

**PPTA No. 4972-NEP  
PREPARING THE IMPROVED WATER QUALITY, SANITATION AND SERVICE DELIVERY IN  
EMERGING TOWNS SECTOR DEVELOPMENT PROGRAM  
NEPAL**

Final Report, Volume 6 D

**SUMMARY INITIAL ENVIRONMENTAL EXAMINATION (SIEE) OF  
THREE PILOT SUBPROJECTS (SUKHAD, DUHABI AND  
KHANDBARI)**

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## I. SUMMARY INITIAL ENVIRONMENTAL EXAMINATION

### A. INTRODUCTION

#### 1. Background

1. The Government of Nepal (GON) requested a Project Preparatory Technical Assistance (PPTA) from the Asian Development Bank (ADB) for “**Preparing the Improved Water Quality, Sanitation and Service Delivery in Emerging Towns Sector Development Program**” (PPTA4972-NEP). The PPTA aims at preparing an investment project to improve community health by providing improved water supply and sanitation facilities, complemented by community development and training, including hygiene and sanitation education.
2. The PPTA defined the criteria for an emerging town and selected 3 pilot towns - Sukhad from the Far Western Region and Khandbari and Duhabi from the Eastern Region.
3. The project will improve infrastructure through the development, design and implementation of subprojects in water supply and sanitation in each town. There will be two types of water supply systems, gravity based systems with a spring or stream source for the hills, and for Terai deep tube-well systems. For Duhabi, a ground water reservoir will be constructed as an overhead tank already exists. A typical gravity water supply system – like in the case of Khandbari town in the hills - consists of an intake, reservoir with chlorination facilities, a treatment plant, transmission mains and a distribution system. A deep tube-well system in the Terai towns consists of a pumping system, an iron removal treatment plant (where necessary), an overhead reservoir, chlorination facilities and a distribution system. The sanitation systems will include construction of toilets, constructed wetland (using reeds) for Duhabi, septage drying reed beds for Sukhad and Khandbari. All the proposed systems for the 3 emerging towns will be new construction.
4. The Project has been classified by ADB as environmental assessment category B. The impacts of providing infrastructure in the three areas have been assessed and the Initial Environmental Examination (IEE) Reports and Environmental Monitoring Plans produced. Studies were conducted according to ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003). Further, GON's Environmental Protection Rules (1997) and Amendment of 20 August 2007 stipulate that an IEE is necessary for a drinking water scheme for a population of 5,000 to 50,000 people.
5. This is the SIEE for the water supply and sanitation subprojects proposed for the 3 towns. It discusses the environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works proposed under these subprojects. It is one of eight environmental documents describing the environmental impacts and procedures related to the Project Preparatory Technical Assistance conducted in 2008. The other documents are IEEs for Sukhad, Duhabi and Khandbari as well as environmental assessments of TDF, sector loan and environmental assessment of programme loan. These documents were prepared by one International and one National Environmental Specialist through assignments of 0.75 months (international) and two and a half months (national).

6. The sub-projects in each town concern urban environmental infrastructure improvements including the following components: (i) water supply; (ii) sewerage and sewage treatment and drainage and (iii) solid waste management.
7. The IEEs show that the planned sub-projects in all the towns will have mainly small and temporary impacts on the environment which can be easily and cheaply mitigated through adequate mitigation measures and regular monitoring is needed during the design, construction and operation phases.
8. Land acquisition, resettlement and compensation of affected persons will be addressed by minimising land areas, (and the use of unproductive land wherever possible) and preparing and implementing comprehensive Resettlement Plans, if required, in accordance with national laws and ADB Guidelines.
9. As a result of the sub-projects and other project activities, there should be significant improvement in personal, household and community hygiene practices, environmental sanitation and the urban infrastructure, thereby increasing the quality of life of the people.
10. This report is intended to be read independently as the Summary Initial Environmental Examination for the 3 emerging towns. It covers the following: (i) a brief description of the proposed sub-projects proposed for each town; (ii) a description of the existing environmental conditions within the sub-project areas; (iii) summary of potential environmental impacts and mitigation measures; (iv) potential enhancement measures; (v) institutional requirements and environmental monitoring programme; (vi) findings and recommendations; and (vii) conclusions.

## **2. Basis and extent of the IEE study**

11. The Nepali law and 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 those impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of lending operations and project development and implementation worldwide.
12. ADB's Environment Policy is to consider environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in the Operations Manual (OM) 20: Environmental Considerations in ADB Operations. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, financial intermediation loans and private sector investment operations.
13. The requirement for Environmental Assessment in Nepal is established by the National Environment Protection Act (1997), and the procedures are defined in the Environment Protection Rules (1997) and its amendment of 20 August 2007.
14. The Nepali rules stipulate that an IEE is necessary for a drinking water scheme for a population of 5,000 to 50,000 people. The urban areas selected under this Project have populations of between 20,000 to 30,000 so the infrastructure subprojects are relatively small, and groundwater abstraction and water treatment will not be of the scale quoted in the EIA regulations as requiring environmental assessment. Components will not be located in protected or sensitive areas and only limited resettlement may be required in a few towns.

15. Nepali Drinking Water Quality Standards and Guidelines (including standard limits, guidelines for the required frequency for water quality monitoring and the process/schedule for taking the standards in active use in the country) have been set in 2006. They are presented in the EARP report of this PPTA together with the effluent standards. The Table of standards for drinking water is attached in the Appendix 2 of this Report.
16. Nepal's procedures for environmental assessment of development projects are described in the Environment Protection Act (EPA), 1997 and the Environment Protection Rules (EPR), 1997 and Amendment of 20 August 2007. Projects that need EIA and IEE are clearly listed in the EPR. The process for carrying out IEEs for small/emerging towns water supply and sanitation projects in Nepal is as follows:
  - (i) The responsibility for undertaking and approving an IEE lies with the Department of Water Supply and Sewerage (DWSS) (the Proponent) and the Ministry of Physical Planning and Works (MPPW) (the Executing Agency).
  - (ii) The environmental assessments are carried out by consultants hired by DWSS. (IEEs are approved by the respective Ministries. All EIAs are approved by the Ministry of Environment, Science and Technology MoEST.)
  - (iii) Public involvement, including notification of stakeholders, dissemination of information and consultation is a requirement, particularly during the review and approval of the IEE report.
  - (iv) DWSS (PMO) prepares the TOR as described in the format of Schedule 3 of EPR, 1997 and submits it to MPPW through the Director General of DWSS.
  - (v) MPPW processes ToR, reviews it and if not satisfied, returns it with comments for improvements.
  - (vi) If satisfied, the Ministry approves it and informs the consultant through DWSS.
  - (vii) The DWSS will arrange for the study to be conducted by a consultant as soon as the TOR is approved by the Ministry.
  - (viii) The IEE report will be prepared in the format as described in Schedule 5, EPR, 1997 and in accordance with the ADB environmental guidelines. The IEE reports prepared for the pilot towns will be used as model reports.
  - (ix) Rule 7 stipulates that a notice has to be published in Nepali in a national daily newspaper and also affixed in the concerned VDC or Municipality, DDC Office, schools, concerned individuals and institutions, hospitals and health offices, requesting them to give written comments and suggestions within 15 days regarding the likely impacts of implementing of the proposal on the environment. A deed of public enquiry has also to be prepared and included in the IEE report.
  - (x) The IEE report should be submitted to MPPW through DWSS. DWSS will review the report and then forward it to MPPW for decision making. Both DWSS and MPPW can send the document back to the consultant for revisions, if required. When approved, MPPW will inform the town through DWSS.
  - (xi) The IEE report will be sent to ADB for concurrence after approval by MPPW.
  - (xii) MPPW will inform the town through DWSS after concurrence has been received from ADB.
  - (xiii) In accordance with the provision of EPA and EPR 1997, the DWSS should implement the proposed subproject only after the approval of the IEE report, which will be monitored and evaluated by MPPW through DWSS.
17. In this PPTA the requirements of ADB and GON have been combined and this report is following the more structure given by ADB, but including the information required in both.
18. Public consultation is the process of exchanging information with those persons and organisations with a legitimate interest in a project and/or who are likely to be affected

by the project (stakeholders). It is a two-way process that informs and involves the community in developing a project, and informs the proponent about issues and concerns, which can then be addressed in project design. Information disclosure involves stakeholders in monitoring the development and implementation of a project and fosters openness in decision-making by presenting documents and other project materials for public scrutiny.

19. Consultation and disclosure is mandatory under the Nepali rules and the ADB Environment Policy, and best practice approaches should be followed. This involves consultation with stakeholders at an early stage of EA preparation, and throughout project implementation. As a minimum, stakeholders should be consulted regarding the scope of the environmental study before work has commenced in earnest, and should then be informed about the likely impacts of the subproject and proposed mitigation once the draft IEE or EIA report is under preparation. The report should record the views of stakeholders and indicate how these have been taken into account in project development.
20. Information is disclosed through public consultation and more formally by making documents and other materials available in a form and at a location in which they can be easily accessed by stakeholders. This normally involves making draft reports available (in the local language) at public locations in the community and providing a mechanism for the receipt of comments and making documents available more widely. All safeguards documents must be endorsed by the Executing Agency and ADB encourages governments to upload all documents onto their own website. For Category A and B-sensitive projects, SEIAs and SIEEs are made available to the public through the depository library system, and are placed on the ADB website no later than 120 days prior to the Board considerations. The full EIA and IEE (B-sensitive) is also made available to interested parties upon request. For other category B projects, the environmental analysis is posted on the ADB website as part of the RRP. The full IEE reports are also made available to the interested parties upon request.

## B. DESCRIPTION OF THE PROJECTS

The following tables summarise the components, locations and environmental characteristics of each sub-project.

