ADB

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Draft Final Report

Discussion Note # 4

Municipal Urban Infrastructure – Part A : Attariya

September 2015

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Municipal Urban Infrastructure – Part A : Attariya

Contents

1 Water Supply

1.1 Principle Sources of Drinking Water

1. The easily accessible source of water for drinking and other purposes is groundwater either from shallow or deep aquifers in Attariya. No surface drinking water projects exist in the municipality. Many individual households rely on shallow tube wells and hand pumps all of which can easily be susceptible to contamination.

1.2 Current Water Supply Schemes

1.2.1 Scheme Coverage

2. There is no NWSC branch office in this municipality. There is one piped water supply system in Attariya operated by a Water Supply User Committees (WSUC) which uses deep wells for supplying water. Of 13,745 households in Attariya, only 16% has access to the piped water supply system. Attariya WSUC provides safe drinking water to 2,000 consumers of Ward No.4 and part of Ward Nos. 3 & 13, while a small water supply scheme provides a drinking water to 200 consumers of Ward No.2 at Malakheti. Details of Attariya WSUC are given in **Table 1-1**.

Table 1-1: Attariya Municipality Water Supply Scheme

S.N.	Description	Attariya Water Supply Project
1	Project Area	Core city area (Ward no.-4, 3 & 13
2	Number of beneficiaries	Total = 2000 HHs
3	Type of source/borehole information	Groundwater, deep boring with depth more than 100 m, No. of borehole = 4
4	Water storage Tank (No., capacity)	RCC OHT = 600 cu m
5	Production (mld)	5 to 7 mld
6	Distribution (mld)	5 mld
7	Losses	~33% (losses due to joint leakage and dysfunction of meters
8	Distribution line	50 km
9	Water Treatment System	Chlorination (use of standard dosage of bleaching powder)
10	Water quality issues	High hardness but not severe
11	Pipe materials and size	GI & HDPE
12	Supply hour per day	11 hrs (Dry season; 18 hrs/day (wet season)
13	Tariff per month	Minimum charge NRs. 110 (up to 7kl); > 9-14 kl= +NRs. 20; 15-21 unit = +NRs. 25; > 22 unit = +NRs. 30

Source: Attarriya WSUC

1.2.2 Funding Water Supply Operations and Management

3. Attariya water supply system is managed and operated by a WSUC. It also provided a share of the construction cost along with central government and development partners.

1.3 Proposed Interventions

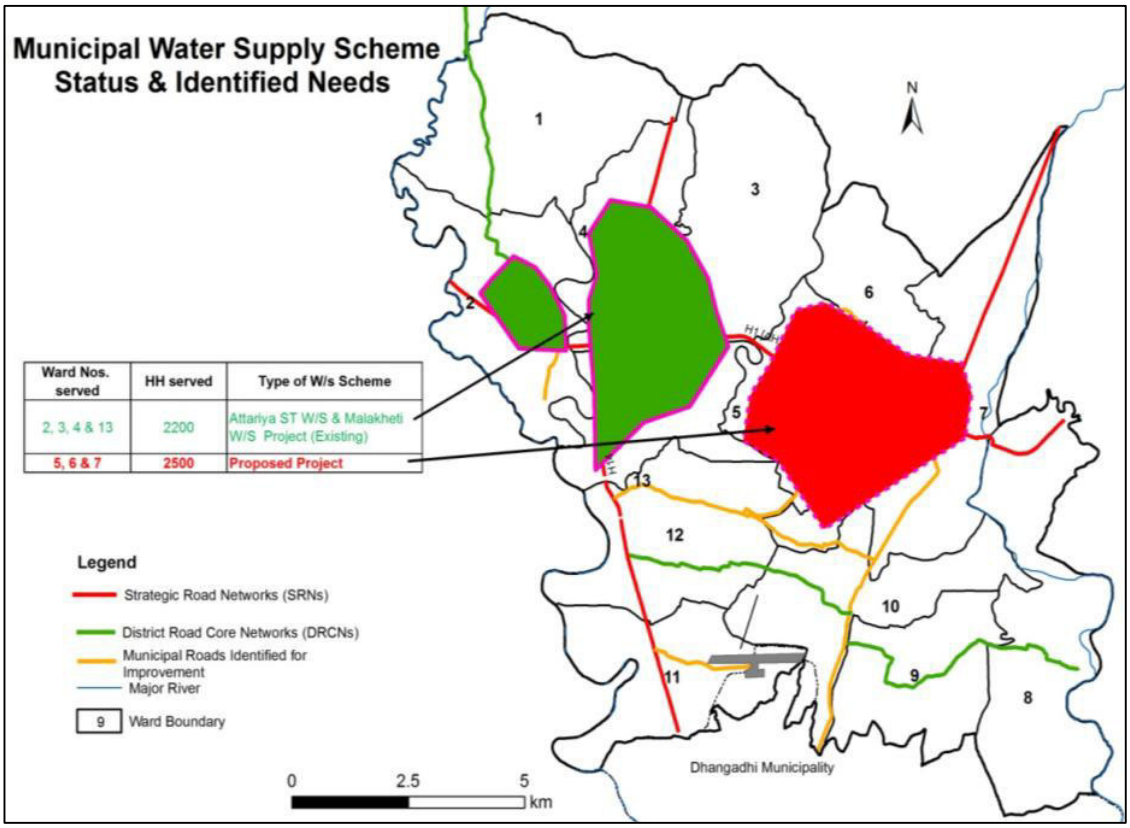
4. As only 16% of households obtain piped water from the existing supply system, the proposal is for an expansion of the water supply network similar to the existing scheme, but avoiding aquifers with high hardness.

5. Based on the regional economic vision and conceptual urban plan, field assessment and consultation with municipal officials and other stakeholders, a water supply scheme is

proposed to serve high population density areas of Wards 5, 6 and 7. This proposal has been approved by stakeholder's consultation and municipal authority. The indicative coverage area and beneficiaries of existing and identified water supply scheme are shown in **Figure 1-1**. For O&M a similar arrangement to the present with a WSUC could be used.

6. Based on a design population of 20,000 and other similar water supply schemes, the total estimated cost including boring, pump house, pump sets, transformers, reservoirs/OHT, water treatment and distribution would be about NRs.400 million ($ 4.00 million).

