annual industrial output is estimated to be NRs.14.6 billion ($190 million), which is nearly 9.4% of the total national industrial output. The industrial sector employment in the valley is about 37,500, which is 22.1% of the national employment in the sector. Similarly, indirect employment in the industrial sector is about 38,900, which is about 21.9% of the national figure.

79. Being the capital city and a commercial center for the country, Kathmandu and its surrounding valley is developing and urbanizing fast, compared to the rest of Nepal. It is the most important urbanized area in Nepal. New products and services are first introduced in the Valley, giving the inhabitants access to modern equipment and technology. An indication of confidence in economic growth is the high demand for new housing real estate and the number of new vehicles on the roads, which is rising rapidly. In addition, there are plans for major transportation improvements such as the Kathmandu outer ring road and the new link road to India via Terai.

2. Land Use

80. The land use and land cover statistics (Table IV-V) derived from the 1992 topographical sheet show that almost 50% of the Bagmati watershed is occupied by forests.

Table IV-V: Land Use and Land Cover in the Bagmati River Basin

Land Use/Land Cover	Area (ha)	Percent
Forest	186,340	49.6
Cultivation	141,986	37.8
Sand	18,118	4.8
Bush	13,367	3.6
Grass	5,241	1.4
Channel	4,441	1.2
Built-up area	2,378	0.6
Barren land	1,264	0.3
Orchard	785	0.2
Scattered tree	551	0.1
Nursery	360	0.1
Pond or lake	141	0.0
Others	628	0.2

Source: DWIDP/SILT/ERMC/TECHDA. 2005. Preparation of Water-Induced Hazard Maps of Bagmati River Basin.

G. Infrastructure

1. Transportation

81. Long-distance bus services from Kathmandu provide services to the people throughout the country. Private transport includes buses, microbuses, vans, cars, jeeps, and three-wheelers operated by petroleum, liquid petroleum gas (LPG), and batteries. A total of 1,331 km of roads within the Kathmandu Valley (Department of Roads 2004).

2. Drinking Water Supply

82. Not all households and people in the Valley receive safe drinking water. Various sources of drinking water for households are shown in Table IV-VI.

Table IV-VI: Sources of Drinking Water

	Kathmandu Metropolitan City		Lalitpur Sub-metropolitan city		Bhaktapur Municipality		Madhyapur Thimi Municipality		Kirtipur Municipality	
	HHs	%	HHs	%	HHs	%	HHs	%	HHs	%
Tap	163,339	64.2	33,378	61.2	15,998	90.7	13,431	66.2	14,734	75.8
Tube well	18,574	7.3	801	1.5	107	0.6	1,412	7.0	47	0.2
Covered well/kuwa	10,890	4.3	6,045	11.1	444	2.5	2,085	10.3	382	2.0
Uncovered well	1,341	0.5	940	1.7	217	1.2	602	3.0	52	0.3
Spouts	4,830	1.9	2,708	5.0	350	2.0	1,389	6.8	754	3.9
River/stream	52	0.0	38	0.1	4	0.0	2	0.0	3	0.0
Others	53,275	21.0	10,242	18.8	425	2.4	1,263	6.2	3,350	17.2
Not stated	1991	0.8	429	0.8	94	0.5	118	0.6	119	0.6
Total	254,292	100.0	54,581	100.0	17,639	100.0	20,302	100.0	19,441	100.0

Source: CBS, 2011.

83. Based on the 2005 data of the Department of Drinking Water and Sewerage, the number and percentage of the population receiving water by district and for the Kathmandu Valley

are shown in Table IV-VII. It shows that less than 75% of the population receives piped drinking water supply from the then Nepal Water Supply Corporation (now KUKL).

Table IV-VII: Population Receiving Drinking Water

District	Estimated Population in 2005	Beneficiary Population in 2005	Percentage
Kathmandu	**1,246,110**	**947,630**	**76.05**

Source: NWSC. 2005.

3. Surface Drainage, Sanitation, and Sewerage

84. Storm water drainage systems function in the valley through side drains but not well enough. The sewers of Kathmandu are largely a combined sewer/drainage system. For many years, reports on Kathmandu sewerage have highlighted the value of separating storm water and sanitary sewage, but the process has not yet started. The increased use of plastic bags has also worsened the problem as plastics frequently clog the drains.

4. Electricity

85. Not all households in the valley have electricity, but the overall proportion of households connected to electricity is high at roughly 95%. Based on the Nepal Human Development Report 2001 (UNDP 2002), about 96.81%, of households in Kathmandu, have electricity.

5. Educational Institutions

86. Kathmandu Valley has long been considered the center for higher education in Nepal. In 2007, it had 6,106 high schools and 474 higher secondary, college, and university-level educational institutions. The number of students enrolled during the period at in high school and higher education level was 573,779 and 156,828 respectively (ICIMOD, MOEST, UNEP 2007).

87. Education has been progressing continuously, specifically in the Kathmandu Valley and as a result, educational institutions, levels of education, and fields of study have been increasing. Table IV-VIII shows the number of schools by level for the three districts.

88.

Table IV-VIII: Total Number of Schools by Grade and Level

	Primary	Lower Secondary	Secondary	Higher Secondary
Kathmandu	**920**	**671**	**514**	**148**

Source: Compiled from NIDI 2006; ICIMOD, Ministry of Environment, Science and Technology (MOEST), United Nations Environment Programme (UNEP) 2007.

6. Health Facilities

89. Kathmandu is the centre for all types of health services (general medicine, surgery, heart care, orthopaedic care, kidney care, dental care, children's care, eye care, mental care, neurology, etc.). The number of health facilities owned by the Government or provided by local and international NGOs and the private sector is relatively higher (and with better services) in Kathmandu.

7. Communications

90. There are 3,991 post offices in Kathmandu Valley, including the general post office, regional postal directorates, district post offices, area post offices, and other post offices. A number of private postal care companies provide a wide range of postal services (ICIMOD, MOEST, WNEP, 2007).

91. The telecommunication system in Kathmandu Valley is excellent. As of 2005-2006, the Nepal Telecommunications Authority had issued basic telephone service license to two

agencies, cellular mobile service license to two agencies, and internet licenses to 38 agencies (more than 50,000 customers) (ICIMOD, MOEST, UNEP, 2007).

H. Economic Characteristics

1. Industries

92. Kathmandu Valley has many traditional cottage industries: textile weaving or handlooms, brick and tiles, pottery, handicrafts, precious ornaments, traditional food processing and preservation (e.g., rice milling, beaten rice, oil milling, sweetmeats, and traditional dairy products), wooden furniture and carving, bamboo crafts, traditional textile printing and dyeing, traditional art and paintings, copper and brass metal utensils, herbal medicines, forges, and leather crafts.

93. Kathmandu Valley has three industrial districts, namely, Balaju Industrial District, Patan Industrial Estate, and Bhaktapur Industrial Estate. Public sector brick factories, leather tanning, and shoe manufacturing are also found in the valley. Food and beverages, plastic products, construction materials, carpets, and readymade garment industries have flourished. Most of the polluting industries such as textile dyeing, tanning, and distilling have been closed or transferred to places outside the Valley.

94. Of the remaining industries in the valley, the main polluting industries are only small scale. These include brick kilns, wool dyeing and carpet washing, textile dyeing, pottery, polyurethane and rubber foam, beaten rice, dairy products, metal casting, metal craft industries and gold plating; and alcoholic and non-alcoholic beverages.

95. With the worsening industrial pollution and rising awareness of the general public about the adverse impact of pollution, complaints have increased and measures have been taken to address them. The Industrial Promotion Board formulated an industrial location policy. There have been revisions to the policy and the latest location policy for industries specifies the following:

(i) List A: Types of industry that can be established in municipal areas of the Valley
(ii) List B: Types of industry that are not allowed in the Valley
(iii) All types of industry that have pollution prevention and safety measures can be established inside any designated industrial district (ICIMOD, MOEST, UNEP, 2007)

2. Agricultural Development

96. The population growth in Kathmandu Valley is bringing considerable changes to farming. Rapid urbanization and the introduction of new agricultural technologies have encouraged farmers to change their cropping patterns from traditional (low-value crops) to new crops (high- value crops). Land under cultivation of green leafy vegetables is increasing rapidly in the urban and semi-urban areas.

97. The increasing population growth and haphazard housing construction have resulted in the rapid decline of agricultural lands. If the current trend continues, there will be no more lands left for agriculture in the Valley. According to the District Agricultural Office, agricultural lands in Kathmandu will be reduced from 64% in the year 2041 to 41% in 2066(http://www.gorkhapatra.org.np/rising.detail.php?article id=28619&cat id=27).

3. Development Organizations

98. The Social Services' National Coordination Council regulates and supervises NGOs, while the Social Welfare National Coordination Council (SWNCC) deals with most of the funding agencies. There are 7,004 active NGOs in Kathmandu Valley registered with the Social Welfare Council (SWC). Kathmandu has 5,969, Lalitpur 856, and Bhaktapur 179 NGOs. According to SWC, there are 157 international NGOs across the country; of these, almost all have head office in Kathmandu Valley and more than 80% are working in the Valley (ICIMOD, MOEST, and UNEP 2007).

99. There are also various NGOs working in the water and sanitation sector in the Valley. These organizations have focused mostly in slums and squatter settlements and rural areas. They have constructed water tanks of 5 m3 capacity and a number of latrines/toilets with

drains for the communities. The major NGOs working in the water and sanitation sectors are:

(i) Lumanti Support Group for Shelter
(ii) NGO Forum for Urban Water and Sanitation
(iii) Centre for Integrated Urban Development
(iv) Environment and Public Health Organization (ENPHO)
(v) Nepal Water forHealth (NEWAH)
(vi) Action Aid
(vii) Water Aid
(viii) Plan International
(ix) UDLE (Urban Development through Local Efforts)
(x) Red Cross.

D. Social and Cultural Resources

100. **Social classification**. The majority of the people living in the valley are Hindus followed by Buddhist. The number of people with other religions is minimal. Households are divided into different ethnic groups such as Newars, Brahmins, Chettris, Tamangs, and Magars. Newars are the prominent inhabitants followed by Brahmins, Chettris, Tamangs, and Magars. These ethnic groups are not of the same level of socio-economic development. In Kathmandu Valley, Newars are considered as advanced indigenous people's group. Besides Newars, Brahmins and Chhetris are the major ethnic groups. Similarly, Tamangs and Magars comprise a small percentage of the total population of the Valley.

Table IV-IX: Population and Land Area of Kathmandu Valley

Municipalities	Area (Hectare)	Population (2011)
Kathmandu Metropolitan City	5,194.15	975,453
Lalitpur Metropolitan City	3,667.28	284,922

Source: CBS, 2011

101. Age. The economically active age group (from 15 to 44 years old) constitutes about 56% of the project district's population. The other main age group is from 5 to 14 years old. Only about 5% of the population are 60 years and above. There are no significant differences in the age distribution of population in KUKL service areas.