**Table 1: Summary of Proposed Sub-projects**

<b>1A – Khandbari Town Water Supply and Sanitation</b>			
<b>Proposed infrastructure (and works)</b>	<b>Function/Purpose</b>	<b>Description of Component</b>	<b>Location and Environment</b>
<b>1. Water Supply</b>			
Intake	Augment water supply in order to provide adequate quantity of water as per the provisions of the design criteria for domestic, non domestic and institutional needs of the proposed service area;	Two intakes will be constructed at remotely located rocky gorges of streams, at an altitude of 2100 m above msl. Small diversion weirs will be constructed across the width of the stream. The intake structure will be excavated on the rocky face of the bank of the	The intakes will be located at Nwar Khola and Simali Khola (tributaries of the Induwa Khola) situated 25 km away from Khandbari. The location is remote forest far above from settlement. The intake structure will be small requiring only to draw 19 lps water. Few trees (2-3

## 1A – Khandbari Town Water Supply and Sanitation

Proposed infrastructure (and works)	Function/Purpose	Description of Component	Location and Environment
		streams.	nos) may have to be removed to make the side intakes and grit chambers.
<b>Transmission pipes</b>	Transmission of water from the intake(s) to the treatment plants and storage tanks	The main transmission pipe from Induwa Khola to the main water treatment plant at 25 km is proposed in 200 mm ND Ductile Iron. Other secondary transmission pipe to supply water to 9 number of water tanks are proposed in HDPE in 90 to 125 mm OD. (altogether 66 km of transmission and distribution pipe)	At the Khandbari end the transmission pipe passes through Diding village of the neighboring VDC (no houses affected). The transmission route will mostly run through dense alpine forest and bare and rocky lands. The trench will only about 0.75m wide and of 1.1m depth. (requires cutting of maximum 20-30 small trees)
<b>Treatment plants</b>	Improve quality of supplied water so that they meet the National Drinking Water Quality Standards;	The treatment units of all 4 conventional treatment plants will comprise of roughening filter, sedimentation tank, slow-sand filters and chlorination plant.	Four treatment plants are proposed at Bhotebas (new one) (19lps), Manebhanjyang (3.5lps), Khanaldanda (4.5lps) and Tumblingtar (Baidy Godan) (5lps). No tree cutting will be involved. The new intake comes to a privately owned land.
<b>Storage tanks</b>	Ensure sustainable water supply (24 h) at adequate pressure	4 existing old and new water tanks (construction completed or to be completed); additional 4 new tanks under the proposed subproject	Multiple numbers of storage tanks, both old and new ones, are proposed to serve separate distribution areas. (same places as above)
<b>Distribution improvements</b>	<b>pipeline</b> Strengthen the distribution network to supply water for 24 hours at adequate pressure as provided in the design criteria;	Existing HDPE distribution pipes in other sub-distribution areas will be retained unless the existing pipes are found inadequate or they are damaged beyond normal repair. Some provision of HDPE distribution pipes has been made under the proposed subproject.	Pipes will be laid on the streets. No tree cutting will be involved.
<b>2. Sanitation</b>			
<b>Septic tank cleaning system and sludge drying bed</b>	Establish basic level of sanitation delivery mechanism (septic tank cleaning services), appropriate for the urbanized part of the service area;	It is proposed to provide a service of septic tank cleaning and disposal system. A vehicle mounted vacuum pump and sludge drying bed is proposed for this purpose.	Sludge drying bed s are proposed near the border of ward 1 and 11 for Khandbari and at Salbisaune for Tumblingtar on government land away from residential area. No clearing of forest required.
<b>Construction of toilets</b>	Promote awareness	About 1200 subsidized	Khandbari and Tumingtar

## 1A – Khandbari Town Water Supply and Sanitation

Proposed infrastructure (and works)	Function/Purpose	Description of Component	Location and Environment
	among the rural communities within the service area to adopt basic level of sanitation practices (construction and use of latrines, health education and hygiene practices); and	household latrines will be constructed.  Two public toilets are proposed. One at Khandbari and another at Tumlingtar	bazaars as and where required which will be decided during the detailed design stage.

### 3. Drainage

Storm water drainage	Establish basic level of surface drainage provisions, appropriate for the urbanized part of the service area;	Storm water drainage covering the core areas of Khandbari and Tumlingtar is proposed. A stone masonry covered drains are proposed along the roads and open drains are proposed in other places.	Core areas of Khandbari and Tumlingtar bazaars along the streets.
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### 4. Solid Waste

Solid waste separation site	Establish basic level of solid waste management, appropriate for the urbanized part of the service area;	A provision for the solid waste separation is proposed near the municipal building.	Two places, one in Khandbari bazaar and one in Tumlingtar, next to the sludge drying beds on government land.
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## 1B – Duhabi Town Water Supply and Sanitation

Proposed infrastructure	Function/Purpose	Description of Component	Location and Environment
<b>1. Water Supply</b>			
Intake	Augment water supply in order to provide adequate quantity of water as per the provisions of the design criteria for domestic, non domestic and institutional needs of the proposed service area;	One additional deep tube well needs to be drilled (and two existing ones on the one under construction will be used as well); to a minimum 60 m distance from existing wells. Extraction of the new well will be limited to 20l/min. The four tube wells will be the source of supply for entire service areas of three VDCs.	The new tube well will be located at the existing Duhabi water supply head works – at the same compound where the existing tube wells and the overhead tank is, on government land with a walled existing compound with trees (buffer) where the present system exists, in populated town center area. No tree cutting involved
Storage	Improve the storage capacity	An additional RCC reservoir of 900 cum capacity has been proposed to be constructed on the ground.	Same as above

## 1B – Duhabi Town Water Supply and Sanitation

Proposed infrastructure	Function/Purpose	Description of Component	Location and Environment
Treatment plant	Improve quality of supplied water so that they meet the National Drinking Water Quality Standards;	Draft aeration and pressure filter has been proposed for the treatment system. Detailed investigations on the provision of the treatment plant shall still be performed.  Disinfection system has been proposed with the chlorination of the water.	Same as above
Distribution network	Strengthen the distribution network to supply water for 24 hours at adequate pressure as provided in the design criteria;	The existing network will be used (most of the 21 km pipes except pipes of diameter 40mm or less) but needs partial replacement and parallel pipeline at places. New pipeline of 54 Km length will be constructed (diameter 63mm to 315mm).	Proposed service areas along existing roads..
<b>2. Sewerage and Sanitation</b>			
Septic tank cleaning system	Establish basic level of sanitation delivery mechanism (septic tank cleaning services), appropriate for the urbanized part of the service area;	It is proposed to provide a service of septic tank cleaning and disposal. A vehicle mounted vacuum pump and sludge drying bed is proposed for this purpose. The WUA shall operate the system and also collect revenue from the cleaning service	
Settled sewerage and treatment		It is proposed to provide a settled sewerage system for the core area of Dubahi covering 34.56 ha. This requires construction of new sewers and some interruption chambers. The sewers lines will lead to a horizontal reed bed treatment plant of 1800 sq.m (4 cells, 450 sq.m each) (see table for details)	Sludge drying bed will be constructed on private agricultural land with only a few houses nearby. The effluent from the drying beds will be discharged into the Budhi river. Resettlement involved. No tree cutting involved.
Latrine programme	Promote awareness among the rural communities within the service area to adopt basic level of sanitation practices (construction and use of latrines, health education and hygiene practices); and	About 1200 subsidized household latrines will be constructed.  One public toilet is proposed	Household toilets will be constructed in individual backyards away from existing shallow wells  The public toilet will be constructed in the bazaar area on an open space belonging to the government.

## 1B – Duhabi Town Water Supply and Sanitation

Proposed infrastructure	Function/Purpose	Description of Component	Location and Environment
<b>3. Drainage</b>			
Storm water drainage	Establish basic level of surface drainage provisions, appropriate for the urbanized part of the service area;	Storm Water drainage covering the core area is proposed (combination of rehabilitation and new construction). Brick masonry covered drains are proposed along the inner roads and pipe drains where the road is in embankment. The outfalls are located in the Budhi River Banks.	Core areas Duhabi Bazaar along the existing roads. Outfall at Budhi River .
<b>4. Solid Waste</b>			
Solid waste disposal and separation site	Establish basic level of solid waste management, appropriate for the urbanized part of the service area;	The Duhabi area falls in the Biratnagar – Dharan corridor and there is already a master plan for provision of a comprehensive solid waste management system in this corridor. In the long run this will provide a solid waste collection and disposal system for Duhabi (a landfill/waste management center serving the entire the corridor will be constructed with Finnish support). Since the implementation of the master plan may take some years, a provision for solid waste separation is provided in this proposal.	Same site as the sludge drying beds (see above). This will be a temporary site, until the final land fill site for Biratnagar-Dharan corridor is constructed. That site is not decided yet (the new solid waste project with Finnish support is yet to be started), but will be outside Duhabi area.

## 1C – Sukhad Town Water Supply and Sanitation

Proposed Infrastructure	Function/Purpose	Description of Component	Location and Environment
<b>1. Water Supply</b>			
Intake	Augment water supply in order to provide adequate quantity of water as per the provisions of the design criteria for domestic, non domestic and institutional needs of the proposed service area;	Three deep tubewells is proposed.	At a public land at the side of EW highway at distance of 750m East of the Main Bazaar. Located on elevated ground (178 m) in a community forest, away from settlements and in 2.5 km distance from the Ghohagodhi conservation area (requires some clearing of forest; cutting of about 20 trees)
Ground and overhead storage tanks		The storage system will comprise of 750 cum capacity under ground tank and 250 cum capacity over head tank. Total capacity of 1000 cum, which is around 20% of total design daily demand of 5100 cum is sufficient for water balance.	