Figure 1-1: Municipal Water Supply Scheme- Status and Identified Needs



2 Sanitation and Wastewater

2.1 Toilet Facilities

2.1.1 Domestic Toilet Facilities

7. The sanitation situation in Attariya is not satisfactory. Many houses concentrated at the intersection and along the main two highways have private toilets but 39% HHs still have no toilet facilities especially in the rural areas (CBS, 2011).

2.1.2 Public and Community Toilet Facilities

8. Although there is a public toilet in Attariya Municipality, which was constructed under Attariya Small Town Water Supply Project, open defecation in open spaces is very common, especially by temporary migrant people who are involved in collecting reusable and recyclable materials from solid waste.

2.2 Current Wastewater Collection and Treatment

2.2.1 Municipal Sanitation Systems

9. There is no sewerage system in Attariya Municipality. The majority of premises in the core city areas of the municipality have septic tanks with soak pits. There is no municipal service offered for removing septage (septic sludge) from the septic tanks when they get full. Usually, households will contact a local contractor who will arrange to empty the tank manually. The collected septage is usually sold to local farmers untreated as fertilizer.

10. Frequently, the septic tanks are not properly maintained or are under capacity resulting in the septage flowing over into the soak pit. In many cases the soak pit does not work, or not constructed, and the septic tank overflows into the surface water road drainage network resulting in a public health risk.

2.2.2 Wastewater Treatment and Disposal Options

11. A detail study is required to determine the appropriate solution to improve the poor wastewater management within the municipality, as follows:

a) Identify areas where wastewater disposal or septic tanks are problematic, i.e. where septic tanks are overflowing onto land or into surface water drainage: e.g. due to i) high water table; ii) impervious ground; iii) no space for soak-pit; iv) septic tank needs frequent desludging; v) no space for septic tank; vi) prolonged seasonal flooding.

b) Identify areas in relation to phased urban development appropriate for on-site and off-site sewage treatment and disposal including staged development options: i.e. i) on-site septic tanks with soak-pit; ii) septic tanks with overflow to small bore sewerage; and iii) conventional sewerage.

12. A phased wastewater management plan should then be prepared in relation to proposed urban development plans by following the approach of using appropriate technology by utilizing and upgrading the existing system as described above, taking into consideration appropriate methods for faecal sludge management (FSM).

2.2.3 Preliminary Wastewater Improvement Cost

13. Until a comprehensive study is undertaken on wastewater management in the municipality it is only possible to provide indicative costs for comparison.

On-site wastewater improvements

14. The main investment cost is the provision of a septage treatment plant. An anaerobic digestion technology is suggested, which generates biogas as well as produces hygienic quality compost fertilizer. In case of septage sludge treatment, anaerobic digestion technology also seems to be better socially and environmentally acceptable option than aerobic composting technology based on past experiences from the municipalities of Nepal. Even if biogas is not utilized fully, at least a quality compost product would be produced. This could be included as part of a bio-degradable component for solid waste management improvements.

15. Other costs would include the provision of sludge vacuum tankers, although these could be provided by the private sector, as is present practice, and the service paid for by the property owner. Operation of the septage treatment plant could be assisted by the sale of compost fertilizer and utilization of biogas.

Component Description		**Cost Estimate (NRs. million)**
Septage Treatment Plant (30 cu.m per day)		25
Equipment:- Two gulley bowzers (4,000 l)		18
	Total NRs.	43
	US $	0.43 million
Operations and Maintenance (Annual)		NRs.1.5 million

Small bore sewerage

16. The main population is concentrated around the main E-W / N-S highway junction, but the majority (~70%) is scattered over the remaining rural area. The following costs therefore only refer to the more urban character areas.

17. In areas where the on-site soak pits do not function properly, small bore sewerage could be installed to prevent the septic tanks overflowing into the open drainage network. Only the settled wastewater which sometimes includes some light floating matter is discharged into the small bore sewer. Consequently, the sewer pipes can be laid at shallow gradients. However, some pumping might be necessary depending on the ground contours to lift the settled wastewater up to a simple treatment plant before discharge to the river. The following indicative costs are dependant of extent of system.

Component Description		**Cost Estimate (NRs. million)**
Small bore sewerage		35
Septic tank effluent pumping station		10
Septic tank effluent treatment plant (lagoon / reed beds)		20
Other miscellaneous costs (land / buildings / power)		70
	Total NRs.	135
	US $	1.35 million
Operations and Maintenance (Annual)		NRs.5 million

18. In the main commercial high or density residential areas the most economical solution might be to install small bore sewerage to collect septic tank overflows connected to a small decentralized effluent treatment (DEWATS) plant. Similar arrangements could be provided in new planned residential settlements or commercial areas.

19. With this option, on-site wastewater management improvements as described above would still be required since property septic tanks would still be utilized.

Conventional sewerage and sewage treatment

20. Conventional sewerage will only operate if there is a regular 24-hour water supply system that provides an excess of 100 lcpd (litres-per-person-per-day) plus a guaranteed power supply and skilled maintenance staff. In addition, as a guide, a population density of over 100 persons/hectare is required for the system to be economical. As a newly created municipality, with no present capacity to operate such a type of sewerage and sewage treatment system in this municipality, this option is not considered further.

3 Solid Waste Management

3.1 Existing Solid Waste Management Practices

3.1.1 Waste Type and Generation

21. In general, municipal solid waste (MSW) covers the waste generated from households, commercial and institutional establishments. Medical and industrial wastes containing hazardous and infectious waste should be treated separately.

22. As a newly created municipality, any field study on solid waste generation and composition has not been carried out. For preliminary planning purposes, the waste generation can be adopted from other towns located at similar geographical, socioeconomic and demographic situation.

23. The average per-capita municipal solid waste (MSW) generation for Attariya has been considered as 0.32 kg/day, which is equal to average national MSW generation rate. This average is a little bit higher as compared to the individual towns with population less than 100,000. However, this high value is justifiable for Attariya, as two major highways are passing through it and a significant amount of additional waste would be generated by floating people from nearby villages/districts and travelers along these highways. With this per-capita waste generation rates and projected population for the year 2015, the total MSW generation from Attariya Municipality is estimated to be 26 tonnes/day.

3.1.2 Solid Waste Composition

24. The waste obtained from the household, commercial and institutional waste is categorized into seven main types, as listed below.

Organic waste	Rubber and Leather
Plastics	Metals
Paper and paper products	Glass
Textile	Others (inert materials etc.)