102. Religion. Kathmandu's present demography is very cosmopolitan in which Newars; the indigenous people of Kathmandu still comprise a large segment of the population followed by Bramhin and Chhetri. Other ethnic groups like Sarki, Damai, Dalit, etc. are in minority. But now many ethnic groups are migrating from other districts of Nepal and found mixed ethnic groups in Kathmandu valley. Kathmandu's culture has been inspired by the convergence of Hindu and Buddhist. Hindu and Buddhist are the main religion with Christian and Muslims as minors.

4. Cultural Heritage

103. Kathmandu Valley is known for its ancient art, culture, craftsmanship, and numerous monuments of historic and archaeological importance that have been described by UNESCO as a "living heritage site." There are many temples, palaces, monasteries, and stupas that are centuries old. UNESCO has classified seven sites as world heritage sites. There are more than 360 'vihars,' 'chaityas,' and monasteries and many important religious and cultural sites on the river banks.

I. Major Environmental Problems

The environmental problems of Kathmandu Valley are many.

104. **Air quality, traffic management, and noise pollution**. The emissions of the increasing number of vehicles (274,000 as of 2004-2005) account for about 38% of the air

pollution in Kathmandu Valley. Industrial emissions also contribute substantially to air pollution (KVEO 2007).

105. Kathmandu Valley is particularly vulnerable to air pollution because of its bowl-shaped topography that restricts air movement. The situation is worse during the winter when temperature inversion during the night and early morning traps a layer of cool air under a layer of warmer air, trapping pollutants close to ground level for extended periods. Besides the topography, the relatively high elevation of the Valley also results in increased vehicular emissions.

106. Vehicular emissions have become the main source of air pollution in Kathmandu Valley. An inventory of emission sources by the then Ministry of Population and Environment (MoPE) indicated that exhaust fumes had increased more than four times in the 8 years between 1993 and 2001. According to a more recent inventory, vehicular emissions are responsible for 38% of the total particulate matter < 10pm (PM10) emitted in Kathmandu Valley, compared to 18% from the agricultural sector and 11% from brick kilns (Gautam 2006; Table 14). Increase in emissions is mainly due to the increase in the number of automobiles, as well as poor transport management and poor vehicle maintenance.

Table IV-X: Comparison of Emission Inventories in 1993, 2001, and 2005

Sources	TSP (tons/year)			PM_{10} (tons/year)		
	1993	2001	2005	1993	2001	2005
Mobile Sources						
Vehicle exhausts	570	1971	NA	570	3,259	4,708
Road dust re-suspension	1,530	7,008	12,239	400	1,822	3,182
Subtotal	2,100	8,979	12,239	970	5,081	7,890
Stationary Sources						
Industrial/commercial fuel	582	NA	NA	292	NA	NA
Domestic fuel combustion	2,328	NA	630	1,166	NA	347
Brick kilns	5,180	6,676	1,850	1,295	1,688	1,437
Himal cement	6,000	3,612	0	800	455	0
Stone crushers	NA	NA	1,720	NA	NA	372
Industrial boilers	NA	28	28	NA	15	15
Fugitive Emissions						
Refuse burning	385	687	172	190	339	172
Agricultural sector	NA	NA	NA	NA	NA	2,337
Cremation	NA	NA	NA	NA	NA	79
Total	16,575	19,982*	16,797	4,712	7,580	12,649

NA = not available, PM = particulate matter, TSP = total suspended particles.

* In original report 19,884

Source: Shah and Nagpal 1997; Gautam 2006; MOEST 2005; and http://www.nepalnews.com.np/contents/englishweekly/sundaypost/2003/mar/mar16/2ndpage.htm

107. Recently, a study on traffic noise in Kathmandu Valley was carried out. The noise levels in Kathmandu City range from 79 decibels (dB) to 112 dB, higher than those of the major cities in India. The rate of increase of noise level in Kathmandu City was found to be 1 dB per year.

108. The permissible level for road traffic noise is 70 dB. An earlier study listed Kupondol Height, Thapathali, Sahidgate, Koteshwor, Gwarko, Gongabu, and Gyaneshwor as hazardous areas because their noise levels were found to be beyond 80 dB. The present study indicated that noise levels in Kathmandu were beyond the permissible values.

109. Three different types of noise areas were identified for Kathmandu Valley, although there is no data available on the noise levels produced from the existing WWTPs:

(i) Low noisy areas: Noise levels below 70 dB.
(ii) Moderate noisy areas: Noise levels between 70 dB and 80 dB; include Hotel

Shangrila, Gairidhara, Galkhupakha, Gausala, Satdobato, Balkhu, Swoyambhu, Pulchwok, and Maitidevi.

(iii) Hazardous areas: Noise levels were beyond 80 dB; include Putalisadak, New Baneshwore, Kalanki, Narayan Gopal Chowk, Tripureshwor, Kalimati, and Koteshwore.

110. A survey showed that the frequency of health problems arising from noise pollution increases with the degree of noise levels. About 95% of tested affected people come from hazardous areas, 88% from moderate noisy areas, and 62% from low noisy areas.

111. **Settlement patterns**. Kathmandu Valley is developing haphazardly with the rapid increase of its population. It was estimated that by 2025, its population will be nearly 4.0 million, from only about 1.3 million in 2001. The valley's fertile lands are getting fragmented and residential houses are being constructed unabatedly. This kind of growth has created problems on transportation, electricity supply, drinking water supply, and river pollution.

112. **Water resources**. Extensive deterioration of river water quality (Annex 2) and quantity in urban areas due to excessive pollution loads has already taken place. Increasing demand for drinking water has placed a heavy strain on already insufficient supply and has created water scarcity. Almost all major rivers have been tapped at source for drinking water. The current water supply is only about 131 MLD during the rainy season and 94 MLD during dry season of the estimated daily demand of 350 MLD. In the dry season, 60%-70% of the water supply comes from groundwater.

113. **Waste management**. The main policy for waste management in Nepal is stated in the Solid Waste Management National Act enacted in 2011. The daily solid waste generation is assumed to be 0.25 kilogram per person per day (kg/p/d). Studies have revealed that the composition of solid waste in Kathmandu is mainly organic (58% to 66%) with 5% plastics. The use of plastic bags has increased over the years and since they are non-biodegradable (taking 400 to 1,000 years to biodegrade fully), its use should be discouraged or even banned. These plastics litter the streets and rivers, clog the drains, fill up landfill sites, get stuck on trees, and ultimately spoil the aesthetics of the natural environment. Animals mistake them for food and eat them and die as they obstruct the digestive systems. People even burn them, unaware of the effect of the toxic fumes. Furthermore, they are made from polyethylene, a product of petroleum, a non-renewable resource (www.reusablebags.letseegreener.co.uk, www.natural- environment.com).

114. A major issue in Kathmandu Valley is the accumulation of huge amounts of solid wastes due to the various demands of the people near the landfill site who obstruct the trucks carrying the solid waste. Another major issue is the dumping of hazardous and infectious wastes from hospitals and nursing homes together with domestic solid wastes.

115. Most of the plastics and reusable materials like bottles, metals etc. are picked up by scavengers daily who are helping the municipality by reducing the waste volume. Tourism is Nepal's topmost industry and if it is to thrive, solid waste management should be tackled well in all the municipalities and be given top priority.

116. The PPTA Team has estimated that nearly 25% of the generated solid waste is spread to open water ways. The five municipalities generate approximately 650 tons of solid waste daily, of which more than 70% comes from the Kathmandu Metropolitan City. The final disposal sites are always controversial and opposed by the local people and most of the solid waste is disposed of at the river banks and in open areas.

117. **Natural disaster preparedness**. Earthquakes and landslides are identified as the two most prominent potential natural disasters in Kathmandu Valley. The Valley is located in a seismic zone; lack of public awareness about earthquakes, lack of adequate planning, and lack of coordination are the main factors that impact negatively on disaster preparedness. Excavation of slopes, deposition of loads on slopes, deforestation, irrigation, mining, and water leakage are the main human activities causing landslides.

118. **Water quality.** Deterioration of water quality during transmission is a problem in almost all urban areas due to the ingress of polluted water into the pipes (intermittent supply), leakage, absence of chlorination, and absence of monitoring of water quality. Almost all available reports on drinking water quality of Kathmandu reveal that most of the urban

water supply has bacterial contamination (Table 15). The chemical quality of most of the water is within the World Health Organization (WHO) guidelines.

Table IV-XI: Water Quality of Different Water Sources in Kathmandu Valley

Parameters	Water Sources				WHO
	PTW	PUTW	Well	SS	GV
p^h	6.5-8.2	6.5-7.5	7.5	7.5	6.5-8.5
Temp (°C)	13-18	12-15	15-18	15-18	25
Iron (mg/l)	ND-0.2	0.2	0.2	0.3	0.3=3.0
Chlorine (mg/l)	ND	ND	ND	ND	0.2
Chloride (mg/l)	10-30	22-45	22-45	23-45	250
$N\text{-}NH_4$ (mg/l)	ND-0.2	0.2	0.2	0.2	0.04-0.4
PO_4 - P (mg/l)	0.1	0.1	0.1	0.1	0.4-5.0
Coliform bacteria (source)	+/-	+	+	+	-
Coliform bacteria	+				-
E.coli cfu/100 ml	10-131	3-20	48-200	58	0

Note: PTW = private tap water, PUTW = public tap water, SS = stone spout, WHO GV = World Health Organisation guideline value.
Source: Pradhan et al. 2005.

119. **Health and sanitation**. Individual septic tanks and soakpit systems and some pour flush latrines and pit latrines do exist in urban areas (the pollution of groundwater due to the leachate does exist but has not yet been quantified), but most of the effluent reaches the municipal drains, and ultimately the rivers or agricultural lands. People without toilets defecate in open fields and river banks. Public latrines hardly exist in urban towns and if they do, they are so poorly maintained (personal observation). There are only 18 public toilets in Kathmandu City, which has a population of around 2 million. They are ill-maintained as well and far below standards thereby turning the main town areas into open defecation place (Sedhai, R. 2012).

120. The Bagmati River is the main river system with tributaries that drain the Kathmandu Valley. The visible pollution of the Bagmati and its tributaries within the city reaches due to discharge of untreated domestic sewage, dumping of solid wastes, washing of vehicles, sand quarrying, and discharge of untreated industrial and hospital wastes, is severe (Bagmati Action Plan 2009-2014, 2008, Annex 2).

121. Sanitary conditions within Kathmandu Valley are hazardous (Halcrow Fox and Associates, 1991). A visual tour of the valley is sufficient to conclude that rivers, drains, and streams are highly polluted with sewage and industrial wastes. The use of septic tanks, pit, or pour-flush latrines is common. Greater Kathmandu have sewerage systems and sewage treatment plants, but the treatment plants in Greater Kathmandu are not functional. Many sewers overflow as there is no regular cleaning and maintenance. This report adopts the findings of UN-Habitat (2009) that overall, 30% of houses have a septic system. UN-Habitat estimated that there are 77,000 septic systems in the Valley. Only 35% have a soak-pit associated with a septic tank. The remaining tanks presumably discharge septic tank effluent directly to surface flows.