## 1C – Sukhad Town Water Supply and Sanitation

Proposed Infrastructure	Function/Purpose	Description of Component	Location and Environment
Treatment plant	Improve quality of supplied water so that it meets the National Drinking Water Quality Standards;	Draft aeration plus a pressure filter has been proposed for the system. Detailed investigations for the provision of an appropriate treatment plant shall be done during the detailed design.  Disinfection system has been proposed with the chlorination of the water.	(same as above)
Distribution network	Strengthen the distribution network to supply water for 24 hours at adequate pressure as provided in the design criteria;	82 km of distribution pipeline will be constructed consisting of 63 mm to 315 mm OD HDPE pipe.  All HDPE pipes of smaller diameter than 90 mm will be 6kg/cm <sup>2</sup> pressure rating and the rest of the larger pipe sizes will be in 4kg/cm <sup>2</sup> pressure rating.	Proposed service areas along existing roads. About 6 km of pipeline is proposed inside the Ghodaghodi conservation area for the areas south of the highway where there is settlement. The pipeline will go along the highway and along the existing roads. Not tree cutting is involved. Major works like pipe laying are trench digging and backfilling.
<b>2. Sanitation</b>			
Septic tank cleaning system	Establish basic level of sanitation delivery mechanism (septic tank cleaning services), appropriate for the urbanized part of the service area;	It is proposed to provide a service of septic tank cleaning and disposal. A vehicle mounted vacuum pump and sludge drying bed is proposed for this purpose. The WUA shall operate the system and also collect revenue from the cleaning services.	Sludge drying bed is proposed near the bank of Doda River. Open government land with no human settlements nearby. The effluent from the drying beds will be discharged into the Doda river. No tree cutting will be required. The area is quite close (30 m) from the Ghohagodi conservation area border, which is on the other side of the river, but the Ghohagodi lake itself is further away in 1.7 km distance.
Sludge drying bed			
Construction of toilets	Promote awareness among the rural communities within the service area to adopt basic level of sanitation practices (construction and use of latrines, health education and hygiene practices).	About 1200 subsidized household latrines will be constructed.  One public toilet is proposed to be constructed at the bus park location.	As and where required which will be decided during the detailed design stage.  Public toilet to the bus park. The area is open space belonging to the government. No tree cutting involved. Distance to the Gohagodhi conservation area is 105 m and the distance to the main lake is 1.7 km.

## 1C – Sukhad Town Water Supply and Sanitation

Proposed Infrastructure	Function/Purpose	Description of Component	Location and Environment
<b>3. Drainage</b>	Establish basic level of surface drainage provisions, appropriate for the urbanized part of the service area;	Storm water drainage covering the core area of Sukhad Bazar (1.95 ha) is proposed. A brick masonry covered drains are proposed along the roads and open drains are proposed in other places. The outfall is proposed in the Doda River just after the bridge.	The drainage is done for the most densely populated areas with clogged drains and stagnant water pondage along earthen streets. Drainage alignment will not pass through private land. No tree cutting involved.
<b>4. Solid Waste</b>	Establish basic level of solid waste management, appropriate for the urbanized part of the service area;	An area (shed) for solid waste separation is proposed.	Near the bank of the Doda River. (same location as the sludge drying beds, see above).

### C. DESCRIPTION OF THE ENVIRONMENT AND MAJOR ENVIRONMENTAL ISSUES

#### 1. Khandbari

21. Khandbari is a rural municipality and is the headquarters of Sankhuwasabha District, Koshi Zone in Eastern Region of Nepal, at an elevation of 1108 meters above mean sea level. The Municipality is the gateway to the Makalu Barun National Park and Conservation Area which attracts many trekking tourists. It is connected to Tumlingtar (457 meters above mean sea level) by an earthen green road which is not serviceable for 3 months in the rainy season. Khandbari town which sits on top of a ridge is 13 km from Tumlingtar and about 3 hours walk uphill a trail. There is an airport in Tumlingtar which is connected to Kathmandu and Biratnagar. Temperatures are elevation dependent. The area experiences a range of climates ranging from tropical (<1000m) to sub-tropical (1000 – 2000m).
22. Khandbari Bazaar is a trade centre and has a total population of 30,000 with 3,579 households. The occupations of the people are mainly agriculture (60%), business (12%), service (15%), industry (4%), wage labour (1%) and others (4%). The migrant population make 43% of the total population. with he main caste/ethnic groups are Brahmins (21%), Cheetris (10%), Newars (21%), Dalits (10%), and Rais. Others are Gurungs, Magars, Sherpas, and Tamangs. The people are mainly farmers, herders and seasonal traders.
23. There is 1 hospital, and 4 health posts in the Municipality. Khandbari Municipality, does not have a sewerage collection and treatment system in place. Most of the households in the main market area have in-house or on-premise latrines and septic tanks. There is no management of solid waste. As the Municipality is rural, there is no air and noise pollution at the moment. All wards are covered by one or another water supply system, though quantity of supplies are grossly inadequate, particularly acute in dry season, and water quality generally unsatisfactory in all the cases.
24. Khandbari is the entrance to the Makalu-Barun National Park and Conservation Area, Nepal's eighth national park, lies about 50km northwest of Khandbari Bazaar and is a protected area but is not located within the Municipality.

25. The Municipality lies in the tropical and sub-tropical zones. The tropical zone (below 1,000 m asl) is characterised by sal (*Shorea robusta*) while the sub-tropical zone (1,000 to 2,000 m asl) is dominated by broad-leaved species (Hill sal, *Schima-Castanopsis*, and mixed broadleaf forest). Chir pine (*Pinus roxburghii*) is found in the upper ridges.
26. Mammals reported to be found in Khandbari Municipality are Bagh (*Panthera tigris*), Ghoral (*Nemorhaedus goral*), Dumsi (*Hystrix indica*), Rato Badar (*Macaca mulatta*), Kalo Badar (*Macaca radiatta*), Barking Deer (*Muntiacus muntjack*) and Salak (*Manis carssicaudata*). Bird species reported are Titra (*Perdix hodgsoniae*), Kalij (*Lophura leucomelana*), and Luiche (*Gallus gallus*). Tumlingtar has a small fish market. Fish are mainly caught in the Arun River and consist of *Schizothorax plagiostomus*, *Tor puttitora*, *Glyptothorax telchitta*, and *G. Cavia*

### **Major environmental issues related Khandbari sub-project**

27. One major characteristic of the proposed Khandbari water supply system is the length of the pipeline to be constructed – the water source is 25 km away from the bazaar – crossing through mountainous non-inhabited area. This makes the scheme expensive and the construction work challenging.
28. Increased quantity of water to consumers will increase the need of proper drainage and sanitation systems including toilet construction and septic tank sludge management, which already are problems in the town, where the space is a problem.

## **2. Duhabi**

29. Duhabi is an emerging town located in the Biratnagar-Dharan industrial corridor in Eastern Region of Nepal, 13 km from Biratnagar. Duhabi has a total population of about 22,000 with 3,373 households. The occupations of the people are agriculture daily labour and trade and industry. The population growth rate is 2.7%. The migrant population make 43% of the total population. The ethnic composition consists of Muslims, Tharus, Brahmins, Baniyas and others. The main religions are Hindu, Islam, and others.
30. Topographically, the town of Duhabi lies on flat terrain in the Terai, South of the Siwaliks at an average elevation of 200m above mean sea level in Sunsari District of the Koshi Zone, Eastern Development Region. Duhabi is located midway along the Ithari-Biratnagar road. The climate of the town is tropical.
31. The flora species found are Siris (*Albizia procera*), Kadam (*Anthocephalus chinensis*), Bakaino (*Melia azederach*), Sisau (*Dalbergia sissoo*), Simal (*Bombax ceiba*) and groves of Bamboo (*Dendrocalamus hamiltonii*). To meet their daily fodder requirement the local people have raised economic plants like Padari (*Stereospermum personatum*), Amaltas (*Cassia fistula*) and Pipal (*Ficus religiosa*). Groves of Bamboo are common in the project area. Exotic species recorded along the road side and nearby canal are Masala (*Eucalyptus spp.*) and Jacaranda (*Jacaranda mimosifolia*).
32. Mammals reported to be found in Duhabi are Nyauri (*Herpestes auropunctatus*), Syal (*Canis aureus*), and Musa (*Rattus rattus*). Major bird species reported are Battai (*Turnix suscitator*), Bhangera (*Passer domesticus*), Lahanche (*Chrysocolaptes lucidus*), Bakula (*Bubulcus ibis*), Saras (*Ciconia episcopus*). Suga (*Psittacula himalayana*), Koili (*Cacomantis merulinus*), Parewa (*Columba livia*), Dhukur

(*Streptopelia chinensis*), Dangre (*Acridotheres tristis*), and Kauwa (*Corvus splendens*).

33. The Koshi Tappu Wildlife Reserve is about 30 km west of Duhabi and is a protected area.
34. About 34% of the households in Duhabi have pour flush toilets, 2% dry pit latrines and 2% have toilets connected to biogas plants. 50% of the people defecate in the open fields or along the river banks. Drains are clogged and have to be rehabilitated. There is no scientific management of solid waste. There is a hospital, a health post and 5 private clinics in Duhabi. The diseases reported are mainly typhoid, pneumonia, stomach problems and asthma.
35. In all the towns, water supply, sanitation and drainage facilities are inadequate and pose an environmental health hazard.

### **Major environmental issues related to Duhabi sub-project**

36. The major environmental concerns in Duhabi are the potential impacts of sewerage management. It is the only town out of the three, where centralised (piped) sewerage system is proposed. There is still not many good examples in proper sewerage management in Nepal and the Duhabi project should become a model for well designed, implemented and operated sanitation scheme. The impacts of water supply are smaller since some of the structures already exist. The impacts of increased waste water and household latrine construction generally may have impacts on ground water pollution, but in Duhabi the pollution shallow ground water is already polluted and the much water is already used through numerous shallow wells. An appropriate latrine design (elevated structure recommended in the densely populated Duhabi area) should be given to the users with advice on site selection.
37. Together with the efforts of the SEAM-N project, which is improving the environmental measures of the industries (e.g. their wastewater management) of the area and also carrying out sanitation programmes, the water supply and sewerage improvements brought along with the proposed sub-project, the environmental situation in Duhabi should improve significantly.