25. The characteristics of MSW collected from any area depends on various factors such as consumer patterns, food habits, cultural traditions of inhabitants, lifestyles, climate, and economic status. Composition of MSW is changing with increasing use of packaging

materials and plastics. Based on average composition of similar towns and average national composition pattern, bio-degradable component is expected to be dominant in this municipality. However, in the core city area with many commercial activities, use of plastics has increased which was observed during field visits while in institutional establishments like schools, colleges and offices, paper products is one the dominant component.

3.1.3 Street Cleaning and Primary Collection

26. No municipal household or commercial waste collection system exists in the municipality. However, waste is collected in the commercial area along the main highways arranged by a business people committee, which also collects waste from houses in the core area by charging a solid waste collection fee.

3.1.4 Waste Transportation

27. The collected waste mainly from the market area along the highway is transported by tractor-trailer and dumped in open spaces, forest land or on the river bank.

3.1.5 Organic Waste Composting

28. There is no municipal level organic composting in Municipality. However in rural areas, organic wastes generated by households are fed to domestic animals such as cow, pig, etc or the decomposable waste is used for composting in a pit at domestic level. But such practices are not applied in the core urban area where the majority of compostable waste comes to the street for final disposal.

3.1.6 Recycling

29. There is no formal recycling practice in the Municipality. However, it is observed that reusable and recyclable fraction of MSW is collected and sorted by waste pickers in the municipality. These reusable and recyclable materials are then transported to India.

3.1.7 Treatment of Hazardous (Industrial / Clinical) Waste

30. The Municipality does not have any separate system for collecting and managing medical waste or any other type of special waste separately. The municipality has a few health institutes including hospitals like Geta Eye Hospital. Hospital waste, industrial waste, construction and demolition waste are mixed and discarded with municipal waste. Hospital wastes (general waste + hazardous wastes) are mixed to MSW stream despite the government regulation, requiring every hospital to properly dispose of waste (The Solid Waste Management Act 2011, states: “the responsibility for processing and management of hazardous waste, medical waste, chemical waste…under the prescribed standards shall rest with the person or institution that has generated the solid waste”). Almost all health institutions, including hospitals, do not have proper facilities to dispose of hospital waste that is hazardous and presents a risk to municipal waste workers, the general public health and the environment.

3.1.8 Final Disposal

31. Attariya Municipality does not have any proper environmental-friendly and socially accepted final disposal site. Although the municipality does not have any SWM system, the collected waste by business people in city area is disposed of in open spaces and on the sides of rivers.

3.2 SWM Institutions

3.2.1 Municipal Authorities

32. No municipal SWM system is in place as it is newly created municipality.

3.2.2 Private Enterprises

33. A committee formed by business people in core city area is involved in waste collection in municipality. However, no other private enterprises are officially involved in waste treatment and resource recovery activities.

3.2.3 NGO and CBO Initiatives and Informal Sector

34. Although no formal connection with municipality, the informal sector like waste pickers are involved in collecting and selling reusable and recyclable fractions of MSW.

3.3 Future Waste Generation

35. From experience, it is noted that there is a relation between the unit waste generation (kg/capita/year) and socio-economic situation in an area. The gross domestic product (GDP) is considered the most important indicator for the forecast of future waste generation, although there is no empirical relationship between GDP and the waste generation rate. Therefore, a constant unit waste generation rate over the planning period is considered. Using the projected population over the period of 2011 to 2041 and the average per capita MSW generation (kg/capita/day) given in earlier section, total daily waste generation in Attariya Municipality has been projected as shown as **Table 3-1**.

Table 3-1: Projected daily MSW generation in Attariya Municipality over 2012-2041

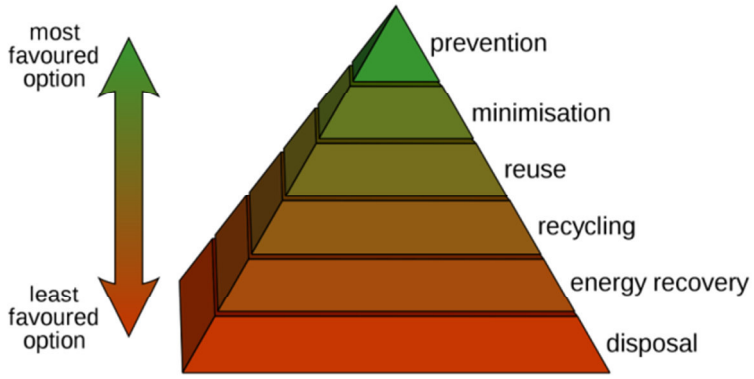
Description	Planning Period						
	2012	2016	2021	2026	2031	2036	2041
Population	72521	83318	95722	112673	132626	159926	192846
MSW (tonne/d)	23	27	31	36	42	51	62

3.4 Proposed SWM Improvement and Costs

3.4.1 SWM Development Strategy

36. As a newly created municipality, the focus is on waste prevention (preventing the generation and minimizing the waste that is being generated) as a first priority. If the first option is neither sufficient nor practical or technically or sociologically feasible, then other solutions have to be considered. The strategic approach applied for strategy development is based on the internationally recognized waste hierarchy which is shown in **Figure 3-1**. The sophisticated waste collection and transportation system and large scale advanced treatment for solid waste would not be acceptable for such a new municipality.

Figure 3-1: Waste Hierarchical Structure



37. The following are the guiding principles:

- Zero waste target: This shall be the ultimate target to be achieved through practicing the concept of reduce, reuse and recycle and extended producers' liability in a concerted manner. All the existing open dump sites should be closed immediately and no more than 25% of waste should be sent to landfill by 2030.
- Provisions of Solid Waste Management Act 2011 (2068), which has fundamentally incorporated the basic principles mentioned above.
- Ensuring Peoples' Participation – Municipality alone cannot meet the challenge of keeping the city clean. Peoples' attitude and behaviour to solid waste needs to be changed through information, education and communication (IEC) programs throughout the municipality. Everyone should minimize the waste produced, including plastic waste, and facilitate sustainable waste management.
- Participation of communities, private sector enterprises and other stakeholders would be effective modalities of SWM in a new municipality.
- SWM services to be made self-sustaining. - service shall be made self sustaining within a period of 5 years by resource recovery and cost recovery approach such as levy of user fee charges and revenue from reusable and recyclable products.
- Maintaining strong communication and dissemination of information

38. In addition to MSW processing, septage (septic tank sludge) could also be treated and included in the composting stream. Thus, Integrated Waste Processing Sites (IWPS) could be developed. These do not necessarily have to be in one location. Small IWPS could be scattered around the municipality depending of waste sources plus environmental and social acceptability. In case of septage sludge treatment, an anaerobic digestion technology would be socially and environmentally acceptable option which generates biogas as well as producing quality hygienic compost fertilizer. Only the by-products (reject waste) would be transferred to the final disposal site.