122. Storm water drains that were constructed more than 60 years ago in the core areas of Kathmandu are being used as combined sewers (Many reports, including the 2010 Conceptual Wastewater Master Plan mention this). Furthermore, the Asset Condition Survey in Buddhanagar and Kalopul also confirmed this. It found that storm water drains laid by the municipality are now working as combined drains. Sanitary sewers have been added to some areas of Greater Kathmandu and there are about 93,000 sewer connections registered with KUKL (KUKL Annual Report, 2008). The rest discharge the effluent ultimately to the holy Bagmati River.

123. The majority of households in the valley districts have toilet facilities: 92% in

Kathmandu (CBS 2001). Most of the households' toilets do not have septic tanks and they are directly connected to the sewerage lines that discharge waste to the nearby river. For households with septic tanks, a municipal service is available for emptying the septic tanks on request. The Ministry of Environment Science and Technology is mandated to regulate unauthorized dumping. Domestic wastewater makes up approximately 93% of the total wastewater generation by the cities; the remaining 7% is industrial wastewater.

124. The existing sewage treatment plants are not functioning, except for the Dhobighat Treatment Plant. The newly expanded residential areas are usually devoid of sewers. In a few cases, however, sewage is channeled through hume pipes connecting to nearby rivers. Due to the direct discharge of untreated sewage and wastewater into the rivers, all the rivers in the Valley have been turned into open sewers. It is estimated that about 50,000 kg of BOD5 per day is produced in the Valley. An average of 20,846 kg BOD/day has been recorded for the Bagmati River at the outlet, constituting 42% of the total BOD load produced (CEMAT 2000).

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V ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

126. The Rapid Environmental Assessment is in Annex 1.Environmental impacts on the physical, biological, and socio-economic and cultural environments during design, construction, and operation phases are discussed here in detail together with the mitigating measures. Most of the impacts will be localized, not greatly significant, and relatively small during construction and operation. The WWTP01 lie on government-owned land and the laying of sewers will be done in the RoWs of existing roads and river banks; thereby land acquisition will not be required and will not directly impact the existing biodiversity values.

127. EMP table has been prepared for WWTP-03. The summary of anticipated environmental impacts and the corresponding mitigation measures are shown in Table 0-1.

A. Planning and Design Phase

1. Environmental impacts due to project design

128. One of the most important activities before construction is the identification of the likely adverse impacts and their mitigation measures before construction works commence.

129. Identification of erosion-prone areas prior to construction is important to prevent or minimize soil erosion, sedimentation, and slope instability. To mitigate these adverse impacts, it is necessary to incorporate drainage plans into the project design, identify measures and sites for handling excessive spoil materials, and stabilize unstable areas. I

130. The design and specifications should consider minimum vegetation clearance and avoid piling of excavated materials close to river.

131. Since the WWTP 03 to be established will employ activated sludge process, odours will already be minimal in comparison to odours emitted from waste stabilisation ponds. However, WWTP 03will be established <100m from the nearest dwelling additional odour management measures will need to be implemented. These may include covering the inlet works as typically majority of the odours are emitted from raw sewage, Wastewater sludge reduction measures using the latest available appropriate technologies should be used in the design. No trees will be cut and only overgrown grass will be cleared. To produce energy, sludge gasification will be used.

132. Green buffer zone will also be proposed around the project area during detail design to avoid or minimize noise and odours for the construction and operation of the WWTP 03.

133. During the preparation phase, the land areas required by the project should be demarcated and sign posted accordingly. On-going consultation with affected communities should be conducted and due notifications to any interruptions as a result of construction should be provided in a timely manner.

134. Haphazard construction of camps for workers without basic amenities could result in social stress and the degradation of the local environment. Therefore, it is very important that these camps be provided with sanitary amenities at designated areas. As Nepal has no standards regarding the number of ablution blocks to be constructed in temporary labour camps, the 2009 IFC Guidelines (Annex 10), that is, 1 toilet for every 15 persons (separate for men and women) will be followed. In Kathmandu, most of the labour will be local people who will not stay in the camps.

135. An employment policy that avoids depriving the local communities of opportunities should be prepared to prevent tensions and dissatisfaction. The local people, especially the project-affected families and women above the age of 16 (Children's Act 1992), should be given first preference in employment. Wages should be settled based on the District Wage Evaluation Committee resolution or guidelines and the list of employees submitted to the Design and Supervision Consultant.

136. Letters of approval and agreements should be obtained for the following: (i)

temporary acquisition of land and properties for use by contractors, (ii) construction in UNESCO recognized areas, from the Department of Archaeology, Permission will have to be obtained from the Department of Archaeology as stated in The Ancient Monuments Preservation Rules 2046 (1989), Chapter II. The permission is granted by the Department of Archaeology as per advice provided by UNESCO in March 2010 during the preparation of Loan 2776, Kathmandu Valley Water Supply Improvement Project and not UNESCO (discussions were held with UNESCO in the earlier TA 4893-NEP, Annex 8).

137. This advice has been carried over for this project as the location of proposed project sites are the same as on Loan 2776. However, during the preparation of detailed design the PID will consult with UNESCO to provide them with more detailed information. However, the WWTP sites are not situated within any archaeological and cultural heritage sites. Chance find protocol will be provided to contractors prior to the commencement of activities.

138. Baseline photographs of the construction areas and water quality of streams and rivers that would be impacted will help the project in identifying/justifying/verifying the adverse impacts due to construction activities (e.g. cracks in houses, restoration of temporary sites to their original condition, water quality deterioration, etc.).

139. Detailed traffic plans should be prepared to help in mitigating traffic congestions and disturbance to pedestrians and businesses. A traffic management planning document that can be easily used by contractors to develop detailed plans should be formulated. Refer to Appendix 10 of the IEE prepared for NEP: Kathmandu Valley Water Supply Improvement Project (http://www.adb.org/sites/default/files/linked-docs/34304-043-nep-ieeeab.pdf).

140. The training manual should be written in Nepali (or local languages) with notes and sketches on community health and safety and occupational health and site safety.

141. WWTP should have buffer zones. As land areas for the WWTP have already been defined and residents are nearby, it is suggested that a minimum of 30 m green buffer zone along the site boundary with trees with thick foliage be planted to minimize nuisance due to odour, noise, lights, and improper operation and maintenance (O&M).

B. Construction Phase

1. Environmental impacts due to project construction

a. Physical Environment

Soil erosion and slope stability due to excavation

142. Haphazard disposal of spoil materials may create erosion problems, disturbances to the existing drainage lines. Mitigating measures to be used are separate stockpiling of topsoil in a safe yard for further use, spoil disposal at designated and stabilized sites, compaction of the backfill of excavated areas including replacement of topsoil, avoiding work during the rainy season as much as possible, mulching to stabilize exposed areas, use of bioengineering techniques (e.g., re-vegetating areas promptly), providing channels and ditches for post-construction flows, lining of steep channels and slopes (e.g., use of jute netting), preventing off-site sediment transport using settlement ponds, and silt fences. Prior to the construction of interceptors along the rivers, erosion and sedimentation control such as blankets, geofabrics and/ or vegetation need to be completed including the installation of appropriate drainage systems.

143. Impacts of surface water discharges on the local drainage from trench excavation should be mitigated by the use of settling tanks before discharging the water to waterways.

144. Excavation and laying of pipelines/siphons at river crossings could have adverse impacts on the river water quality and the aquatic ecosystem. Mitigation measures to be used include construction to be done in the dry season only, use of river diversions with bundings, and prior notification to temple and religious *ghat* officials of construction activities.

145. Deep excavations can intercept and interfere with the local groundwater thereby affecting flows from irrigation canals, springs, and wells and causing water shortages. Mitigation measures to be used include the following: (i) local wells, springs, and irrigation canals to be bunded from temporary spoil dumps; (ii) local wells and spring fed spouts or

kuwas to be monitored, particularly downhill of excavations plus temporary supply provided if flow is affected; and (iii) permeable base and side backfill required at deep excavated sites or an alternate source of drinking water provided at the existing location.

Change in river hydrology and morphology

146. The construction, rehabilitation, and operation of the sewerage system could have impacts on the river hydrology and morphology due to quarrying from river beds for sand and gravel, particularly during the dry season. Water pollution problems could occur because of the dumping of spoil materials into the river, excavation of boulders from the river channel, direct disposal of liquid wastes, and leakage of oil and lubricants. Quarrying/mining activities in river/streams for extraction of construction materials shall not be done to avoid changing the river cross sections and longitudinal profiles and should be done in approved sites only.

Water and land pollution

147. Dumping of wastes or discharging wastewater effluents from toilets into the river can pollute the river water, making it unhealthy for downstream users. Mitigation measures to be used include avoiding construction of labor camps facilities within the drainage area, providing designated areas with collection of bins for wastes, providing toilet facilities and prohibiting open defecation, and prohibiting washing of vehicles next to rivers and streams.

148. Pollution of land and water could also be mitigated by observing proper storage of construction aggregates, hazardous toxic materials, lubricating oils, used tyres, and exhausted batteries; and segregating and disposing of chemical containers, packaging materials, plastic bags, etc. Used oil and lubricants should be recovered and reused or removed from the sites. Storage areas for fuels and lubricants should be away from any drainage leading to water bodies. All fuel use areas (e.g., generator) must have drip basins installed to prevent any leakages and recycled. All fuelling, repair, and maintenance work should be done on a concrete surface provided with a catch tank that can be cleaned and all spilled fuel recovered and recycled. Provision of training on the safe handling of toxic materials and occupational health and safety measures during construction could help in mitigating many of the adverse impacts mentioned above.

Pollution due to air, noise, and vibrations

149. Earth excavation, construction materials stockpiling, aggregate crushing, drilling, quarrying, and plying of vehicles will produce dust (TSP, PM10), hydrocarbons (CO, CO2, CH4), SO2, NOX, H2S, etc.), noise, and vibrations. Plying of trucks on non-metallic roads will produce huge amounts of dust that can deteriorate the air quality and increase the noise levels to above 90 dB. Annex 5 gives the national ambient air quality standards for Nepal.

150. Mitigating measures to be employed include the following: (i) dust suppression on roads or at open sites by sprinkling water as required at regular intervals; (ii) covering earth stockpiles using plastic sheets or cement jute bags; (iii) routine monitoring of sound and vibrations at regular intervals; (iv) limiting vehicle speeds and banning power horns; (v) seeing that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS; (vi) fitting of mufflers in vehicles to control noise; (vii) regular maintenance of vehicles; (viii) prohibiting the operation of crushing plants and construction vehicles between 7 p.m. and 6 a.m. in residential areas; (ix) compensating the damages caused by vibrations to buildings, and (x) providing ventilation in confined working areas. Annex 7 gives the recommended standards for vibration in construction sites.