### **3. Sukhad**

38. Sukhad is an emerging town located along the east-west highway in Darakh VDC of Kailali district in the far western region of Nepal. It is around 50 km east of Attariya and 20 km west of Lamki, the two other small towns under STWSSP. Dhangadhi, the headquarters of Kailali district is 1.5 hrs drive away. The airport in Dhangadhi is serviced by regular flights from Kathmandu. Topographically, the town of Sukhad lies on flat terrain in the Terai, South of the Siwaliks at an average elevation of 172 m above mean sea level in Kailali District of the Seti Zone and has a tropical climate. The Ghodaghodi Lake (which is one of the Ramsar Wetlands) lies 1km west of the Sukhad bazaar and is the largest natural lowland lake of Nepal.
39. Sukhad consists of 3 VDCs (Darakha, Sadepani and Ramsikar Jhala) with a service area population of 19,533 (51% males and 49% females) with 3,180 households. The occupations of the people are agriculture (57%), business (12%), migratory labour (12%), daily labour (8%), education and health service (4%), other government service (2%) and others (4%). Subsistence fishing is done in Ghodaghodi Lake. The majority of the people are Brahmins and Chhetris (48%), Tharus (40%), other ethnics (2%), Dalits (7%) and others (3%).

40. Agriculture is the main stay of economy for the most part of the service area of Sukhad, but lack of irrigation facilities, inputs and traditional practices of cultivation, lack of market linkages and support limits its scope for subsistence rather than profit oriented. Attractions for moving out to urban areas and abroad for jobs were evident. The effect of remittance money on land price increase was also obvious. It was reported that a large number of people work in apple orchards in Simla, India. Apart from agriculture, people are engaged in trade and small-scale cottage industries. Except for some small-scale industries, big industries are almost non-existent in the service area.
41. The Ghodaghodi Lake, one of the Ramsar Wetlands is a protected area and is not affected by the Project activities. The lake system is a cluster of 14 lakes, which are located in a rectangular area of 5.5 km by 1.5 km, the total area under water is about 258 ha. Ghodaghodi Lake possesses rich biodiversity.
42. Sukhad is characterised by its tropical vegetation type with the occurrence of Willow (*Salix sp.*) occurring on the lake shoreline. The terrestrial vegetation is dominated by Sal (*Shorea robusta*) forest. The prominent associate species include Black plum (*Syzygium cumini*), Myrobalan (*Terminalia alata*), Silk Cotton (*Bombax ceiba*) and Haldu (*Adina cordifolia*).
43. 27 fish species have been recorded in the Ghodaghodi lake area. Ghodaghodi is renowned for the large turtles residing in this lake. A small population of Marsh Muger crocodile also reside here. About 140 species of birds, both migrant and resident, representing over 16 % of national avifauna has been reported from the Ghodaghodi lake area. Most of the area has been turned into agricultural farmlands and so wildlife has decreased to an extent.

#### **Major environmental issues related to Sukhad sub-project**

44. Sukhad does not have any existing piped water supply schemes. Presently, shallow tube wells are the only sources of water supply. Many households own shallow tube wells in their premises. Some households share community tube wells. Arsenic is the major menace of the town, as tests conducted in a large number of shallow tube-wells have recorded more than 50 ppm of arsenic. Water borne diseases like diarrhea, gastroenteritis, jaundice and typhoid are quite prevalent. The sanitation situation is poor in the entire area. Most of the houses in the main market have latrines with soak pits. But in the rural areas very few houses have toilets. Most of the population in the areas still practices open defecation on the banks of the rivers. The Rural Village Water Resources Management Project (RVWRMP) is promoting effective health and hygiene and latrine (Eco-san) promotion program in Sadepani VDC, which is urgently needed also in other rural wards of the VDCs of Sukhad area. RVWRMP are supporting sulab (double pit) latrines, many with separate urine collection system (urine diluted and used for rice and vegetable cultivation). RVWRMP is working with "local government approach" through DDCs and User Committees (UC).

The main issue in Sukhad is the arsenic content in water. One major aim of the sub-project is to provide arsenic-free water for people of Sukhad. It is a challenge to the project to really provide fully arsenic-free – and also bacteria free water for consumers

## D. ENVIRONMENTAL CRITERIA

45. Environmental criteria to be followed in the subproject selection is described in the following table:

**Table 2: Environmental criteria for the selection and development of sub-projects**

SUBPROJECT	ENVIRONMENTAL SELECTION CRITERIA
All Subprojects	<ol style="list-style-type: none"> <li>1. Comply with all requirements of relevant national laws, including the Environmental Protection Regulations, and other laws in specific sectors where appropriate;</li> <li>2. Comply with all requirements of ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003), and follow procedures set down in the Environmental Assessment and Review Framework for the program when developing new subprojects;</li> <li>3. Avoid involuntary resettlement by locating facilities, pipelines and other infrastructure elements on vacant government land where possible;</li> <li>4. Designs must be consistent with ADB Involuntary Resettlement Policies and follow the Resettlement Framework prepared for the project and agreed by the Government and ADB;</li> <li>5. Avoid any work in or near environmentally sensitive locations as defined in the national regulations, and any sites with national or international designation (eg. for ecological/biological conservation, historical or cultural importance, etc).</li> </ol>
Water Supply	<ol style="list-style-type: none"> <li>1. Utilise ground water sources at sustainable levels of abstraction only (ie. without significant reductions in the quantity or quality of the source overall);</li> <li>2. If river water is used as the source, maintain a sufficient flow for downstream users and to maintain natural ecological conditions in the river;</li> <li>3. Avoid using water that may be polluted by upstream users wherever possible;</li> <li>4. Avoid water-use conflicts by not abstracting water that is used for other purposes (eg. irrigation) where possible;</li> <li>5. If there is no alternative to the abstraction of water that is used for other purposes, negotiate agreements with other users and the appropriate regulatory agencies and establish controls to ensure that water is not abstracted in excess of agreed volumes;</li> <li>6. Locate new facilities on vacant government land if possible;</li> <li>7. Avoid locating facilities close to socially and culturally important buildings and sites, including schools, health centres, temples and shrines;</li> <li>8. Locate pipelines within the right of way of roads wherever possible, to reduce the acquisition of new land;</li> <li>9. If there is no alternative to the acquisition of private land, develop a Resettlement Plan and compensate land owners and users according to measures established in the Plan;</li> <li>10. Ensure that owners and users of any land that is relinquished for pipelines or other facilities are provided with an improved water supply as part of the scheme;</li> <li>11. Ensure that water supplied to consumers meets national drinking water standards at all times, and confirm this by regular monitoring in domestic premises.</li> <li>12. Comply with all requirements of relevant national law;</li> <li>13. Locate all new facilities (WTP, TW, etc) within a buffer from houses, shops or any other premises used by people, thus establishing a zone to reduce the effects of noise, dust and the visual appearance of the site;</li> <li>14. Locate WTP at sites where there is no risk of flooding or other hazards that might impair functioning of the plant or present a risk of damage to the plant or its environs;</li> <li>15. Consult the relevant national and/or local archaeological agencies regarding the archaeological potential of proposed sites of WTP, TW and primary mains, to ensure that these are located in areas where there is a low risk of chance finds;</li> <li>16. Avoid all usage of pipes that are manufactured from Asbestos Concrete (AC);</li> <li>17. Locate pipelines within the right of way (ROW) of other linear structures (roads, irrigation canals) as far as possible, to reduce the acquisition of new land;</li> <li>18. Ensure that improvements in the water supply system are combined with improvements in sewerage and drainage to deal with the increased discharge of domestic wastewater.</li> <li>19. Ensure proper disposal of sludge generated from water treatment so that it is safely treated and disposed of so as not to create contamination of water and land resources.</li> </ol>
Sewerage/Sanitation	<ol style="list-style-type: none"> <li>1. Ensure that no wastewater is discharged into a watercourse in which it could be a hazard to downstream users (eg a river that is used for as a source of water for</li> </ol>