39. It is expected that the fully functional requirements for integrated solid waste management (ISWM) system may be difficult to implement in the project municipalities during the first phase of the project. Gradual improvement in waste management with associated public awareness and education is suggested for the planned transformation from open dumps to sanitary landfills.

40. The final disposal site (engineered landfill site/ sanitary landfill site) as required will only accept rejects from the compost plant and residue from recycling plant / facilities and other unwanted wastes.

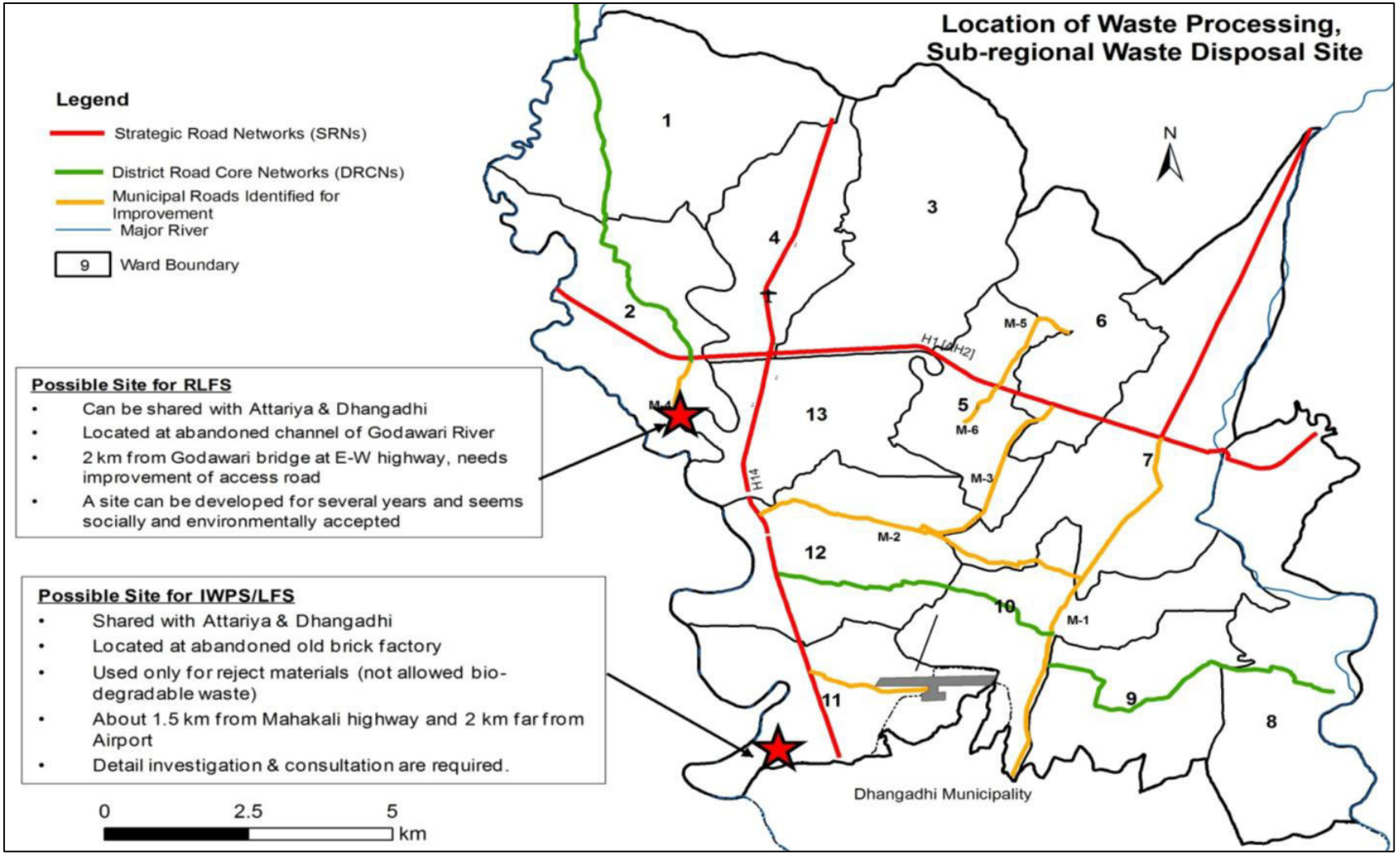
Based on field visits and stakeholder's consultation meetings, there is also the opportunity for a sub-regional shared landfill site to be developed by both Dhangadhi and Attariya municipalities. The identified site is an abandoned channel of Godawari river located in Attariya Municipality, less than 2km south from East-West highway. The site can be developed as a sub-regional shared landfill site for several years but the access road needs to be upgraded, including a few hundred meters new road development. It is also noted that, the technical and financial viability for shared landfill site for two or more regional municipalities as well as institutional / financial mechanism for operational arrangement have to be carefully examined during detail design. The possible sites for waste sorting/ transfer station and landfill site are shown in **Figure 3-2**.

3.4.2 Indicative SWM Component Packages and Cost

41. Costs are based on development of Integrated SWM system for Nepalgunj (IUDP-1) with a similar geographical condition and waste generation pattern. If there is opportunity for a sub-regional shared landfill site to be developed by both Dhangadhi and Attariya municipalities, cost would be increased; but shared. The principal should be on developing sub-regional landfill sites for reject materials only.