151. Adverse impacts could be caused due to inadequate buffer zones around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities. Adequate mitigating measures (including developing buffer zones around the treatment plants) should be included in the project design. Noise should be monitored as provided for in Annex 6. As land areas for the WWTPs have already been defined and there are residents nearby, it is suggested that a minimum of 30 m green buffer zone along the site boundary with trees with thick foliage be planted to address nuisance due to odour, noise, lights and improper O&M. To avoid disturbing religious ceremonies, construction activities in Dhobighat treatment plant should be restricted in consultation with the head priest of the temple. For example, worshippers visit the temple from about 5 a.m. to 9 a.m. during which no construction activities should be done.

b. Biological Environment

152. Although most of the construction and improvement works will take place in urban areas, there will be some impacts on the ecological resources (loss of trees and vegetation, damages to fisheries and riverbed aquatic ecology) due to construction of project structures vegetation clearance for construction activities, and construction activities at pipeline crossings over riverbeds.

153. Mitigation measures consist of the following: (i) cutting only the trees that are marked and will be agreed with contractor in a piece meal approach for removal and planting and rearing tree saplings at the rate of 25 saplings for each cut tree; (ii) providing LPG/kerosene to the workforce; (iii) stockpiling the cut trees and obtaining permission from concerned authorities for their use; and (iv) compensating all the affected private trees. To save the fisheries and riverbed aquatic ecology, disposal of construction materials and solid wastes generated from the camps into the rivers shall be avoided and river diversions and bunding of sections should be carried out.

c. Socio-Economic and Cultural

***Environment* compensation**

154. The contractor's temporary land use and housing acquisition and compensation to affected people are two of the most important aspects of any construction project. The mitigation measures include the following: (i) establishment of a "grievance redress committee"; (iii) restoration of temporary sites to their natural or stable conditions as agreed with the land owners; (iv) planting endemic vegetation in exposed areas of temporary sites; (v) making sure that the proponent reports in writing that temporary areas have been vacated and restored to pre-project conditions before acceptance of the works (vi) protection of the traditional rights of the local people; and (vii) establishment of a technical committee to assess the compensation for damages caused by vibrations of construction equipment and vehicles (photographs of the damaged structures should be taken and compared to the baseline photographs taken before construction).

Reinstatement of damaged community services and infrastructure

155. Construction activities could have adverse impacts on community services and infrastructure. Any adverse impacts (e.g., cracks in buildings and structures during trenching, use of rollers for compaction and pneumatic drills, and unusable access roads) on community assets such as, temples, bridges and irrigation channels, electricity poles, telephone lines, drinking water pipes, sewerage lines, roads, etc. will be mitigated, compensated, reinstated, or relocated to the satisfaction of the community. Mitigation is to be done through coordination with concerned utilities personnel and the local people, detailed design drawings, geotechnical testing in sensitive areas, and traffic management and emergency response plans.

Influx of outside workers, money, and unwanted activities

156. Alcohol abuse, gambling, prostitution, and other social disharmony are likely to occur in the construction site. There will be an influx of workers to the project site with their immediate family members. This can increase crime and social stress, create unwanted congestion, and exert pressure on the limited local resources. The mitigation measures to be carried out consist of prohibiting gambling and alcohol consumption in construction camp sites; instructing the outside workforce to respect the local cultures, traditions, rights etc.; and providing security in the camps.

Health and safety

157. There could be adverse impacts on the health and hygiene of the workers due to unsafe working conditions, accidents, fire hazards, transmission of communicable diseases etc. To mitigate these adverse impacts, these should be undertaken: (i) provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce; (ii) launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards; (ii) make available first aid kits, ambulance, and fire extinguishers in camp sites; (iii) provide personal protection equipment to all construction workers and

compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries; and (iv) provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory. Another significant impact is the effect on people and communities, particularly health, if water supply is interrupted for extended periods during works on the sewer networks. If water supply has to be stopped, notice should be given to the affected people and alternative provisions of potable water arranged.

Occupational Health and Safety

158. The potential occupational health and safety impacts or hazards are likely during the time of construction and mitigation measures for the laying of drinking water pipes and sewers as well as construction of WWTP 03are given in Table 0-1. Before construction begins, the contractor will inform and provide training to its workers on occupational health and safety and mitigation measures to be used during construction. The training must be done in Nepali (or local language of the workers) with handouts distributed and information posted in conspicuous places. As most of the workers would be uneducated, pictorial presentations depicting the hazards and the mitigation measures should be used during the training. Appropriate signage providing safety messages including restrictions to public access need to be erected at construction sites.

Community Health and Safety

159. The contractor should be aware of the adverse health and safety impacts of the construction works on communities along the construction areas. There is an increasing number of houses and rapid urbanization at the vicinity of the proposed WWTP site rendering direct disposal of wastewater into the Bagmati River resulting detrimental impact upon river ecology. However, the contractor will be fully aware upon the health and safety impacts upon the adjacent communities during the time of construction.

160. The WWTP 03 site will play more numbers of construction vehicles carrying construction materials. Existing traffic around the vicinity of WWTP 03 will not be affected due to construction vehicles. Contractor will be responsible to manage and control traffic around the WWTP site. Safety signals and traffic signals will be installed at entry gates and major junctions if required around the WWTP sites. Any sort of grievances if recorded from the locals will be resolved by grievance redress committee formed. The committee will comprise a person from local elected body. The detail of the grievance redress mechanism is presented in the chapter VIII.

Traffic management

161. Traffic congestion and temporary disruption to local access due to open trenches, excavation across roads, or road closures due to construction could have impacts on pedestrians, vehicles, and businesses. To mitigate these, traffic management plans should be developed for key areas along the construction site. There should be a traffic management planning document that can be easily used by contractors to develop detailed plans. Refer to (Annex 11). Advance local public notifications of construction activities, schedules, routings, and affected areas including road closures should be made. Erect signage in Nepali and English languages. Use steel plates or other temporary materials across trench facilities in key areas such as footpaths or livestock routes; arrange for pedestrian access and sidewalks and parking areas; and arrange for night-time construction for activities in congested or heavy day-time traffic areas. Arrange for onsite "grievance handling." Undertake trench closure and facilitate rehabilitation as quickly as feasible. Coordinate with the Kathmandu Metropolitan Traffic Police Division, the authority in charge of traffic management. Obtain permission from the Department of Roads for digging in the main urban roads and from the municipalities for digging in inner urban roads.

C. Operation and Maintenance Phase

162. The release of untreated wastewater or sewage could cause downstream pollution and adversely impact the aquatic ecosystem and pose health risks to humans. The following should be undertaken to address the impacts: Treat the wastewater to meet the prescribed effluent standards of BOD_5 or less before releasing it to the receiving waters. Regularly monitor the quality of the treated wastewater and that of the receiving water both upstream and downstream (Annex 3). Operate the WWTP using a risk management-based approach to ensure optimal operation of the plant at all times. This will include the development and

implementation of a WWTP safety plans which are similar to a hazard analysis and critical control point plan (HACCP) prior to the commissioning of the WWTP. Safety plans will need to be submitted to ADB for review and endorsement prior to plant commissioning. WWTP will also need to employ programmable logic controllers for plant operation.

163. Hazards to public health due to overflow flooding and groundwater pollution due to failure of the sewerage system could have adverse impacts on human health and the environment. The system will have to be carefully designed and operated. The project design should include stand-by generators (the diesel generator is the second backup power). The first source is the power generated from the gasification plant. An emergency response plan (ERP) that includes notification and reporting protocols will need to be developed. The ERP is important for managing wastewater systems during emergencies as pipe breaks, equipment malfunctions, power outages takes place, and leakage or spills of hazardous materials happen. Floods, earthquakes, and storms can also damage collection systems and equipment. Having emergency response procedures can save lives, prevent diseases, and minimize environmental and property damage. The ERP should be developed in coordination with all the key stakeholders, including the Executing Agency (EA), project implementation units, consultants, contractors, and other key government organizations. ERP will be prepared by the contractor. A modified ERP Template (www.rcap.org) is attached in Annex 12.

164. Health and safety hazards to workers could occur from toxic gases and hazardous materials which may be contained in sewage flow and exposure to pathogens in sewage and sludge. The workers should be trained in the management of occupational health and safety hazards and provided with personal protective equipment. Inoculations should be administered on a regular basis.

165. Improper operation and breakdown of the WWTP will lead to the accumulation of untreated wastewater that may cause smell and nuisance to the surrounding residential areas. To address this, the project should prepare and strictly follow standard operating procedures (SOP) and provide regular training to staff. A green buffer zone made by planting trees around the WWTP boundary should be established so that residents living next to the WWTP do not get annoyed by the foul smell and noise. Standby generators should be provided (the diesel generator is the second backup power.) The constant source of electricity supply, if available, will also be used. Emergency response procedures have to be developed and implemented (The plant operation will follow the Hazard Analysis and Critical Control Point Plan and programmable logic controllers

166. The contractor will provide sufficient staff and equipment for cleaning, and establish a system for registering public complaints (grievance redress mechanism).

Potential Environmental Enhancement Measures

167. Potential environmental measures that shall be taken by KUKL before the project commences are training and awareness programs on health, occupational health and safety measures, and community health and safety to the general public.

168. Sufficient human resources should be trained in maintaining the sewerage systems and treatment plants. The efficiency level of the treatment plants should be recorded by regularly monitoring the wastewater characteristics.

169. There are many environmental youth clubs in Kathmandu Valley. They should be mobilized to observe the WWTP in their areas and report problems like overflows to KUKL. By 2010, there were 4,321 youth services affiliated or registered with the Social Welfare Council: 697 were from Kathmandu. Out of the registered 30,284 NGOs working in the environmental protection sector, 514 were from Kathmandu They include Batabaran Samrachahan Tatha Digo Bikasko Lagi Yuba Sakti, Bishnumati Yuba Club, Buddhanagar Yuwa Samuh, Batabaran Samrachhan Samudaya, Nepal Batabaran Club, Friends of Environment, Swacha Pani Tatha Batabaran Samuha etc.

170. Dhobighat wastewater treatment plants should have a basic laboratory for the analysis of wastewater and a dedicated, trained, and qualified laboratory technician.

D. Cumulative Impacts Analysis

171. The valued components identified in the IEE are air quality, water (surface and

groundwater) quality, noise, traffic management, socio-economic, cultural resources, and human health.

172. Air quality will be affected during construction. Emissions of common air contaminants and fugitive dust may increase near the construction sites but will be short term and localized. Greenhouse gas emissions may increase due to vehicle and equipment operation, disposal of excavated material, concrete production, etc. But their contribution during construction will not be very significant.

173. Noise levels near the construction sites will increase but the duration will be short. Ground vibrations due to concrete mixers, rollers, and excavators may be annoying, and damages may occur especially to older buildings, but mitigation measures if implemented as proposed in the environment management plan (EMP), will minimize these problems.

174. Traffic management during construction will be very important. Site-specific mitigation measures will be implemented to see that disruptions are minimized and are temporary. After the project is over, the improvements made will have a long-term cumulative benefit to the people.

175. Although there will be temporary increase in the noise levels, fugitive dust, and common air emissions near the construction areas, no adverse residual effects to human health will occur because the impacts are short-term, localized, and not significant.