SUBPROJECT	ENVIRONMENTAL SELECTION CRITERIA
	<p>domestic supply); ensure that the effluent tolerance limits are followed in wastewater discharge (standards given in Appendix);</p> <ol style="list-style-type: none"> <li>2. Ensure that the sewerage and sludge treatment is carried out in safe manner;</li> <li>3. Ensure an adequate buffer zone around treatment plant;</li> <li>4. Locate new latrines and soakage pits within house plots to avoid the acquisition of new land;</li> <li>5. Site all new latrines a sufficient distance from existing or new tube-wells or shallow wells to avoid faecal contamination of groundwater sources;</li> <li>6. Include within the scheme a program of community education to raise awareness of the importance of good sanitation and cleanliness in maintaining individual and public health.</li> <li>7. Comply with all requirements of relevant national law</li> <li>8. Locate STP at sites where there is a suitable means of disposal for the treated wastewater effluent (eg. into a natural water course or irrigation canal) or provide a means of disposal (eg. new irrigation canal) as part of the scheme;</li> <li>9. Locate STP at sites where there is no risk of flooding or other hazards that might impair functioning of the plant and present a risk of damage to the plant or its environs;</li> <li>10. Consult the relevant national and/or local archaeological agencies regarding the archaeological potential of proposed sites of STP, pumping stations and main sewers, to ensure that these are located in areas where there is a low risk of chance finds;</li> <li>11. Ensure that sewage is treated at all times to national wastewater discharge standards, and confirm this by regular monitoring of effluent from the STP;</li> <li>12. Ensure that no wastewater is discharged into a water course in which it could be a hazard to downstream users (eg. a waterway that is used for as a source of water for domestic or municipal supply);</li> <li>13. Include measures to ensure the safe disposal of sewage sludge without causing an environmental hazard, and if possible to promote its safe and beneficial use as an agricultural fertilizer;</li> <li>14. Locate sewage pipelines within the right of way (ROW) of roads wherever feasible, to reduce the acquisition of new land;</li> <li>15. Ensure that routes of sewage mains do not require the acquisition of land from individual farmers in amounts that are a significant proportion of their total land holding (10%);</li> <li>16. Ensure that communities that relinquish land needed for sewage mains or other facilities are connected to the new sewerage system as part of the scheme;</li> <li>17. Avoid locating sewage pumping stations and wet wells within safe distance of inhabited areas, sensitive sites such as hospitals, schools, temples, etc, to minimise nuisance impacts from odour, rodents, etc.</li> </ol>
Drainage	<ol style="list-style-type: none"> <li>1. Locate new drains in the Right of Way alongside existing roads as far as possible, to avoid the need to acquire new land;</li> <li>2. Ensure that new drainage systems dispose of all drainage water safely and adequately without polluting surface water or groundwater.</li> </ol>
Solid Waste Management	<ol style="list-style-type: none"> <li>1. Avoid encroachment to precious ecology/ Interference with human settlement.</li> <li>2. Avoid nuisance/hazards to surrounding areas.</li> <li>3. See that there is no Impairment of historical/cultural/ monumental areas.</li> <li>4. Select an area where decrease in land value does not affect the people.</li> <li>5. Do not select a site which is in close proximity to water bodies including contamination of ground water.</li> <li>6. Design a system with adequate capacity.</li> <li>7. See that there is adequate protection of water bodies.</li> <li>8. Proper waste disposal is very important.</li> <li>9. Soil erosion from exposed areas should be checked.</li> <li>10. Minimize dust nuisance during construction activities.</li> <li>11. Provide adequate monitoring and management.</li> <li>12. Avoid open dumping as it breeds vermin, is hazardous to health and harms tourism.</li> <li>13. Burning of waste is harmful due to noxious gases and so should be avoided.</li> <li>14. Practice the concept of reduce, recycle and reuse. Awareness creation and trainings for this are important.</li> </ol>

## E. SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

46. Potential adverse environmental impacts due to location, design, construction and operation and mitigation measures for the individual sub-projects (solid waste management, sewerage and sewage treatment, and water supply) are very similar for all the towns. Screening of environmental impacts indicates that most interventions result in positive environmental impacts and the potential negative impacts can be mitigated with reasonably easy and cheap methods..
47. The following table summarises main potential impacts and their mitigation measures for different components:

**Table 3: Summary of Potential Negative Impacts and Mitigation Measures**

SNo	Potential Adverse Impact	Mitigation Measures	Responsibility
<b>WATER SUPPLY</b>			
<b>Location and Design Impacts</b>			
1	Risk of dispute (afterwards) on site selection	Prevent any possibility of a late stage obstruction to the construction of the intake (prepare a MOU) (Khandbari)	WUSC
2	Risk of pollution of raw water supply.	Water quality testing. Safe intake sites with minimum risk of pollution shall be selected. Redesign with an alternative intake location (e.g. if arsenic occurs). Adequate source and intake protection measures shall take place. Contingency plan for arsenic areas – in case arsenic occurs during operation.	WUSC/ Municipal. EDCSC
3	Risk of inadequate yield of the aquifer; excessive abstraction could deplete aquifer and cause ground subsidence and shortage of well water.	A program for yield monitoring shall be designed. (The abstraction percentage of the dry season flow.) Redesign project with alternative water source if proposed abstraction rate exceeds sustainable yield.	EDCSC
4	Risk of pollution of water distributed to the users – due to inadequate structures of water supply system.	Properly protected intake and storage tanks shall be designed and distribution pipe located away from drains (to avoid infiltration of drain water). Treatment system (iron removal, chlorination) to be well designed. Water quality testing. Good drainage system to be designed (to avoid ponding).	EDCSC
5	The increase in the availability of water will automatically increase the consumption and use with increased production of waste water.	The drainage facilities and septage pumping facilities (from latrines) shall be improved to meet the new requirements. Wastewater treatment plant and sewerage system to be provided.	EDCSC WUSC
6	Inadequate disposal of sludge from reservoirs and treatment plant will cause nuisances to affected properties.	Disposal of sludge should be made properly; location and designs for sludge disposal sites shall be made accordingly.	EDCSC WUSC
<b>Construction Impacts</b>			
7	Disturbance to the conservation area during distribution line construction.	Obtaining clearance from the district forest office. Planting new trees.	WUCS
8	Contamination of ground water during tube well construction	Proper protection during and after drilling and disinfection of the well after drilling	Contractor
9	Nuisance due to excavated soil. Deterioration of air quality due to dust.	Safe disposal and re-use of excavated soil. Remove waste soil as soon as it is excavated. Sprinkling of water to avoid dust.	Contractor
10	Soil erosion, silt runoff and settling of street surfaces. Water could get polluted; land values degraded and be a nuisance to pedestrians. Street	Precautionary measures should be taken during construction. Proper backfilling of excavated trenches should be done and construction activities should be, as far as possible, avoided during the rainy season. Temporary diversions and sign boards for pedestrians to be	Contractor

SNo	Potential Adverse Impact	Mitigation Measures	Responsibility
	surfaces would settle, bringing about ponding of water.	provided.	
11	Workers and the public are at risk from accidents on site	Prepare and implement a site health and safety plan that includes measures to: <ul style="list-style-type: none"> <li>o Exclude the public from all construction sites</li> <li>o Ensure that workers use protective equipment</li> <li>o provide health and safety training for personnel</li> <li>o follow documented procedures for site activities</li> <li>o keep accident reports and records</li> </ul> As far as possible, the local people (who know the local conditions) should be hired.	Contractor
12	Local residents and sites of social/cultural importance may be disturbed by noise, dust and impeded access	Carry out the work as quickly as possible to minimise disturbances. Consult residents; inform them of work in advance.	Contractor
13	People may be inconvenienced and their health may be at risk if water supply system is shut down during construction.	Plan work carefully to keep shutdown to minimum. Provide alternative water to affected residents.	Contractor Municipal.
<b>O&amp;M Impacts</b>			
14	Risk of contaminated water in the distribution system	Regular O&M for chlorinators. Regular water quality monitoring of water of the distribution system. Immediate action in case of water quality problems. Training and operational supervision of system staff.	WUSC DWSSO
15	Unmanaged use of chlorine can cause health hazards to the workers and public.	The storage, in-plant handling and dosages must be addressed and procedures set up and guidelines developed for the handling of chlorine (both bleaching powder and gaseous chlorine) and first aid measures to be introduced for emergencies	WUSC
16	Public health may not improve without improved practices	Conduct campaigns to raise awareness of health and environmental sanitation issues	DWSS WUSC
<b>SANITATION</b>			
<b>Location and Design Impacts (sewer lines, sludge drying beds)</b>			
17	River bank erosion and flooding which if river bank is not properly protected.	Proper river bank protection	EDCSC
18	Risk of environmental pollution / pollution of domestic water due to interruption chambers and sewer pipes	Sewers and chambers need to be properly located (not next to water supply pipes or tube wells) and designed to avoid any possibility of pollution.	EDCSC
19	Risk of pollution of river waters by effluents	Quality of effluent and river water need to be regularly monitored.	WUSC
20	Risk of pollution of ground water or river water due to seepage from the sludge drying bed and the reed bed	Sludge drying bed and reed bed needs to be properly located and designed (reed bed) to avoid any possibility of pollution. Ground water pollution can be avoided by providing a clay liner or a geomembrane liner at the bed.	EDCSC
21	Public health hazard due to the location	Sludge drying bed and reed beds need to be properly located and designed to avoid public health hazards	WUSC/ Municipal. EDCSC
22	Rejection of the location by people	Mutual agreement between the municipality and the community / land owners concerned	WUSC/ Municipal.
23	Resettlement impacts due to acquisition of land for the treatment plant	Provision of due compensation and assistance to the affected people (2 households) as detailed in the Short Resettlement Plan (Duhabi only)	Contractor/ DWSS/ WUSC
<b>Construction Impacts (sewer lines, sludge drying beds)</b>			
24	Negative impacts to the river due to river bank protection works	Proper care during river bank protection works.	Contractor
25	Workers and the public are at risk from accidents on site	Prepare and implement a site health and safety plan	Contractor
26	Nuisance due to excavated soil	Safe disposal/re-use of excavated soil	Contractor

SNo	Potential Adverse Impact	Mitigation Measures	Responsibility
27	Deterioration of air quality due to dust	Remove waste soil as soon as it is excavated. Sprinkling of water to avoid dust.	Contractor
<b>O&amp;M Impacts (sewer lines, sludge drying beds)</b>			
28	Communicable disease hazards to workers – septic tank cleaners, sewer system maintenance workers and treatment plant workers.	Prepare and implement a health and safety plan.	WUSC
29	Nuisance to neighboring areas due to transportation of sludge/septage	Proper (covered) transportation systems to be provided.	WUSC/ Municipal.
30	Nuisance to neighboring areas due to odour, insects and rodents	Regular O&M (and lime spreading on the bed) of the sludge beds. Providing buffer zone (<100 m) around the area. Training and operational supervision of system staff.	WUSC/ Municipal.  DWSO
31	Flooding of the bed during rainy season and bed clogging.	Proper Drainage and regular maintenance.	WUSC
<b>Construction and O&amp;M Impacts – Drainage</b>			
32	Same as 8-11, 15 above		
33	Blockage of drainage by people throwing waste	Public awareness building needed	WUSC/ Municipal.
<b>Impacts of O&amp;M of a Public Toilet and Household Latrines</b>			
34	Pollution of shallow ground water used for domestic purposes	The latrines/soakpits need to be kept away from tubewells.	WUSC Households WUSC
35	Nuisance due to odour, insects and rodents	Proper maintenance and regular emptying.	Households
36	Public health may not improve without proper practices	Conduct campaigns to raise awareness of health and environmental sanitation issues	DWSS WUSC
<b>SOLID WASTE MANAGEMENT</b>			
<b>Location and Design Impacts</b>			
37	Risk of pollution of river water due to waste disposal	Waste sorting and disposal site needs to be properly located and designed to avoid any possibility of pollution.	WUSC/ Municipal.  EDCSC
38	Public health hazard due to the location	Waste sorting and disposal site needs to be properly located and designed to avoid public health hazard	WUSC/ Municipal.  EDCSC
<b>Construction Impacts</b>			
39	Nuisance due to excavated soil	Safe disposal/re-use of excavated soil	Contractor
40	Deterioration of air quality due to dust	Sprinkling of water.	Contractor
<b>O&amp;M Impacts</b>			
41	Nuisance to neighboring areas due to transportation of waste as well as odour, insects and rodents at the waste disposal site	Proper transportation systems to be provided. Proper O&M of the waste disposal site.	WUSC/ Municipal.