Component Description	**Cost Estimate (NRs. million)**
Engineering Landfill Site / Sanitary Landfill Site development	140
Other development works (internal service road, weighbridge, power supply, water supply, administrative building etc)	40
Compost Plant for bio-degradable fraction (5 ton/day windrow composting plant) with digested components of septage treatment plant	20
Equipments/Vehicles/Tools	40
Recycling facilities	2
Community level small scale treatment plant/3R promotion activities	20
Miscellaneous costs including land, access road etc.	100
Total NRs.	362
US $	US$ 3.62 million
Annual operation cost (first year cost)	NRs. 15 million

Figure 3-2: Location of Proposed Waste Processing and Sub-regional Landfill site



4 Urban Roads and Surface Water Drainage

4.1 Municipal Roads

4.1.1 Current Status of Municipal Road

42. There is a network of about 285km roads (black topped, gravel and earthen road) including the East-West Highway (H-01) and Mahakali Highway (H-14) in Attariya Municipality. Beside these sections of highway less than 10km municipal road are reported as blacktopped status. All the remaining urban roads are either gravel or earthen surfaced. As reported in the Municipal Transport Master Plan (MTMP) Draft Report of Attariya which is being developed under technical assistance of MoFALD, the total length and status of road is given in **Table 4-1**[1,2] and **Figure 4-1**. **Table 4-1** shows the total road networks including municipal road and their surface type.

Table 4-1: Length and status of roads in Attariya Municipality

Road Type	Total Length (km)	Blacktop (km)	Gravel (km)	Earthen (km)
Strategic Road Networks (SRNs)	35	28	7	0
District Road Core Networks (DRCNs)	20	0	20	0
Municipal Road (MR)	230	10	198	22
Total	**285**	**38**	**225**	**22**

4.1.2 Road Network Responsibility

43. Strategic road networks (SRNs) such as highways and feeder roads are maintained by the Department of Roads (DoR). The District Development Committee (DDC) maintains all the local rural roads while the municipality is a responsible for the maintenance of all the urban municipal roads. However, as per new DTMP guidelines, DDC will be mainly responsible to plan, upgrade and construct District Road Core Networks (DRCNs)[3].

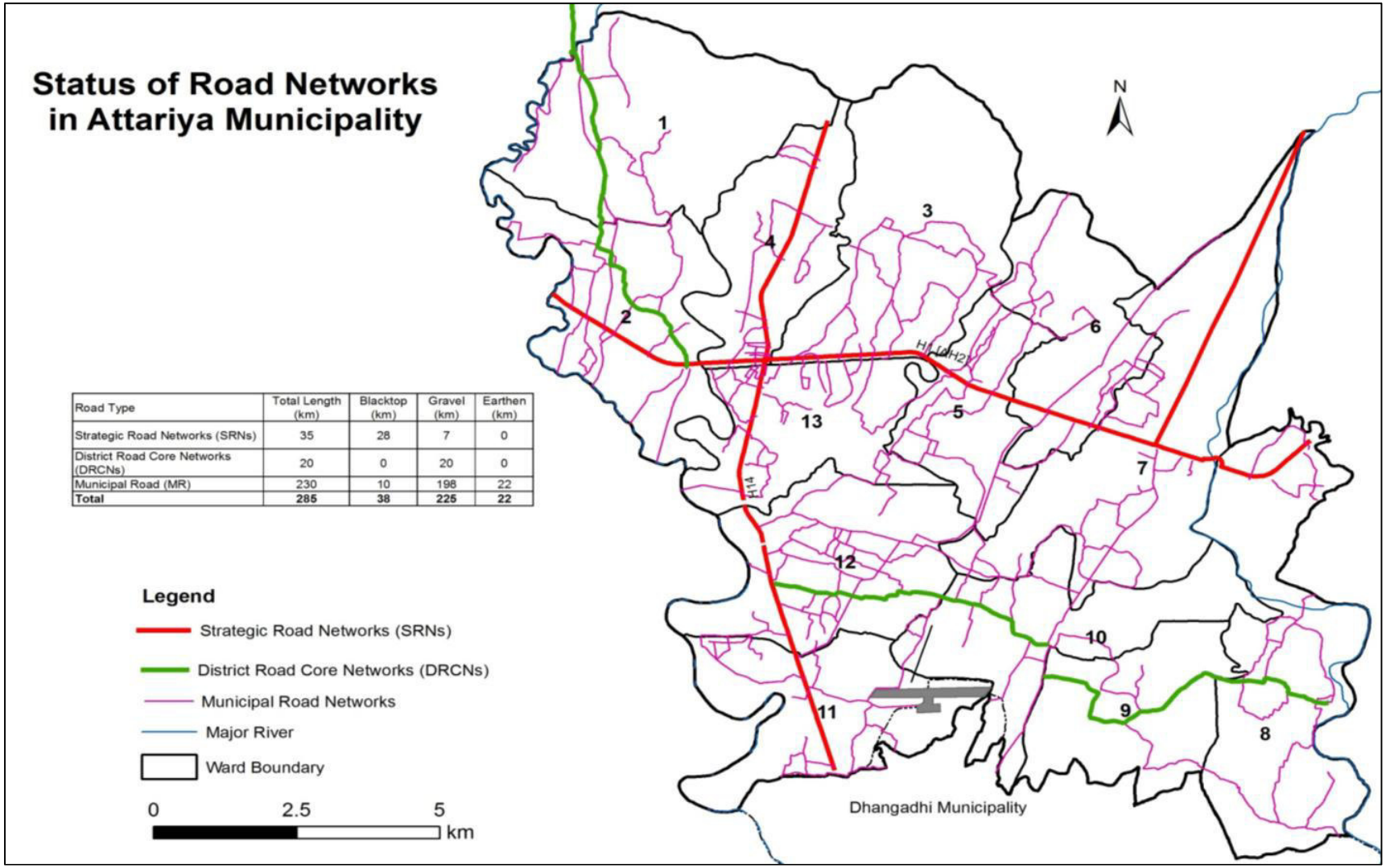
4.1.3 Issues and Problems

44. The section of Mahakali Highway and East-West Highway passes through the center of the municipality. As part of regional development, this should be upgraded into a 4-lane highway with service roads and proper drainage and facilities for travellers.

45. As a newly created municipality, road access is a major problem. Although about 250km of roads has been reported in the municipality, most of the municipal roads are not accessible throughout the year in large parts of the municipality. Further, due to lack of proper drainage, drainage crossing structures and regular maintenance, most of the sections of the road network are in a poor state and need to be improved or upgraded. To provide access to all settlements within the municipal boundary, construction of several new roads and/or upgrading existing earthen tracks is essential. This should be part of future urban development planning and investment based on the regional economic and urban development vision.