Transboundary and Cumulative Impacts

176. There will be no environmental trans-boundary and cumulative impacts with respect to air pollution and loss of habitat. However, with respect to water pollution, the Bagmati River will be less polluted than it is today when it reaches the Indian border. It can be seen from Annex 2 (Figure 2.6 Bagmati Pollution) that the BOD level increases from the source (Sundarijal) and keeps on rising as it traverses through the Kathmandu City and starts decreasing at Teku Dovan (where the Bagmati River meets the second biggest tributary, the Bishnumati river). As the Bagmati River leaves the Kathmandu Valley at Chovar gorge, the BOD is still above 60 mg/l. The BOD then keeps on decreasing downstream where the area is less habited and the Bagmati River gets bigger as it is fed with numerous tributaries. The WWTP will contribute to reducing the current level of water pollution.

177. The project will help develop employment opportunities and enhance the local skills construction of WWTPs for future works in Nepal. Concrete sewer pipes can be manufactured locally, which can boost the local construction industries. EMP table has been prepared for WWTP 03. The summary of anticipated environmental impacts and the corresponding mitigation measures are shown in Table 0-1.

Table 0-1: Impact Matrix

Project Stage	Project Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility
Pre-project activity (Project Design)	Incorporation of critical areas in project design	Soil erosion and slope instability	Incorporate measures and sites for handling excessive spoil materials	Design Supervision Consultant (DSC)/ Kathmandu Upatyaka Khanepani Limited (KUKL)/ Project Implementation Directorate (PID)
			Incorporate drainage plan into the final design Geotechnical investigations to be carried out prior to design of interceptors	
			Design technical specifications to include minimum vegetation clearance and avoid areas where slope stability is a concern	
			WWTPs to incorporate sufficient drainage around infrastructure. Elevated tanks to be designed where appropriate.	
			Wastewater infrastructure to be designed as per Nepal"s earthquake codes and standards.	
	Training preparation	Health and safety of the community and workers Operations and maintenance (O&M)	Prepare training in Nepali (or local languages) with notes and sketches on community health and safety and potential occupational health and safety. Worksite checklist and safety rule for work site (Appendix D) has been translated in Nepali.	DSC/KUKL/PID
			Prepare training in Nepali with notes and sketches, erection of signage in construction areas.	DSC/KUKL/PID/ Contractor
	Estimation of sludge volume (wastewater) and provision for their treatment	Sludge waste problem	Incorporate sludge reduction measures using gasification into the design to generate power to run the wastewater treatment plan (WWTPs)	DSC/KUKL/PID/ Contractor

	WWTP design	Odor emission	Design technical specifications to include appropriate odor control measures/ technologies including appropriate environmental buffer to be maintained (i.e. tree screening etc).	DSC/KUKL/PID/ Contractor
	Incorporation of bypassing arrangements	Health hazards caused by the overflow of sewage	Provide bypassing arrangements to control overflow since sewerage network will be in built-up areas; detailed design to minimize overflow and flooding and storm water ingress management.	DSC/KUKL/PID/ Contractor
Preparation for construction	**Preparation of project site**			
	Consult relevant persons and submit applications to get approvals. Submit agreement and permits to DSC for official information	May result in social conflict and legal obstructions resulting in the delay of works	Obtain letters of approval and agreement for (i) temporary acquisition of land and properties, (iii) disruption of water supply and irrigation canals, (iv) get required permits (e.g. cutting trees, construction works in heritage sites and religious river ghats from the Department of Archaeology)	KVWSMBKUKL/PID
			Transfer land and treatment plant in the Kathmandu Valley Water Supply Management Board (KVWSMB)'s name. Provide detailed designs, initial environment examination (IEE), etc. to relevant authorities.	
			Sites to be demarcated and sign posted. Affected communities to be consulted and due notifications given for possible interruptions due to construction.	

	Construct temporary workforce camp	Haphazard camps resulting in social stress and degradation of the local environment	Establish temporary workers camps with sanitary amenities at designated sites only. As Nepal has no standards regarding number of ablution blocks to be constructed in temporary labor camps, follow the 1 toilet for every 15 persons (separate for men and women) based on the IFC Guidelines. In Kathmandu, most of the laborers will be local who will not stay in the camps.	Contractors/ DSC
	Make employment policy for local and affected people based on the environmental management plan	The local people may be deprived of opportunities, minors may be employed	Employ local people (not under age 16) especially the affected families and women. Settle wage rates based on the District Wage Evaluation Committee (DWEC) and provide the list of employees to DSC.	Contractors/ DSC
	Baseline photographs of project area (including buildings and temporary sites) and river water quality	False claims from people; water quality changes due to construction	Take photographs of buildings and temporary sites before construction for verification.	KUKL/DSC
	Prepare traffic plans	Traffic congestion and public annoyance	Prepare traffic plans to prevent traffic jams and annoyance by the public.	KUKL/DSC
Construction Phase	**Construction Activity**			
	Earthworks	Soil erosion and slope instability due to topsoil stripping and excavation for trenches	Separate stockpiling of topsoil for further use; spoil disposal at designated and stabilized sites; compact the excavated areas' backfill and include replacement of topsoil; adopt cut and fill approach; avoid work during the rainy season as much as possible; do mulching to stabilize exposed areas; use bioengineering techniques (e.g, re-vegetating areas promptly); provide channels and ditches for post-construction flows; line steep channels and slopes (e.g. use of jute matting); prevent off-site sediment transport	Contractors/DSC

			using settlement ponds, silt fences. Dispose of excess materials in designated areas.	
		Surface water discharges to local drainage from trench construction	Use settling basins at reservoir sites; use straw to filter small discharges; do routine inspection and monitoring of larger discharges to water courses. Excavation dewatering to use settlement tanks.	
		Runoff from construction areas including stockpiled materials	Use temporary bunds and catchment basins. Grade soil/sand stockpiles to prevent erosion.	Contractors/DSC
		Interception and interference with localized groundwater flows due to deep excavations.	Bund local wells, springs, and irrigation canals from temporary spoil dumps; monitor local wells and spring fed spouts or kuwas particularly downhill of reservoir excavations, including temporary supply provided if flow is affected; provide permeable base and side backfill at deeply excavated reservoir sites or an alternate source of drinking water at the existing location.	Contractors/DSC
	Quarrying from river bed	Change in river hydrology and morphology	Do not allow quarrying/mining activities in river/streams to extract construction materials	Contractors/DSC
	Dumping of waste in the river	Water and land pollution	Provide designated areas with collection bins for wastes.	Contractors/DSC
			Provide toilet facilities and prohibit open defecation.	
			Prohibit washing of vehicles next to rivers and streams.	
	Construction of toilets in the camps		Ensure site is well-signed indicating the restrictions.	

	Storing of materials and dumping of excess materials in the project area		Store construction aggregates, hazardous and toxic materials, lubricating, oils and used batteries in safe areas and away from any drainage leading to water bodies; have designated bunded areas for storage. Dispose of any wastes generated by construction activities in designated areas.	
	Handling of toxic materials		Provide training to workforce on safe handling of toxic materials and occupational health and safety measures during construction. Use personal protective equipment at all times while on site.	
	Quarrying operations Movement of vehicles Operation of crusher Earthworks Stockpiling of construction waste and construction materials	Air quality deterioration	Dust suppression on roads or at open sites by sprinkling water as required at regular intervals.	Contractors/DSC
			Cover earth stockpiles using plastic sheets or cement jute bags. Use tarpaulins to cover sand and other loose materials during transport.	
			Limit vehicle speed to 10-15 km/hr; site to be signed specifying speed limits.	
			Ensure that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS.	
			Do regular maintenance of vehicles.	
			Provide ventilation in confined working areas.	
	Movement of vehicles Operation of crusher Operation of construction machineries and equipment Horn honking	Noise and vibration	Monitor noise levels regularly at site to meet the noise standards (Annex 6)	Contractors/DSC
			Fit mufflers in vehicles to control noise.	
			Limit the speed of vehicles.	

			Ban the use of power horns in vehicles. Regularly maintain the equipment.	
			Prohibit the operation of crushing plants and construction vehicles from 7 p.m. to 6 a.m. in residential areas.	
			Compensate the damages caused by vibration if caused by construction activities.	
	Construction of project structures	Vegetation clearance	Cut only trees that are marked and have been approved by the Department of Forestry. Plant and rear tree saplings at the rate of 25 saplings for each felled tree.	Contractors/DSC
	Reinstatement of damaged community services and infrastructures.	Reinstatement of community services and infrastructures	Compensate or reinstate/relocate community assets that are disturbed such as irrigation canals, electricity poles, telephone lines, drinking water pipes, roads, etc. to the satisfaction of the people. Coordinate with concerned utilities, local people, design maps of the area with utilities and emergency response plans (develop and include an emergency response plan/template that includes notification and reporting protocols)	KVWSMB/KUKL/Contractor/DSC
	Influx of outside workforce, money, and unwanted activities.	Increase in crime and community stress	Prohibit gambling and alcohol consumption in contractors' camp sites.	KVWSMB/KUKL/Contractor
			Instruct the workforce to respect the local cultures, traditions, rights, etc.	
			Provide security in contractors' camps.	
	Project activities relating to health and safety issues at work areas	Health and hygiene (unsafe working conditions, accidents, fire hazard, transmission of communicable diseases, etc.)	Provide regular health checkups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce.	Contractors/DSC/KVWSMB/KUKL

			Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AiDS using brochures, posters, and signboards.	
			Provide insurance to workers and training in occupational health and safety.	
			Give importance to community health and safety	
			Provide alternate potable water supply during maintenance works and notify the public in advance	
			Prevent pollution of air in agricultural land, vegetation, and human settlements due to dust and vehicular emissions.	
			Avoid wastewater pollution on land, humans, receiving waters, and the environment.	
			Minimize nuisance due to traffic noise and vibrations.	
			Prevent nuisance from odors and noise from wastewater treatment plants.	
			Avoid traffic accidents and traffic jams.	
			Make available first aid kits, ambulance and fire extinguishers in camp sites.	
			Make available protection gears to all construction workers and compensate for the loss of life or any type of injuries.	
		Injury to a member of the public during pipe delivery	Provide fencing and/or barricades as per site risk assessment. Apply signage and pedestrian control.	
			Devise and implement system for site inspection and security.	

			Ensure security and equipment necessary to minimize vandalism.	
		Traffic can cause personal injury to the public, contractors, and employees; and vehicle accidents.	Develop a traffic control plan and keep areas clean and clear of obstacles.	Contractors/DSC
		Slips, trips and falls, strains and sprains; manual handling of injuries such as back damage	Conduct site inspection to ensure access/space is adequate for the task activities.	Contractors/DSC
		Existing underground services can cause explosion, electrocution, and damage	Inform site in-charge before digging/excavation; check relevant authority (e.g. power, water, telephone) records for existing location of services.	Contractors/DSC
			If in doubt use the experienced service of people in the locality.	
		Excavation by plant and equipment will create noise, falling objects, damage to existing surfaces, material spillage, and injuries by moving parts.	Operations of plant by licensed personnel. Use personal protective equipment–hardhat, high visibility vest, hearing protection etc. Maintain a safety working area clear of any clutter etc. Around the moving plant.	
			Protect surfaces from plant movements. Ensure plant noise control. Maintain clean- up equipment on site.	
			Maintain (specified) spillage control equipment.	
			Employ observers where possible.	
		Falling objects during storage of materials during excavation.	No materials to be placed or stacked near the edge of any excavation.	
			No load to be placed or moved near the edge of the excavation where it is likely to cause collapse of side of work. No load handling/movement across excavation. No rollable objects stored uphill from excavation.	