## 1. Water Supply

48. There are two types of sources for new schemes in the Project (surface water for Khandbari and groundwater for Sukhad and Duhabi).

There will be no major adverse environmental impacts foreseen due to the location of project location in the 3 towns since:

- the only stream source is located far away from human settlements and so pollution of raw water supply from upstream waste discharge is not foreseen
  - as arsenic is a problem in shallow tubewells of Sukhad, it is suggested that test drilling of deep boreholes be done as soon as possible and monitoring of arsenic done before the best site is selected without the presence of arsenic.
  - water use conflicts and the question of resettlement will not occur since the sources and land around the sources belong to the Government and there is plenty of groundwater in Sukhad and Duhabi and surface water source (Induwa Khola) for Khandbari
  - there are no historical/cultural monuments around the intakes and along the routes of the transmission mains
49. If the following points are considered during the design phase, adverse environmental impacts could be mitigated:
50. The intakes should be well protected with good drainage (for surface sources) and distribution pipes should be kept away from drains such that drain water could not infiltrate into the distribution system, thereby contaminating the drinking water. The town should also have a good drainage system to avoid ponding. Sedimentation and filtration (for surface water sources) and chlorination should be done so that an appropriate residual chlorine is available. A monitoring plan should be prepared for regular monitoring of the distribution system for leaks and the availability of residual chlorine.
51. The increase in the availability of water would automatically increase consumption and will produce a corresponding increase in volume of sewage. Wastewater treatment plants with sewerage systems should be designed which allow for the increased volumes of sewage.
52. Disposal of sludge from reservoirs and treatment plants should be made properly on low lands. The sludge disposal areas should be identified during design. Water treatment facilities should be provided so that the water is potable.
53. Provision should be made for security fencing and good drainage and security personnel at the intake, treatment and reservoir sites during the final design. Trees should be planted around the compound to curtail any noise generated.
54. The storage, in-plant handling (occupational health hazards) and dosages must be addressed during the design phase and procedures set up and guidelines developed for the handling of chlorine (both bleaching powder and gaseous chlorine) and first aid measures to be taken in case of emergencies.
55. The laying of transmission lines in trenches during construction will not lead to the loss of precious ecology, loss of environmental aesthetics and soil erosion plus damage to water quality and land values as the transmission line will be underground. Grass that will be destroyed during construction in laying the mains will rapidly grow back.

56. Provision should be made for regular O&M for chlorinators and regular monitoring of residual chlorine in the distribution system.
57. Minor, temporary adverse impacts to the environment can occur but mitigation measures outlined below would minimise the impacts:
58. Precautionary measures should be taken during construction to avoid collapses during excavation of reservoirs and deep well boring; and settlement. All excavated material should be safely disposed. Proper backfilling of excavated trenches should be done and construction activities should, if possible, be minimised during the rainy season.
59. The safety measures for workers, especially during the construction of the reservoir should be considered. The contractor should be responsible for all safety measures, especially eye protection, chemical handling, provision of hard hats and safety boots and the provision of sanitation in the camps. As far as possible, local labour should be hired. The site in-charge should properly monitor the construction activities of the contractor to ensure that the mitigation measures specified in the contract documents are being followed.
60. Minor adverse impacts could occur during the regular operation of the system but can be avoided by adequate training and operational supervision of system staff.

## **2. Sewerage and Sewage Treatment**

61. The systems proposed are the Reed Bed Treatment System (Root Zone Treatment) that utilises a settlement chamber and horizontal and vertical reed beds consisting of sand, gravel and reeds
62. If properly designed, there should be no major adverse impacts on the environment. On contrary, the improvements would uplift the health of the people. According to experience in Nepal, the constructed wetland system using reed beds are aesthetically pleasant with no water stagnation for mosquito breeding, requiring no electricity and mechanical equipment and which has BOD<sub>5</sub>, total suspended solid removal efficiencies of more than 97% and removal rates of total coliforms, E-coli and Streptococcus of more than 99%.
63. During design the following aspects must be looked into, carefully planned, designed and monitored:
  - adequate capacity of the system
  - adequate protection of groundwater using an impermeable lining
  - proper sludge disposal

Land acquisition will be necessary in some towns. GON and ADB guidelines in compensation of the land acquired would be followed.

64. During construction of the sewerage/drainage system, care should be taken to minimise soil erosion and disturbance to traffic. The works of the contractors should also be carefully monitored as to whether they are following the environmental mitigation measures specified in the contract documents (workers' safety, sanitation at camps and the use of the local people as far as possible and the avoidance of child labour).

65. There will be no significant impact during the construction of the Reed Bed Treatment System since the construction technology is very simple (using gravity flow, gravel, sand and reeds).
66. The mitigation measures to be adopted for minimising the adverse impacts would be to design an efficient impermeable lining system on the bottom of the reed beds to avoid groundwater pollution and to ensure proper operation and management training.
67. The positive impacts brought about by sewage collection and treatment are:
- the town would become neater and cleaner
  - the rivers become less polluted
  - tourists would be attracted, thereby generating revenue
  - health hazards are minimised

### **3. Solid Waste Management**

68. Organic wastes for all the 3 towns are disposed off in individual backyards and does not pose a problem at the moment except for paper and plastic bags which litter the streets and clog the drains.

## **F. POTENTIAL ENHANCEMENT MEASURES**

69. It should be stressed here that effective community participation is of utmost importance during the planning, design, construction and post-construction stages of the sub-projects. Raising awareness among the communities regarding the objectives and benefits of the proposed sub-projects is very important. The towns should work closely with community organisations throughout the different stages for the success of the sub-project.

### **a. Water Supply**

70. Training and operational supervision of system staff is very crucial in effectively running the system. The design and implementation of institutional mechanisms by the town for cost recovery should be an integral part of the sub-projects.

### **b. Sewerage and Sewage Treatment**

71. Sufficient human resources should be trained in maintaining the sewerage system and treatment plant. The efficiency of the treatment plant should be well recorded by regularly monitoring the influent and effluent characteristics of the wastewater.

### **c. Solid Waste Management**

72. Awareness regarding health and sanitation among the community should be imparted on a wide scale to all the people including policy makers and politicians. With the assistance of NGOs and CBOs, the following steps could be taken:
- community mobilisation and people's participation in health and sanitation programmes;
  - training and awareness programmes in health and sanitation, minimisation of waste at the source, reuse, recycling, and separation at the source etc.; and
  - technical training to the municipality staff on solid waste management and landfill site management

## G. INSTITUTIONAL REQUIREMENT AND ENVIRONMENTAL MONITORING PROGRAM

### 1. Environmental Procedures and Institutions

73. The Government has in recent years felt the importance of Environmental Impact Assessment and made it mandatory for including environmental aspects in development programmes. Separate environmental guidelines for some sectors have been formulated and implemented. The Ministry of Population and Environment (MOPE) was established in 1996 (now renamed as the Ministry of Environment, Science and Technology, MOEST) and the Environment Protection Act, 1997 and the Environmental Protection Regulations, 1997 (2054) have been promulgated and two amendments to the regulations has been made so far
74. Besides MOEST, which is in charge of environmental control and management for all sectoral agencies, the Ministry of Physical Planning and Works (MPPW) has the overall responsibility for environmental monitoring of all water supply projects. In case of an EIA, it has to be finally approved by MOEST. In case of an Initial Environmental Examination (IEE), the final approval lies with MPPW.
75. In addition to the IEE/EIA requirements stated in environmental rules and mandatory public notices and land agreement, some clearances are requested in the forest regulations, if the project “will result clear cutting of national forest” or “falls within protected area”.
76. The following table defines the roles of different organisations and groups in environmental monitoring:

**Table 4: Roles and Responsibilities in Environmental Monitoring**

S.N.	Organization	Roles and Responsibilities	Timing
1	Ministry of Physical Planning & Works (MPPW)	Monitoring of project design, construction and operation activities according to the approved IEE report.	At least three times in a year during construction and once a year during the operation phase
2	Department of Water Supply and Sewerage (DWSS)	Ensure that all environmental measures to be adopted during different phases of project implementation and operation have been fully adhered to as per the approved IEE report. Water quality monitoring during the survey and design phase.	Assist Ministry on monitoring activities. Provide technical assistance through its division/sub-division offices to WUSC in project operation.
3	PMO	Ensure that mitigation measures as mentioned in the IEE report are incorporated in the final engineering design of the project. Acquire permits and approval for project construction Ensure all environmental measures prescribed by approved IEE have been fully adopted. Ensure that the roles and responsibilities to be borne by the consultants, NGO, WUSC, and the contractor are incorporated in the respective agreements.	During the final engineering design. Before construction During construction During construction and operation phase. Prior to construction