[1] Municipal Transport Master Plan (MTMP) of Attariya Municipality, Draft Report
[2] District Transport Master Plan (DTMP) of Kailali, DTO/DDC Kailali
[3] DTMP Guidelines 2012, http://rtiswap.gov.np/dtmp_guideline.php

Figure 4-1: Status of Road Networks in Attariya Municipality



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Municipal Road (MR)	230	10	198	22
Total	**285**	**38**	**225**	**22**

4.2 Drainage Adequacy and Key Issues

4.2.1 Municipal Surface Water Drainage

46. There is no proper surface water drainage in the municipality except a few kilometers of highway drainage including a recently constructed 400m of surface drainage along Mahakali highway by DUDBC. The sizes of the existing drains are not adequate and lack regular maintenance.

4.2.2 Fluvial (river) Flooding

47. During stakeholder consultation meetings, river flooding was reported to be common during the monsoon. Two major rivers called Khutiya in east and Mohana in west often flood during the monsoon each year. Other rivers like Godawari which also pass through the municipality also occasionally cause flooding. River bank erosion, especially in Khutiya, Mohana and other small rivers is very problematic in Attariya. Many hectors of land are washed way every year during the monsoon.

4.3 Proposed Roads and Drainage Improvements

4.3.1 Road Improvements under Implementation and Planned

48. Three DRCNs pass through Attariya Municipality are initially being planned to upgrade as rural road standard by DTO/DDC Kailali under a World Bank funded project. However, among three mentioned roads, one strategic road (Hasanpur-Syaule Road) which is equally important for both Attariya and Dhangadhi municipality is proposed to be transferred to IUDP2 to be developed to a higher urban road standard due to pressure from both Attariya and Dhangadhi Municipalities.

49. A few roads are also being constructed and improved by Attariya Municipality, however, these roads are not constructed as per minimum urban road standard and drainage.

4.3.2 Sustainable Drainage Systems

50. Surface water drainage systems (SuDS) objectives should be used in the project to minimize the impacts from development on the quantity and quality of the runoff, and maximize amenity and biodiversity opportunities. Their characteristics include natural features such as ponds, wetlands and shallow ditches called swales. Hard engineered elements are often used in high density, commercial and industrial developments. These include permeable paving, canals, treatment channels, attenuation storage and soakaways.

51. SuDS should be developed in-line with the ideals of sustainable development. The system should be designed to both manage the environmental risks resulting from urban runoff and to contribute wherever possible to environmental enhancement[4].

52. The primary purpose of SuDS is to mimic the natural drainage of the area prior to development. This is achieved by capturing rainfall, allowing as much as possible to evaporate or soak into the ground close to where it fell, and then conveying the remainder to the nearest watercourse. Along the way any pollutants, such as metals and hydrocarbons from roads and car parks, are reduced. Water entering a local watercourse is therefore

[4] For detail information on visit http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

cleaner. If the water is kept on the surface as much as possible the SuDS can provide valuable amenity asset for local residents and create new habitats for wildlife.

53. SuDS will become increasingly important to control surface water as rainfall increases because of climate change. It can also provide other benefits in developments such as passive cooling, which will again help mitigate any increase in temperatures due to climate change.

4.3.3 Components and Benefits

54. Road networks have been identified considering future urban growth pattern, regional and strategic importance and feedback from stakeholder's consultation. Other than the main highways, less than 10km roads are blacktopped. None have been constructed to required urban road standards (two lane road 7.5m to 10m pavement width) with storm water drainage and footpaths on each side of road. Thus, almost all municipal roads within Attariya need to be improved and upgraded. Based on series of stakeholder's consultation and field assessment, a total of nearly 21km high importance municipal road was identified as priority for upgrading and improvement under the project.

55. The Hasanpur-Syaule Road is strategically important to both Attariya and Dhangadhi Municipalities. The road starts near Dhangadhi municipal offices and joins the East-West Highway at Syaule Bazar in Attariya, close to the proposed new Attariya municipal offices.

56. It is also regionally important because it will be an alternative route between Dhangadhi- and Attariya parallel to the Mahakali Highway and could provide alternative access to Dhangadhi regional airport located between the two roads, see **Figure 4-2.**

57. A right of way (ROW) of 20 meters throughout the section has been already acquired. Of a total 10km length, 7.5 km lies in Attariya Municipality, while 2.5km is in Dhangadhi Municipality. This road not only functions as alternative of Dhangadhi-Attariya highway but also directs future urban development along the North-South corridor in both Attariya and Dhangadhi Municipalities.

58. The names of roads identified for possible intervention within this IUDP2 are listed in **Table 4-2** and shown in **Figure 4-3** along with the SRN and other municipal road networks.

Table 4-2: Roads Identified for Possible Intervention

S.N.	Name of Road	Length (km)	Proposed Road Width (m)	Cost per km (NRs. in million)
1	Hasanpur-Syaule Bazar Road (Attariya Part)	7.5	30	40
2	H14 (Geta Hospital) - Jonapur Road	6	16	40
3	H01 - Haraiya Chaurahi Road	3.5	16	40
4	H01 (Malakheti) - Proposed landfill site Road	2	16	20
5	H01 (Lalpur) - Chaumala (Part of Rong Road) Road	1	16	40
6	H01 (Lalpur) - Geta Hospital Road	1	16	40

4.3.4 Roads and Drainage Improvement Cost Summary

59. For the estimation of roads and drainage improvement cost, the unit rate was adopted from Department of Road. The recent cost for improvement/upgrading of urban road with varying width under Kathmandu Valley road improvement/extension program is

about NRs.9 million to NRs.38 million with an average NR.23.5 million/lane/km. The cost for just widening, upgrading and providing drainage and minimum footpath is around NRs.40 million/km. Based on this reference rate, the estimated cost for the improvement of nearly 20km road in Attariya Municipality would be almost NRs.800 million ($8.00 million).