		Overhead and underground power cables can cause electrocution during excavation.	Determine location of underground services. If underground power cables are located in the vicinity, exercise extreme care while excavating. Consider any restriction on kinds of tools and equipment that may be required and comply with the requirements. Liaise with relevant authority.	
		Sloping ground can cause the falling of rolling objects.	Maintain good housekeeping (remove debris, trip hazards, site tidiness).	
			Select locations to minimize potential for movement. Stack materials at level below excavation.	
			Secure/retain potential falling/rolling	
		Trench collapse and falling objects	Support / bench / batter excavation.	
			Keep safe distance from edge of trench (at least 0.6 m away from sides of trench depending on soil type and conditions to be decided by DSC during detailed design and to be barricade/fenced to debar the public). Materials not to be placed or stacked near the edge of trench.	
			No load to be placed or moved near the edge of trench where it is likely to cause collapse of the trench.	
			All trenches to have safety barricades when left open for a period of time.	
			Provide submersible pump to dewater trenches where ground is water-charged.	
			Use personal protective equipment. No load/personnel movement across trench.	
		Falling into trenches	Install a shoring system. Where possible backfill trenches.	

			Erect 1.8 metre (min) security fence if open excavation is to be left unattended, or cover open excavation with steel plating if left unattended.	
			No personnel movement across	
		Other risks associated with confined spaces such as gases etc.	Where trench/conduit is considered to be confined space, use experienced trained personnel.	
			No smoking and use of mobile phone use, and avoid sparking.	
		Trip hazard; dust–eye injury; environmental damage due to storage of fill.	Provide necessary environmental protection measures:	
			Secure fill stockpile. Provide a dedicated area for fill.	
			Watering of material.	
			Provide necessary personal protective equipment to workers.	
			Covers fill when unattended or unable to be watered.	
		Manual handling (shoveling) can cause strains and sprains, injuries such as back damage, injuries due to lifting pipes and swinging loads	Correct manual handling techniques.	
			Provide adequate rest periods, allowed job rotation, minimize repetitious twisting and shoveling.	
			Use mechanical aids where possible. Maintain control of loads when lifting and moving.	
			Carry pipes close to ground while moving if mechanical aid is used.	
		Contaminated soil can cause impact on health of persons.	Use protective clothes/shoes/gloves.	
		Defective materials can cause injuries	Visual inspection of materials by experienced persons.	
		Storage of hazardous materials can cause injuries and illnesses.	Handling and storage to be done carefully under guidance.	

		Earth mounds can cause engulfment and dust can cause eye injuries.	Control operation of mobile plant by competent person. Watering of material. Control slopes. Delineate earth mounds. Put up warning signage. Cover earth mounds when unattended or unable to be watered.	
		Personal injury due to working plant and equipment	Maintain a safe distance from working plant. Wear personal protective equipment (PPE) including high visibility clothing and hard hat, etc. Put up perimeter fencing place trained personnel on the look-out. Have a first aid kit at the site.	
		Public hazards due to inadequate compaction, construction refuse, and inadequate re-surfacing during site restoration	Compaction to specified international standard (backfill shall be compacted to a dry density of not less than 90% of the maximum dry density); clear site of debris and refuse; re-surface without leaving gaps or uneven surfaces and erect fence around hazardous areas until they are safe and restored.	
		Inadequate training, consultation, planning and improvisation can cause task-specific injuries due to inexperience, inadequate consultation or failure to provide required equipment	All personnel on - site should be trained and kept aware and should be suitably qualified. Provide competent supervision to be on site.	
		Weather conditions (e.g. Hot, cold, wet, flooding/inundation, high winds) can cause dehydration	Supply adequate drinking water in the work	
		Slippery surfaces can cause slips and falls	Wear non-slip safety footwear in all work sites. Ensure extreme care when working in wet and slippery areas.	

			Personnel should never run on worksite.	
		Untidy site can cause slips and falls.	Keep worksite clean and tidy at all times, free from clutter and rubbish. Store materials in designated areas as specified in site plans	
		Materials stored may be dislodged and fall onto people or property particularly when site is unattended.	Store materials safely by barricading or fencing the area.	
		Public safety make be at risk due to pipes or drums accidentally rolling onto the roadway causing an accident or may be rolled by unauthorized persons particularly when site is unattended causing injury to persons.	All materials to be secured by blocks or wedges, sandbags or other means. All pipes not laid during the course of a day are to be returned to the stockpile and secured.	
		Public safety may be at risk due to improper storage of plant.	Store/park plant and equipment off site and in a secure area.	
		Nuisance due to excavated soil. Deterioration of air quality due to dust.	Provide for safe disposal and re-use of excavated soil. Remove waste soil as soon as it is excavated. Sprinkle water to avoid dust.	
		Soil erosion, silt runoff, and settling of street surfaces. Water could get polluted; land values degraded and be a nuisance to pedestrians. Street surfaces would settle, bringing about ponding of water.	Precautionary measures should be taken during construction such as backfilling of excavated trenches. Construction activities should be, as far as possible and avoided during the rainy season. Provide temporary diversions and sign boards for pedestrians.	
		Workers and the public are at risk from accidents on site	Prepare and implement a site health and safety plan that includes these measures:	
			exclude the public from all construction sites	
			ensure that workers use protective equipment	

			provide health and safety training for personnel	
			follow documented procedures for site activities	
			keep accident reports and records As far as possible, the local people (who know the local conditions) should be hired.	
		Local residents and sites of social/cultural importance may be disturbed by noise, dust and impede access	Carry out the work as quickly as possible to minimize disturbances. Consult residents; inform them of work in advance. Erect “work to commence” and “work in progress” signage.	
	Traffic management at construction sites	Traffic congestion (temporary disruption to local access due to open trenches, excavation across roads, or road closures due to construction).	Develop a traffic plan to minimize traffic flow interference from construction activities.	Contractors/DSC
			Provide advance local public notification of construction activities, schedule, routing and affected areas including road closures.	
			Erect alternative routing signage in Nepali and English languages.	
			Use steel plates or other temporary materials across trench facilities in key areas such as pedestrian access, sidewalks and parking areas.	
			Arrange for night-time construction for activities in congested/ heavy day-time traffic areas.	
			Arrange for onsite “grievance handling” through the use of liaison officers.	
			Undertake trench closure and facilitate surface rehabilitation or paving as quickly as feasible.	

Operational Phase				
	Release of inadequately treated wastewater to river	Downstream pollution, health and environmental risks.	Treat wastewater to meet the effluent standards (50 mg/l BOD5 or 15 mg/l BOD5 at Gokarna and Guheshwori) before releasing it to receiving waters; regularly monitor (using online meters hooked up to the SCADA network) the quality of the treated wastewater and that of the receiving water upstream and downstream from the outfall. Develop and implement a WWTP safety plans (similar to HACCP plans).	KUKL/KVWSMB
	Overflow flooding	Hazards to public health and the environment due to overflow flooding and groundwater pollution	Ensure careful design and operation of wastewater system to meet peak wastewater loads of 3 times the dry weather flow; provide stand-by generators form pumping stations.	KUKL/KVWSMB
			Train operators for regular inspection cleaning, and maintenance of plant and sewers.	
	Discharge of industrial wastes	Hazards to public health and the environment due to overflow flooding and groundwater pollution	Train workers in OHS hazards and provide PPE; monitor illegal discharge of industrial wastes to the system through regular audits/spot inspections of the industries in the catchment area; monitoring of DO and electrical conductivity at the inlet of the WWTPs and enforce strict regulations in coordination with the Ministry of Environment, Science and Technology. Storage of treatment chemicals in designated areas that are bonded.	KUKL/MOEST
		Improper operation and breakdown will lead to accumulation of untreated	Prepare a WWTP safety plan for the WWTPs that will include standard operating operation of the WWTPs (automatic shutdown procedures etc).	KUKL
		wastewater that may cause smell and nuisance to the surrounding residential areas	Provide regular training to the staff.	

	WWTP operation	Spill and contamination from fuel and lubricants	Provide a green buffer zone by planting trees around the WWTP boundary (appropriate buffer to be determined following air quality dispersion modeling at the design stage).	
			Provide standby generators (the diesel generator is the second backup power.	
			Recover used oil and lubricants, and reuse or remove them from the sites. Storage areas for fuels and lubricants should be away from any drainage leading to water bodies. All fuel use areas e.g. generator, must have drip basins installed to prevent any leakages and must be recycled. All fuelling, repair, and maintenance work should be done on a concrete surface provided with a catch tank that can be cleaned and all spilled fuel recovered and recycled.	
	Grit (from WWTP) and char (from gasification plant) collection and disposal	Grit can reduce the efficiency of the WWTP	Collect inert grit from grit chambers and dispose of at landfill sites Char from gasification plants can be used as construction material.	KUKL

DSC = Design and Supervision Consultant, DWEC = District Wage Evaluation Committee, IEE = initial environment examination, KUKL = Kathmandu Upatyaka Khanepani Limited, KVWSMB = Kathmandu Valley Water Supply Management Board, MOEST = Ministry of Environment, Science, and Technology, PID = Project Implementation Directorate, WWTP = wastewater treatment plant.

VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

200. As part of the feasibility studies, an extensive consultation program with key stakeholders was carried out, in line with the requirements pertaining to environment and social considerations of ADB. The tools used for consultations were stakeholder workshops and meetings, interviews, structured questionnaires, and focus group discussions (FGD). These consultations provided inputs for identification of the felt needs of the communities, and the relevant stakeholders.

201. During the business survey, business/shops of different core areas of cities were informed about the project activities such as replacement, rehabilitation, cleaning of sewer, separation of storm water drain and sewer, new laying of sewer etc. in the main road and inner roads of the cities. They were informed about the possible impacts such as disruption to the local inhabitants, and pedestrians during construction. During the business survey, the business owners and the shop keepers were informed about the possibility of disruption to the business and the survey was a preliminary activity to determine possible profit losses if full closure of the road was required during construction. They were informed that future public consultations and disclosures would be held regarding possible disruption to businesses and issues of compensation modality would be discussed. They were also informed that they will get more information about the project activities during topographical survey.

202. FGDs were not thought to be necessary for Dhobighat WWTP because there is enough land for the addition of another modern unit and maintenance of the existing unit; and at Dhobighat WWTP as recently there have been a number of strikes and bandhs from the local people opposing the rehabilitation of squatters that were evicted from the Bagmati River banks and tensions prevailed.