S.N.	Organization	Roles and Responsibilities	Timing
		Assist WUSC on source registration and transfer of land ownership	
4	Town Development Fund (TDF)	<p>During the funding decision, ensure all necessary environmental screening and assessments have been carried out.</p> <p>Ensure that cost incurring items of environmental mitigation measures and monitoring activities are considered in financial analysis during project design and reflected in the water tariff.</p>	During project design, construction and operation phase.
5	Water Users and Sanitation Committee (WUSC)	<p>Ensure all environmental measures to be adopted in the project design, construction and operation phase have been incorporated.</p> <p>Source registration and transfer of land ownership in the name of WUSC.</p> <p>Make users and the public aware on environmental aspects that are required to be complied by them. Activities such as toilet construction with septic tank and soak away facilities, control on haphazard dumping of solid wastes and adoption of recycling, reuse and composting waste management techniques.</p> <p>Arrange and acquire land for the system</p> <p>Monitor water quality during operational phase and maintain records of water quality data.</p> <p>Ensure implementation of environmental measures to be adopted for source protection, intake structures, transmission, treatment and distribution in order to maintain the water quality and for overall sustainability of the project.</p> <p>Monitor that environmental mitigation measures are implemented at all stages of project implementation.</p> <p>Ensure that public participation is maximized as per the project objectives.</p>	<p>During engineering design phase.</p> <p>Prior to construction</p> <p>During construction and operation phase.</p> <p>Prior to construction phase.</p> <p>During operation phase.</p> <p>During operation phase.</p> <p>During construction phase.</p> <p>Prior to and during operation phase</p>
6	Engineering Design and Construction Supervision Consultants (EDCSC)	<p>Ensure that all mitigation measures are incorporated in the final design of the system .</p> <p>Ensure environmental prescriptions are being met by construction contractor during construction of different system components (EDCSC shall have an environmental specialist to do the environmental monitoring.</p>	<p>During final design</p> <p>During construction phase.</p>
		<p>Assist NGO in environmentally-related public awareness programmes.</p> <p>Incorporate environmental measures that are proposed to be carried out through construction contractor in the contract document and cost estimates.</p> <p>Supervision of environmentally-related activities carried out by the construction contractor that are included in the contract documents.</p>	<p>During construction phase.</p> <p>During final design.</p> <p>During construction phase.</p>
7	Non-governmental Organization (NGO)	<p>Incorporate environmental assessment study recommendations in a public awareness campaign, training, and in public sanitation activities in the town.</p> <p>Raise awareness in the community on environmental implications of haphazard dumping of wastes, sullage water, and</p>	<p>Prior to and during construction phase.</p> <p>Prior to and during construction phase.</p>

S.N.	Organization	Roles and Responsibilities	Timing
		benefits of toilet construction, hygiene practices on public health. Encourage appropriate toilet construction (with septic tank and soak away facilities) at household basis and raise awareness among the public of their proper use and maintenance	Prior to and during construction phase.
8	Construction Contractor (CC)	Implement mitigation measures as specified in the contract	Daily during construction phase.
9	Beneficiary Community	Ensure that hazard dumping of all wastes is controlled. Implement activities to support maintenance of water quality of the system. Ensure public participation through WUSC during project construction and operation. Assist other stakeholders, including WUSC in environmental management and related activities.	During construction and operation. During operation phase. During construction and operation phase. During construction and operation phase.
10	Ministry of Health and Population (MOHP)	Keep records on water and hygiene related diseases. Water quality surveillance.	At all times

## 2. Environmental Monitoring Plan

77. The Environmental Monitoring Program should be designed in such a way that the contractor should be monitored during the construction phase (to see if the work is being done according to the contract documents where mitigation measures were specified. It also requires that regular monitoring of the actual environmental impacts during project operations over the years following project completion. These impacts that have been monitored should be compared with the anticipated impacts at the time of the preparation of the project.

78. The summary environmental monitoring plan for the three subprojects is presented in the following table:

**Table 5: Summary Environmental Monitoring Plan**

(ES = Environmental Specialist of EDCSC)

(numbering follows the numbers of the impact table 3)

SNo	Mitigation Measure	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
<b>Water Supply</b>					
<b>Location and Design Impacts</b>					
1	Prevent any possibility of a late stage obstruction to the construction of the intake (Khandbari)	WUSC	MOU must be signed between Khandbari municipality and Num VDC before decision on the sub-project implementation is taken	One before final design and construction.	WUSC together with municipality
2	Safe intake sites with minimum risk of pollution shall be selected.	WUSC/ Municipal.	Water quality monitoring reports of the source/intake water	Once before final design and construction	DWSS / ES
	Adequate source and intake protection measures shall take place.	EDCSC		Once a year (every dry season)	WUSC
3	A program for yield monitoring shall be designed.	EDCSC	Monitoring reports the source discharge.	Once before final design and construction	DWSS
	Redesign project with		Survey report of water		

SNo	Mitigation Measure	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
	alternative water source if proposed abstraction rate exceeds sustainable yield.		demand downstream in dry season.  Design reports; DWSS record	Once a year (every dry season)  As needed	WUSC  DWSS / ES
4	To avoid pollution of water distributed, properly protected intake and storage tanks shall be designed and distribution pipe located away from drains (to avoid infiltration of drain water). Treatment systems (iron removal, chlorination) to be well designed. Good drainage system to be designed (to avoid ponding).	EDCSC	Water quality monitoring reports of the water in the network as per the Nepalese drinking water standards (2006)	Once before final design and construction  Monthly	DWSS / ES (initially)  WUSC (during operation)
5	Drainage facilities and septage pumping facilities (from latrines) shall be designed to meet the new requirements.	EDCSC WUSC	Design reports	One check	ES
6	Sludge disposal from reservoirs should be designed properly and appropriate locations identified.	EDCSC WUSC/ Municipal.	Design reports	One check	ES
<b>Construction Impacts – tube well/stream intake, storage tanks, treatment plant and distribution lines</b>					
7	Obtaining clearance from the district forest office for cutting trees at intake area and constructing pipelines in conservation area  Planting new trees.	WUCS	Reports, Observations	As needed	ES
8	Proper protection during and after drilling and disinfection of the well after drilling	Contractor	CC records	As needed	ES
9	Safe disposal and re-use of excavated soil. Remove waste soil as soon as it is excavated Sprinkling of water to avoid dust.	Contractor	Site observation	Monthly Weekly	ES WUSC
10	Precautionary measures to avoid soil erosion and silt runoff should be taken during construction. Proper backfilling of excavated trenches should be done and construction activities should be, as far as possible, avoided during the rainy season. Temporary diversions and sign boards for pedestrians to be provided.	Contractor	Site observations; CC records	Monthly Weekly	ES WUSC
11	Prepare and implement a site health and safety plan that includes measures to: o Exclude the public from all	Contractor	CC records; worker interviews	Monthly Weekly	ES WUSC

SNo	Mitigation Measure	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
	<ul style="list-style-type: none"> <li>o construction sites</li> <li>o Ensure that workers use protective equipment</li> <li>o provide health and safety training for personnel</li> <li>o follow documented procedures for site activities</li> <li>o keep accident reports and records</li> </ul> <p>As far as possible, the local people (who know the local conditions) should be hired.</p>				
12	Carry out the work as quickly as possible to minimise disturbances. Consult residents; inform them of work in advance.	Contractor	Observations; CC records; resident interviews	Monthly Weekly	ES WUSC
13	Plan work carefully to keep shutdown of water system to minimum. Provide alternative water to affected residents.	Contractor Municipal.	Observations; CC records; resident interviews	Monthly Weekly	ES WUSC
<b>O&amp;M Impacts</b>					
14	Regular O&M for chlorinators. Regular water quality monitoring of water of distribution system. Immediate action in case of water quality problems. Training and operational supervision of system staff.	WUSC/ Municip.  DWSO	O&M manual.  See No 3 above.  O&M records	As needed	DWSS
15	The storage, in-plant handling and dosages must be addressed and procedures set up and guidelines developed for the handling of chlorine (both bleaching powder and gaseous chlorine) and first aid measures to be introduced for emergencies	WUSC	O&M manual.  O&M records	As needed	DWSS
16	Conduct campaigns to raise awareness of health and environmental sanitation issues	DWSS WUSC	Records, resident interviews/surveys	As needed	DWSS
<b>Sanitation</b>					
<b>Location and Design Impacts – Sewer lines and Sludge drying bed</b>					
17	Proper river bank protection	EDCSC	Design reports	One check	ES
18	Sewers and chambers need to be properly located (not next to water supply pipes or tube wells) and designed to avoid any possibility of pollution.	EDCSC	Design reports	One check	ES
19	Quality of effluent and river water need to be regularly monitored.	EDCSC	Effluent and river water quality monitoring reports	Monthly	DWSS WUSC
20	Sludge drying bed and reed beds need to be properly located and designed (reed bed) to avoid any possibility of pollution.	WUSC/ Municipal.  EDCSC	Design reports	One check	ES