Figure 4-2: Dhangadhi, Hasanpur to Attariya Syaule Road

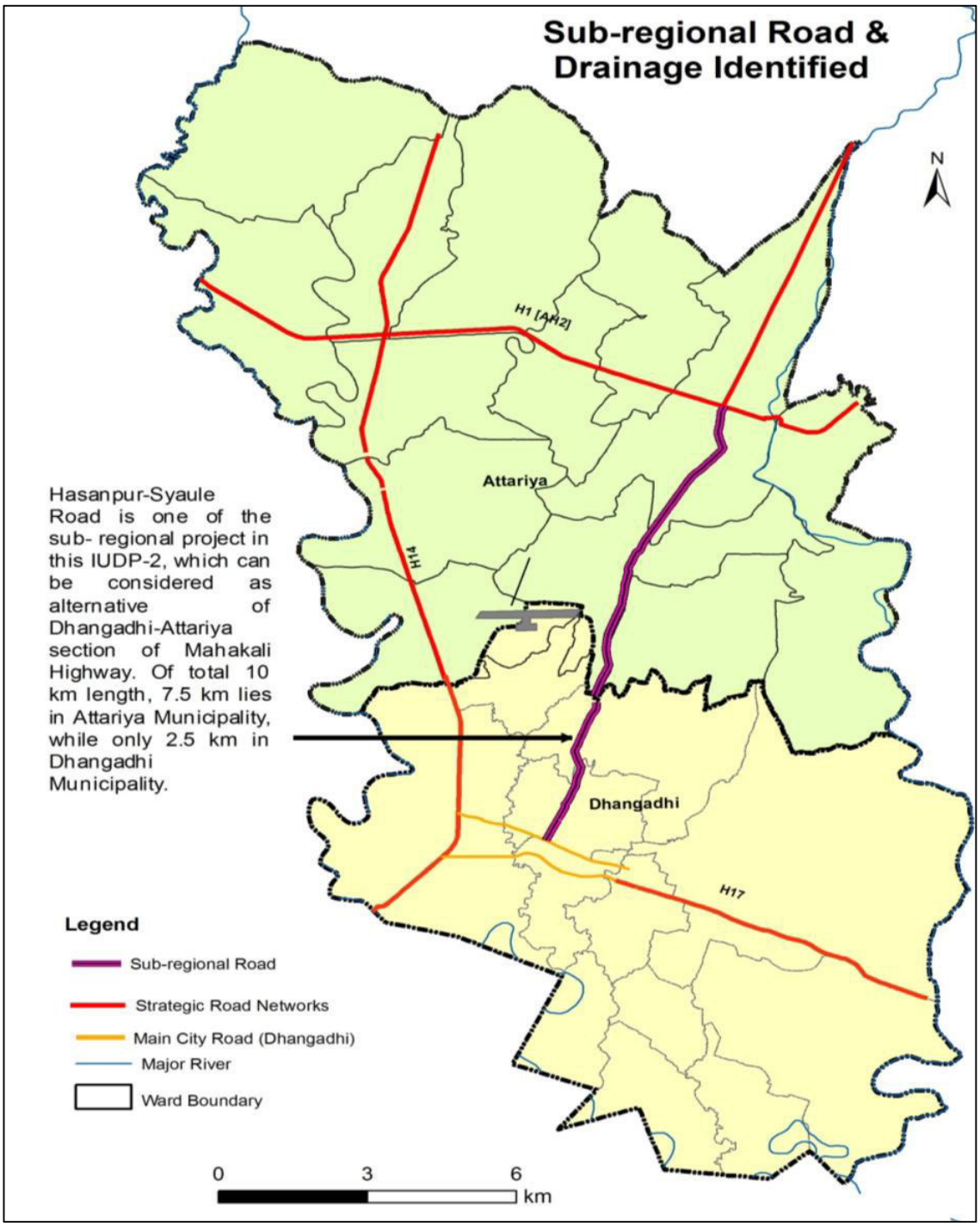
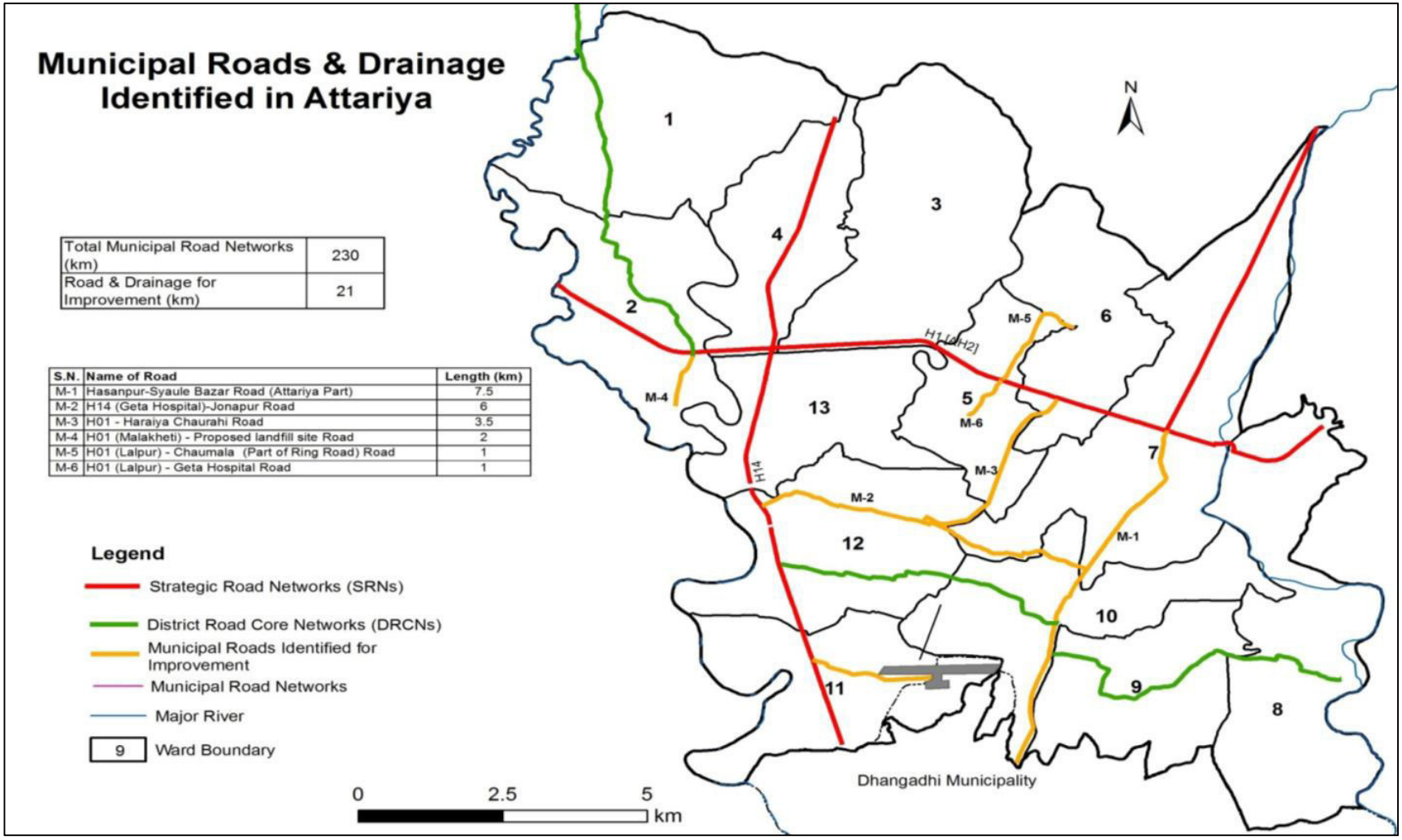