The Project Affected People of Kathmandu Valley have been informed about the rehabilitation/modernization of existing and new construction of WWTPs s. Discussions were held with the participants in a closed circle and the details of the dates, numbers of participants are given in
Table 0-1and in Annex 9.

Table 0-1: Meetings, workshops, consultations and focus group discussions held

SNo.	Date	Topic	No. of participants	Institutions
1	26 March 2012	Scope and objectives of PPTA -7936 and PPTA-43448; ongoing activities of HPCIDBC; BAP implementation	6	Project Manager and Deputy Project Manager HPCIDBC; PPTA Team
2	19 April 2012	Scope and objectives of PPTA -7936; ongoing activities and problematic areas of Lalitpur Municipality	4	Environment Section Chief and Drainage Section Chief Lalitpur Municipality; PPTA Team
3	19 April 2012	Scope and objectives of PPTA -7936; ongoing activities and FGD on problematic areas of Kathmandu Metropolitan City	4	Division Chiefs, PPTA Team
6	24 April 2012	Scope and objectives of PPTA -7936; ongoing activities and FGD on problematic areas of Kirtipur Municipality	3	Municipality Engineer, PPTA Team
7	26 April 2012	FGD on identification of project intervention areas	17	Kirtipur Municipality, Lalitpur Sub-Metropolitan City, Bhaktapur Municipality, Madhyapur Thimi Municipality, KVWSMB, KUKL, PID, PPTA Team
9	22 June 2012	Meeting on coordination on the wastewater sector	13	MoUD, HPCIDBC, PID, KUKL, Kathmandu Metropolitan City, KVWSMB, PPTA

SNo.	Date	Topic	No. of participants	Institutions
13	9 July 2012	FGD in Ta Dhoka Purnchandi, Lalitpur	12	Local people

203. Mr. Bhim Prasad Nepal, the Chief of the National Archives, the Department of Archaeology, who was involved in the drafting of the Ancient Monuments Preservation Rules 2049 (1989), considered that an Archaeological Impact Assessment (AIA) would not be necessary for the Project since all works would be done in the existing public roads. However, an application should be made by KUKL/PID to the Department of Archaeology with detailed drawings of the proposed work according to the prescribed format (Annex 8) for obtaining permission to proceed.

204. The PID will extend and expand the consultation and disclosure process during the detailed design stage and construction period of the project. A community awareness firm will be recruited to ensure ongoing consultations and public awareness during project implementation. The firm will continue the consultations with the affected communities through distribution of leaflets, about the project activities and entitlement matrix and the project contact persons for outreach and queries. Intensive consultations will be made on those WWTP areas where people have different opinion for the construction of WWTP.

205. The community awareness consultant will coordinate with the PID, design and DSC, and contractors to ensure that communities are made fully aware of project activities in all stages of construction. A community awareness and participation plan was also prepared for the project, and will be implemented by the recruited firm in coordination with the PID and DSC safeguards staff. Community groups such as tole committees and vendor associations will be consulted and made aware of the civil works and project activities prior to construction.

Recent meeting held regarding Dhobighat WWTP construction are listed below.

S.N.	Date	Location	Participants	No. Present Participants	Major issues
1	Dec, 22, 2017	Prasodhan Kendra	Ward representative as well as local people	9	Provide the information about environment and social
2	Jan 6, 2018	La. Ma. Na. Pa. ward no 4, Dhobighat	Biraj Bista Sceince and Technology minister and related persons	123	Establish of waste water treatment plant and its design
3	Feb 6, 2018	La. Ma. Na. pa. Hall	Respected Pampha Bhusal and Ex. Minister Jiwan Khadka, Mayer Chiribabu Maharjan and Raj Kaaji Maharjan .	56	Construction of WWTP and sewerage in Dhobighat.
4	March 16, 2018	La. Ma. Na. pa. Ward no 4, Dhobighat.	Ex. Minister Jiwan Khadka and word president and ward representative	27	Map development discussion program ho WWTP.
5	April 17,2018	La. Ma. Na. pa. ward no 4, Jaulakhel	Ward president Narayeb K.c. and members and active womens group	25	Interaction program with Women's group of La. Ma. Pa. ward no 4
6	Appril 20, 2018	WWTP curidor park and Bagmati ……	Ward elective members and active woman's groups of La. Ma. Pa. ward no	25	Field visit.

			4.		
7	May 3, 2018	La. Ma. Na. pa. ward no 4, Jaulakhel	Narayen K.C. Ward president and other related peoples.	11	Grievance committee formed.
8	May 27, 2018	La. Ma. Na. pa. ward no 4, Dhobighat	Mayer Chiribabu Maharjan and waard president and others related members.	50	Review of Grievance committee and Provide the information to start work.
9	June 1, 2018	La. Ma. Na. pa. ward no 4, Dhobighat	Ward president Narayen K.C. and general members.	19	First meeting of Grievance committee
10	June 12, 2018	Lalitpu metro - municipality. ward no 4, Dhobighat	President of Malpokhari women group Bina maharjan and their members.	44	Awareness program about the projects and Management of waste water.
11	July 20.2018	Lalitpu metro - municipality. Ward no 4, Office hall.	Ward president Narayen K.C. and general members.	32	Meeting with start the treatment plant.

VII GRIEVANCE REDRESS MECHANISM

206. A grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns. The GRM for the project is outlined below, and consists of four levels with time-bound schedules and specific persons to address grievances.

207. **First level of GRM.** The first level and most accessible and immediate contact for the fastest resolution of grievances are the contractors and supervision consultants on site. Prior to construction of any works, the community awareness consultants, DSC, and contractors are to hold local community meetings to notify the local residents and businesses of the temporary disturbance, and to inform them of the project. If a local area committee (LAC) exists, they should also be informed. If any complaints arise, the contractors, DSC, and PID can immediately resolve the complaints on site. The PID branch offices can also be involved in grievance redress at this stage. The KUKL hotline and PID office phone numbers will be posted in public areas within the project area and construction sites. Any person with a grievance related to the project can contact the project to file a complaint. The PID branch offices are staffed with a consumer relations officer to field and resolve complaints. The consumer relations officer or branch manager will document the complaint, and immediately address and resolve the issue with the contractor within 1-2 days, if the complaint remains unresolved at the field level. The branch manager may seek the assistance of the DSC safeguards specialists (the environmental specialist or social safeguards specialist) to help resolve the issue. The consumer relations officer or branch manager will notify the PID safeguards unit that a complaint was received, and whether it was resolved. The branch manager will fully document the following information: (i) name of the person, (ii) date complaint was received, (iii) nature of complaint, (iv) location, and (v) how the complaint was resolved.

208. **Second level of GRM.** Should the grievance remained unresolved, the branch manager will forward the complaint to the PID safeguards unit. The person filing the grievance will be notified by the consumer relations officer or Branch Manager that the grievance was forwarded to the PID safeguards unit. For resettlement issues, the resettlement officer will address the grievance; for environmental issues, it will be the environmental officer. Grievances will be resolved through continuous interactions with affected persons, and the PID will answer queries and resolve grievances regarding various issues, including environmental, social, or livelihood impacts. Corrective measures will be undertaken at the field level by the PID safeguards staff within 7 days. The relevant safeguards unit staff will fully document the following information: (i) name of the person, (ii) date complaint was received, (iii) nature of complaint, (iv) location, and (v) how the complaint was resolved.

209. Third level of GRM. Should the grievance remain unresolved, the PID's Project Director will activate the third level of the GRM by referring the issue (with written documentation) to the local Grievance Redress Committee (GRC) of KUKL, who will, based on review of the grievances, address them in consultation with the PID safeguards unit, Project Director, and affected persons. The local GRC will consist of members of PID, affected persons, and local area committee, among others determined to provide impartial, balanced views on any issues. The GRC should consist of around 5 persons. A hearing will be called with GRC, if necessary, where the affected person can present his or her concern/issues. The process will promote conflict resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 days. The functions of

the local GRC are as follows: (i) to provide support to affected persons on problems arising from environmental or social disruption, asset acquisition (if necessary), and eligibility for entitlements, compensation, and assistance; (ii) to record grievances of affected persons, categorize and prioritize them, and provide solutions within 15 days; and (iii) to report to the aggrieved parties developments regarding their grievances and decisions of GRC. The PID safeguards officers will be responsible for processing and placing all papers before the GRC, recording decisions, issuing minutes of the meetings, and taking follow-up action to see that formal orders are issued and the decisions carried out.

210. Fourth level of GRM. In the event that a grievance is not addressed by the contractor, DSC, branch office, PID, or GRC, the affected person can seek legal redress of the grievance in the appropriate courts, the fourth level of the GRM, which is the formal legal court system. The grievance redress mechanism and procedure are depicted in Figure VIII-1.

211. GRC Composition. Below is the GRC members composition under the project:

(i) GRC Chairman - PID Director
(ii) GRC Members:
(iii) Concerned municipality representative
(iv) Tole Community representative as AP's representative
(v) Appointed NGO representatives as independent party
KUKL/ KVWSMB/DSC (as relevant)

212. ADB Accountability Mechanism. In the event when the established GRM is not in a position to resolve the issue, Affected Person also can use the ADB Accountability Mechanism (AM) through directly contact (in writing) to the Complaint Receiving Officer (CRO) at ADB headquarters or to ADB Nepal Resident Mission (NRM). The complaint can be submitted in any of the official languages of ADB's DMCs. The ADB Accountability Mechanism information will available in the PID to distribute to the affected communities, as part of the project GRM.