SNo	Mitigation Measure	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
	Ground water pollution can be avoided by providing a clay liner or a geomembrane liner at the bed.				
21	Sludge drying bed and reed beds need to be properly located and designed (reed bed) to avoid public health hazards	WUSC/ Municipal.  EDCSC	Design reports	One check	ES
22	Mutual agreement between the municipality and the community/ land owners concerned about the sludge drying bed location	WUSC/ Municipal.	Resident interviews	As needed	ES
23	Provision of due compensation and assistance to the affected people (2 households) in Duhabi	Contractor/ DWSS/ WUCS	Records, interviews, observations	As presented in the RP	DWSS
<b>Construction Impacts – Sewer lines and Sludge drying bed</b>					
24	Proper care during river bank protection works.	Contractor	Site observations; river water quality reports	As needed	ES
25	Prepare and implement a site health and safety plan	Contractor	CC records; worker interviews	Monthly Weekly	ES WUSC
26	Safe disposal/re-use of excavated soil	Contractor	Site observations, CC records	Monthly	ES
27	Sprinkling of water to avoid dust.	Contractor	Site observations	Monthly	ES
<b>O&amp;M Impacts – Sewer lines and Sludge drying/reed beds</b>					
28	Prepare and implement a health and safety plan that includes measures to:	WUSC	Records; worker interviews	Monthly Weekly	ES WUSC
29	Proper (covered) transportation systems to be provided.	WUSC/ Municipal.	Site observations; Records	As needed	DWSS
30	Regular O&M (including lime spreading on the bed) of the sludge beds. Providing buffer zone (<100 m) around the area. Training and operational supervision of system staff.	WUSC/ Municipal.  DWSO	O&M manual; site observations	As needed	DWSS
31	Proper Drainage and regular maintenance.	WUSC	O&M manual; site observations	As needed	DWSS
<b>Construction and O&amp;M Impacts – Drainage</b>					
32	Same as 8-11, 15 above				
33	Public awareness building needed	WUSC/ Municipal.	Records, resident interviews/surveys	As needed	DWSS
<b>Impacts of O&amp;M of a Public Toilet and Household Latrines</b>					
34	The latrines/soakpits need to be kept away from tubewells.	WUSC Households	Latrine construction manuals/instructions ;	As needed	DWSS

SNo	Mitigation Measure	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
			site observations		
35	Proper maintenance and regular emptying.	WUSC Households	O&M manual; site observations	As needed	DWSS
36	Conduct campaigns to raise awareness of health and environmental sanitation issues	DWSS WUSC	Records, resident interviews/surveys	As needed	DWSS
<b>Solid Waste Management</b>					
<b>Location and Design Impacts</b>					
37	Waste sorting and disposal site needs to be properly located and designed to avoid any possibility of pollution.	WUSC/ Municipal.  EDCSC	Design records	One check	ES
38	Waste sorting and disposal site needs to be properly located and designed to avoid public health hazard	WUSC/ Municipal.  EDCSC	Design records	One check	ES
<b>Construction Impacts</b>					
39	Safe disposal/re-use of excavated soil	Contractor	Site observations, CC records	Monthly	ES
40	Sprinkling of water.	Contractor	Site observations, CC records	Monthly	ES
<b>O&amp;M Impacts</b>					
41	Proper transportation systems to be provided. Proper O&M of the waste disposal site.	WUSC/ Municipal.	O&M manual; site observations	As needed	DWSS
<b>Long-term surveys</b>					
42	Survey of water quality in the intake and distribution system	WUSC	Water quality reports	Once in 6 months	WUSC / DWSS
43	Survey of effluent quality and river water quality	WUSC	Effluent and river water quality reports	Once in 6 months	WUSC / DWSS
44	Public health survey / Incidence of water and hygiene related diseases	DWSS, MOHP	Hospital records; Resident survey	Once a year	EDCSC

79. Most of the costs related to the mitigation and monitoring activities mentioned in the above table are included in other costs e.g. of detailed design consultants and not detailed here. Further funds are needed mainly for developing the capacity and facilities of the WUSC for environmental monitoring as well as environmental awareness raising as well as:

- (i) Laboratory analysis especially before and during construction; later on most of the analyses are done by DWSS regional laboratory as part of their routine work (once the laboratories are functioning) and partly done by WUSC (once they have the capacity).
- (ii) Water testing kits (to test water quality, especially residual chlorine in distribution lines and household taps)
- (iii) Setting up of microbiological laboratory in the reservoir area will need an incubator, an autoclave, and glassware and an annual cost for chemicals
- (iv) Training of WUSC staff in water quality testing
- (v) Environmental Awareness campaigns
- (vi) Water quality and health impact surveys once a year

80. The environmental monitoring costs presented in the table below are also included in the overall summary project cost estimates presented in the Volume 3 of the final report of this PPTA:

**Table 8: Environmental Monitoring Plan costs for each Subproject (NPR)**

No.	Item	Cost (NPR)
<b>A. Equipment</b>		
i.	Dip meter for ground water level monitoring (for Sukhad and Duhabi)	50,000
ii.	Water testing kits (residual chlorine, other)	20,000
iii.	Laboratory equipment (incubator, autoclave, glassware)	60,000
<b>B. Monitoring during Construction Periods</b>		
i.	Water quality testing	50,000
	a. Monsoon, Post Monsoon, Dry season (chemical and bacteriological)	
	b. Handover	
<b>C. Monitoring during Operation Period (Annual Cost)</b>		
i.	Laboratory chemicals	5,000
ii.	Water Quality and Health Impact surveys	90,000
<b>D. Training</b>		20,000
i.	Training for WUSC staff	
	a. water quality testing	
	b. chlorine handling and management	
<b>D. Other</b>		
i.	Environmental Awareness Campaign	30,000

81. Specific thing for Sukhad is to get test drilling and arsenic tests from intake ground water carried out the soonest and for Khandbari to get bacteria testing of the intake water as soon as possible. In Duhabi it will be very important to follow up the quality of the Budhi river. Those actions will require some extra funding and should be done before final designs are finalised.

### 3. Implementation

#### a. During Design Phase

82. EMP monitoring activities should be a regular part of the activities. During the design phase, the PMO (Project Management Office) and DEDCSC should see that mitigation measures are included in the design and the contract documents in compliance with the Environmental Protection Act and Regulations.
83. It is recommended that the design consultant also help in developing a Water Safety Plan which is the most effective means of securing drinking water safety, thereby improving the sanitary conditions. The Water Safety Plan includes assessment of the system (existing system and assessment of the existing hazards and risks); monitoring (identify control measures from risks and monitoring mechanisms; and management and communication (training, upgrading and improvement, R&D; actions to be taken during disasters; and creating a database on water quality and consumers' reactions). The design consultant should see that all materials relevant to

the project (flow diagrams, pipeline routes, reservoirs, possible hazards and risks, water quality etc.) be documented and be kept at the WUSC office and the staff trained to understand the system.

#### **b. During Construction Phase**

84. It is assumed at this stage that during the construction phase, the parties involved will be DEDCSC, WUSC and CC. DEDCSC and WUSC should see that the works carried out by the Contractor are according to the contract documents and that mitigation measures are carried out accordingly.

#### **c. During Post-construction**

85. Inputs from the Central/Regional levels are required. The three parties that will be active during the post-construction or project duration phase are STWSSP, the Regional Directorate, and WUSC. STWSSP and WUSC should regularly monitor (and remedy) the system for leakage, water quality (residual chlorine, chemical and microbiological analyses), pump maintenance and disease outbreaks etc. and prepare a monthly report that should be sent to DWSS.
86. One part of the building of institutional capacity of WUSCs will be training in environmental issues and water quality monitoring. The WUSCs will be equipped with a portable water testing kits.

### **H. PUBLIC CONSULTATION**

87. Series of public consultations and focus group meetings were held during the PPTA and the IEEs and the different individuals and community groups, community leaders, representatives local administration and other projects active in the areas. Main concerns of the people are reported in the IEE and social assessment reports or the three towns. A household survey was also carried out in each town.
88. Generally people wanted the schemes. Especially people living in the bazaar areas of the towns eager to get the projects almost in any cost. In some rural parts the poorest people concerned about costs and sometimes about big schemes in general. In areas where the water quality and environmental problems were most severe, the willingness to have the scheme was also bigger. For example in Sukhad, where arsenic is a problem in shallow ground water, people are eagerly waiting for the water supply scheme and in Duhabi, where the waste water/sewage management is the biggest problem, people really look for solutions for that.
89. In order to enhance ownership and sustainability, it is suggested that the design consultants will keep in close contact (fortnightly meetings in the town) with the WUSC members, WSSDO and the local engineers for suggestions and advice during the design phase so that the designs are appropriate, use indigenous construction materials and local

### **I. CONCLUSIONS AND RECOMMENDATIONS**

90. It is expected that the planned water supply and sanitation projects of Khandbari, Duhabi and Sukhad will have mainly positive environmental impacts and only small adverse environmental impacts, which can be easily and cheaply mitigated through

adequate mitigation measures and regular monitoring during the design, construction and operation phases.

91. The proposed project will significant improvement in personal, household and community hygiene practices, and environmental sanitation thereby increasing the quality of life and community health.
92. The potential harmful impacts of the proposed project can be mitigated and full scale EIA is not required.
93. Each of the three towns have their characteristics and different requirements before the work can commence:
  - In Khandbari, to secure the use of the water source at the two proposed intake sites, a MOU shall be signed between Num VDC and the Khandbari Municipality before the work is commenced. Also, permission for forest clearing (cutting about 20 trees) around the intake areas shall be obtained from the Department of Forestry.
  - In Duhabi some resettlement compensation is needed for 20 people of 2 households that are affected by the sludge drying bed construction. The short resettlement plan has been prepared to the subproject to mitigate adverse impacts.
  - For Sukhad, a specific issue will be the obtain permission for the location of some subproject components within (6 km pipeline) or close (sludge bed and solid waste unit) to the Ghodaghodi conservation area shall be obtained from the Ministry of Environment, Science and Technology. These components are small by scale and will not have adverse impacts on the conservation area and thus preparation of full EIA is not required.
94. It is proposed that all the information presented in the IEE reports will be utilised during the next phases of the work and the monitoring plan utilised for environmental monitoring of the sub-project.
95. Since the IEE carried out in parallel to the feasibility study will not satisfy the legal requirements of Nepal, the IEE process will have to be continued detailed design phase, completing the due process laid out in the EPA and EPR. The present IEE report will then be updated if need arises. The remaining stages are:
  - (i) DWSS prepares the TOR for the remaining IEE phase
  - (ii) The design consultant conducts the study
  - (iii) DWSS publishes public 15-day notice in national paper and local offices and receives public comments
  - (iv) Design consultant finalises the IEE report (at the same time with detailed design)
  - (v) DWSS submits both the detailed design and the IEE reports to MPPW for approval
  - (vi) The final IEE report will be sent to ADB for concurrence