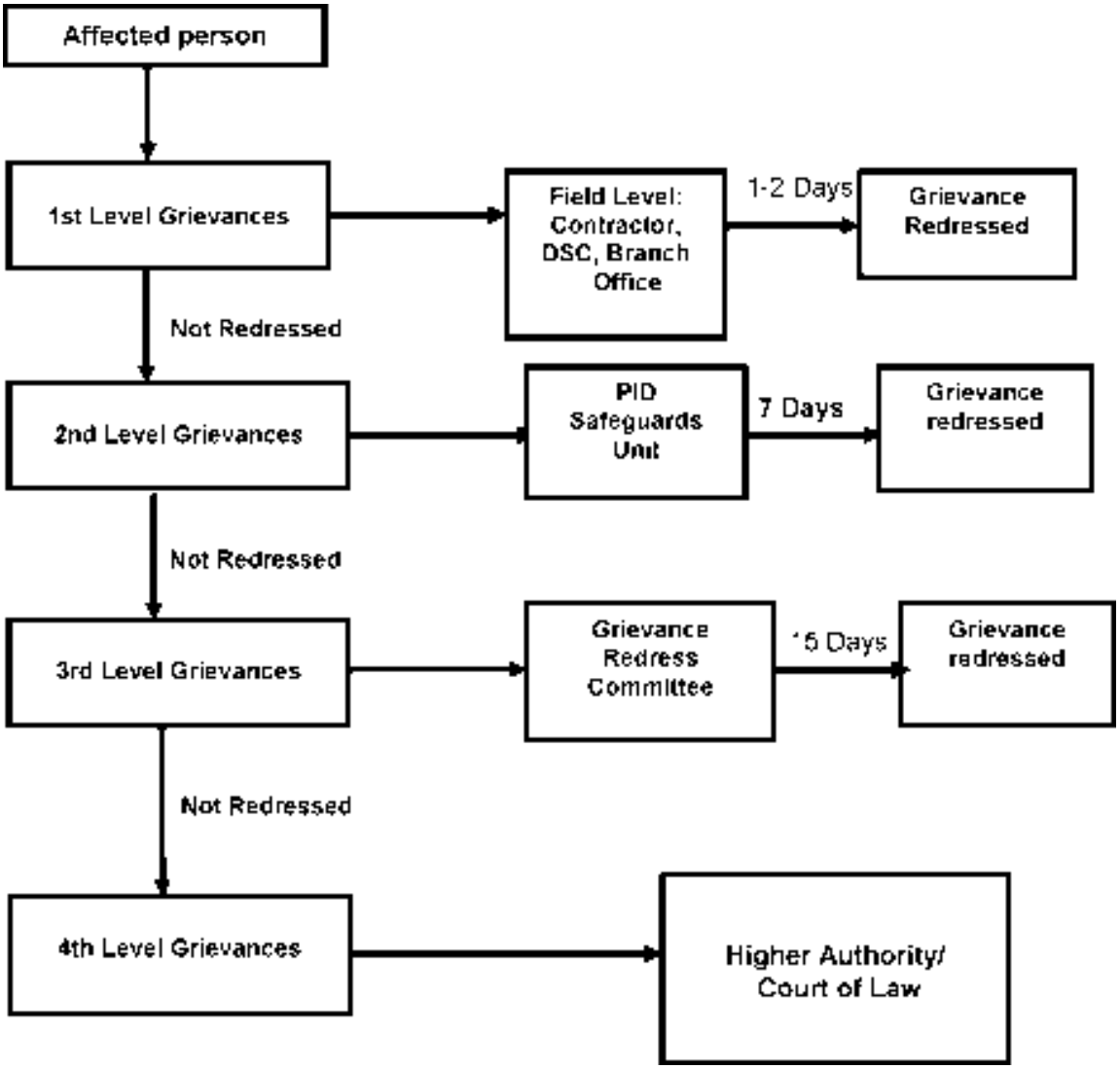

Figure 0-1: Grievance Redress Mechanism (GRM)

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VIII ENVIRONMENTAL MANAGEMENT AND MONITORING COST

A. Environmental Management Plan and Objectives

213. The basic objectives of the EMP are to:

(i) to ensure that all mitigation measures and monitoring requirements will actually be carried out at different stages of project implementation and operation - pre-construction, construction and operation and maintenance;
(ii) recommend a plan of action and a means of testing the plan to meet existing and projected environmental problems;
(iii) establish the roles and responsibilities of all parties involved in the project's environmental management;
(iv) describe mitigation measures that shall be implemented to avoid or mitigate adverse environmental impacts and maximizing the positive ones;
(v) ensure implementation of recommended actions aimed at environmental management and its enhancement; and
(vi) ensure that the environment and its surrounding areas are protected and developed to meet the needs of the local people and stakeholders.

B. Environmental Management and Mitigation and monitoring

214. Anticipated environmental impacts and mitigation measures have been dealt in detail in Section D and Table16.

215. A detailed self-explanatory environmental management and monitoring program is presented in **Error! Reference source not found.** for TP-03. The Table lists the environmental impact, its mitigating measures; the parameters to be monitored (including location, measurement and frequency) and the cost. The program will evaluate: (i) the extent and severity of the adverse environmental impacts as compared to what was predicted, (ii) how effective the mitigating measures were and compliance with the regulations and the (iii) overall effectiveness of the EMP.

216. The environmental monitoring of the Wastewater System includes field supervision and reporting of project activities prior to and during the project construction and operation in order to ensure that the works are being carried out in accordance to the approved design and that the environmental mitigation measures are fully implemented in accordance with the EMP.

Table 0-1: Environmental Management and Monitoring Plan

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
CONTRACTORS DESIGN PHASE						
stoppage of existing WWTP	Minimum stoppage planned	Work plan should be properly prepared				
Soil erosion and slope instability	Incorporate drainage system in final design	Review if detailed drainage systems with plans have been designed				Contractor
Sludge disposal	Incorporation of optimum sludge reduction using anaerobic digestion in design for power generation.	Review if designs for sludge management have been made				Contractor
Health and safety of community and workers	Prepare training manuals in Nepali (or local languages) with notes and sketches on Community Health and Safety and Potential Occupational Health and Safety	Review information for errors and quality				Contractor
Treatment plant inefficiency	Develop and Implement HACCP plans as part of the O&M manuals and provide in Nepali with sketches and regular training to the staff	Operation of plant as per HACCP Plan and O&M Manual. Operational reports (including incidence reports)	Audit of HACCP Plans and O&M manuals (Audit reports) Submission of operational reports			Contractor
PRE-CONSTRUCTION ACTIVITIES						
Permits and Approval	Obtain required permits and approval for disruption of existing wastewater treatment plant during construction	Ensure work plan such that no disruptions to WWTP are planned				Contractor
Lack of public consultations and awareness programs	Develop and implement a project communications plan to make the stakeholders feel they are part of the project and it belongs to them.	Implementation of communications plan throughout the project.	Audit of communications plan (Audit reports) Number of meetings, awareness programs held	Project sites	Bi-annually for the first 2 years of the project then annually in	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
		Arrange meetings, workshops and group discussions to disseminate project final designs, plans and activities			O & M period	
Workforce camps	Establish temporary workforce camps with sanitary amenities at designated sites only	Ensure temporary workforce camps are established within designed area with sanitary facilities and first aid facilities	Visual inspections of wastewater disposal, solid waste management, noise and air pollution, health of workforce, potable drinking water, kerosene availability	Project site	Monthly	Contractor
CONSTRUCTION PHASE						
Job opportunity	Employ local people (not under age 16). Settle wage rate based on DWEC and provide the list of employees to DSC	Number of local persons employed, number of under-aged people employed. Whether the wage rate is at par with DWEC	List of employees , nationality, age of employees, wages	Project site	During construction every month	Contractor
Change in hydrology and morphology of streams and rivers	Quarrying/mining activities in river/streams for extraction of construction materials shall not be done so as to change the river cross sections and longitudinal profiles.	Cross sections of river before construction and during construction upstream (at the quarry site, upstream and downstream) and river discharge	Cross-section of river; Visual inspection, discussion with locals, discharge measurements and photographs before and during construction	Quarrying/mining Sites in river course	During construction every month	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Soil erosion and slope stabilization	Separate stockpiling of topsoil for further use; spoil disposal at designated and stabilized sites; excavated areas' backfill to be compacted and include replacement of topsoil; avoid work during the rainy season as much as possible; mulching to stabilize exposed areas; use bioengineering techniques (e.g. re-vegetating areas promptly); provide channels and ditches for post-construction flows; lining of steep channels and slopes (e.g. use of jute matting); prevent off-site sediment transport using settlement ponds, silt fences Use of settling basins at reservoir sites; use of straw for filtering of small discharges; routine inspection and monitoring of larger discharges to water courses. Use of temporary bunds; use of catchment basins below steep reservoir sites. Construction to be done in the dry season only; use of river diversions with *bundings*. Local wells and springs to be bunded from temporary spoil dumps; local wells and spring fed spouts or kuwas to be monitored particularly downhill of excavations plus temporary supply provided if flow is affected; permeable base and side backfill required at deeply excavated sites or an alternate source of drinking water provided at the existing location.	Drainages systems Stockpiling of top soil for its re-use Bio-engineering measures Management of excessive spoil materials	Site drawings showing drainage system in project sites. Visual inspections, photographs and the local people's views if excavation and other site works have caused soil erosion; stockpiling of excavated soils have been done or not (logbook on transportation of excess spoil materials from the site); whether spoils have been disposed in approved areas or not and whether the contractor has taken mitigation measures or not (site plan showing areas for disposal Number of trees or saplings planted Site operations log book (to determine if construction works is being carried out in the wet or dry season).Log book of water delivery to people being served.	Project Site	During construction (Weekly)	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Water pollution	Avoid camping facilities within clear water supply rivers Provide designated areas with collection bins for wastes. Provide safe toilets and septics tanks in site Prohibit open defecation in open areas. Storage of construction aggregates, hazardous, and toxic materials in safe areas and disposal of chemical containers, packaging materials, plastic bags etc. Prohibit washing of vehicles next to rivers and streams. Provide training to workforce on safe handling of toxic materials and OHS measures during construction. Recover used oil and lubricants and reuse or remove from the sites. Storage areas for fuels and lubricants should be away from any drainage leading to water bodies. All fuel use areas e.g. generator must have drip basins installed to prevent any leakages and recycled. All fuelling, repairing and maintenance work should be done on a concrete surface provided with a catch tank that can be cleaned and all spilled fuel recovered and recycled.	Water quality and health status of workers before and during construction. Site plan of camp facilities showing nearby receptors, toilet facilities/ablution blocks. Site plan showing designated storage areas, list of chemicals on site; prohibition/restrictive signage at the construction sites. OHS training plan and material safety data sheets (MSDS) on site at all times Oil and lubricant spill prevention measures	Baseline water quality of receiving water (complete physical, chemical and bacteriological tests). Inspection of site plans, distance of camping facility from drainage areas (at least 100m); number of toilets/ablution blocks provided; audit of training plan, inspection of signage and MSDS, health/clinic reports of workers. Observation of fuelling and generator areas	Streams and rivers, Project sites and camps	Once in a month	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Air Quality	Dust suppression on roads or at open sites by sprinkling water as required at regular intervals. Cover earth stockpiles using plastic sheets or cement jute bags. Limit vehicle speed. See that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS. Regular maintenance of vehicles. Provide ventilation in confined working areas.	Operation of dust suppression tanks, sprinklers on site Stockpiles covered with appropriate sheeting. Vehicle maintenance records; renewal of "green stickers". Ventilators in confined spaces	Visual inspection if water is sprinkled or not; logbook of operation of dust suppression trucks. Photographs of stockpiles, visual inspection reports Check maintenance records and "green stickers". Inspection reports of site plans and no of ventilators (meets international standards).Site drawings showing location of ventilators, no of ventilators	Project location	During construction/ every week	Contractor
Noise level and vibration	Monitoring of noise levels regularly at site. Fit mufflers in vehicles to control noise. Limit the speed s of vehicles. Ban the use of power horns in vehicles. Regular maintenance of equipment. Prohibit the operation of crushing plants and construction vehicles between 7 PM to 6 AM. Compensate the damages caused by vibrations.	Baseline noise level Adoption of noise level control measures as specified; vehicles with mufflers installed or not; speed limit signage erected; maintenance schedule of equipment; operation log of crushing plants. Nearby structures/buildings in construction areas.	Sound level (DBA); feedback/complaints from nearby residents; number of vehicles installed with mufflers; number of vehicles with/without power horns; number of speed limit signage at the project site; inspection reports/photographs of nearby buildings/structures for cracks before/during construction	Project Site	Every week	Contractor