Figure 4-3: Municipal Roads and Drainage Improvements



5 Urban Development Facilities

5.1 Municipal Building

60. As a newly created municipality, the municipality does not have its own municipal building. Although a minimum budget (NRs. 10 million) has been allocated from MoFALD for a municipal building, the required land is yet to be identified. A number of alternative sites have been identified. **Table 5-1** provides a brief description of each site, which are indicated in **Figure 5-1**. The cost of building should be shared with municipal fund (grant from MoFALD). The cost estimate for the municipal building is Rs.70 million ($0.7 million).

Table 5-1: Brief Description of Alternative Sites for the Municipal Building

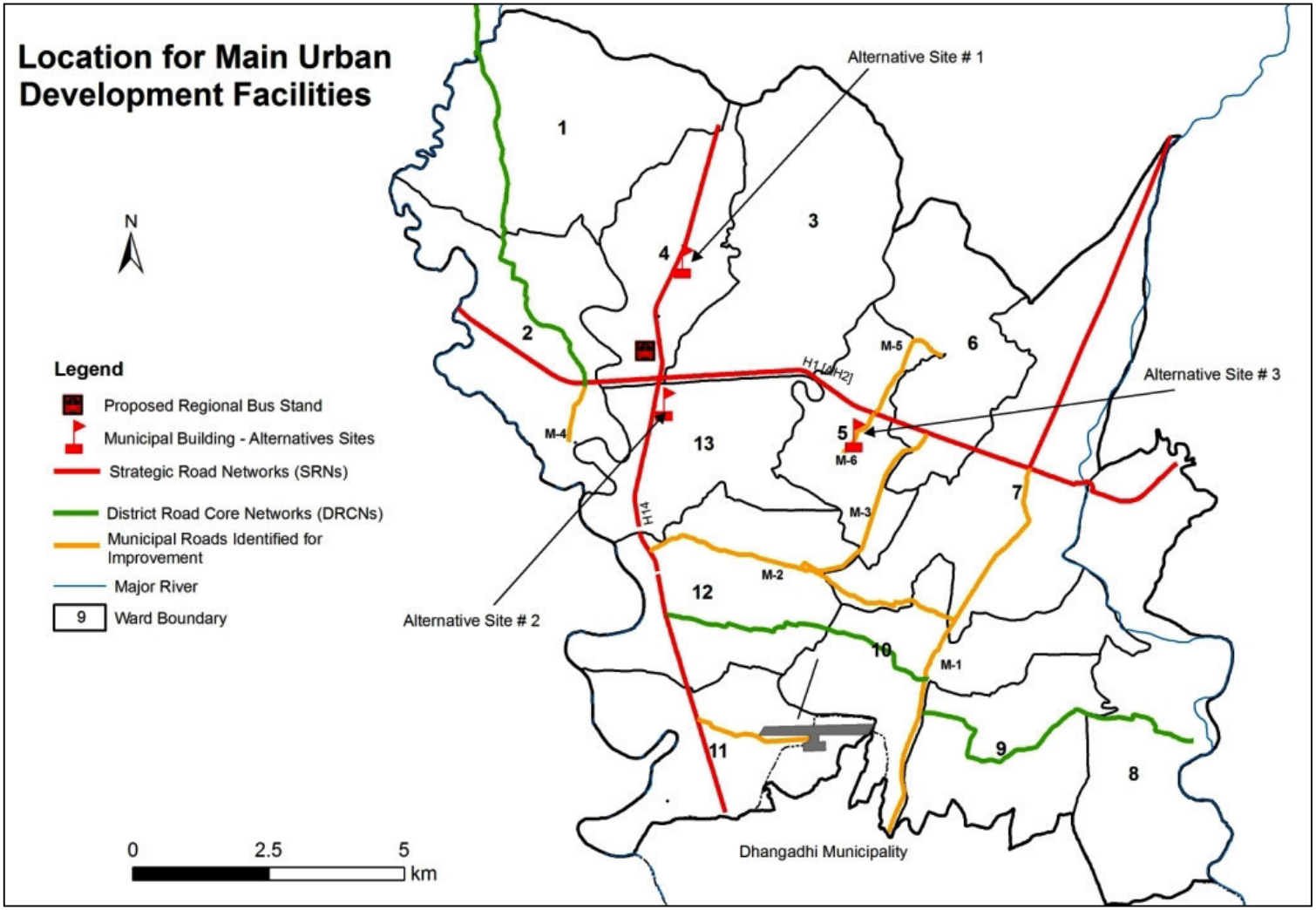
Site # 1	• Located 2km from Attariya main chowk at the east side of Mahakali highway (H14) • Private land and reported that a small plot of land would be provided to municipal authority free of cost if municipality to use for a new municipal building • But, located north of the main activities and development areas of the town.
Site # 2	• Located just south of Attariya chowk at east side of Mahakali highway (Dhangadhi-Attariya section) • Land owned by Ministry of Forest but leased to Rojin and Turpentine private company for staff quarter and other official facilities of company, but not used. • Tree cutting not required since buildings already constructed, which would need to be demolished and the site re-developed. • Although location is at strategic point, not easy to transfer land ownership from Ministry of Forest due to complicated legal procedures
Site # 3	• Located about 4km East of Attariya chowk near Lalpur close to the the East-West Highway • Flat land accessible by road (but needs to be improved) owned by Laxmi Narayan Temple. Reported that land owner is ready to provide land to municipal authority if municipality agrees to build municipal building at the given site • A little bit far from existing city area however land is geographical located at almost center of the municipal area. • This site may be appropriate for developing municipal service centers including municipal building if additional land is acquired by municipality. It has a strategic location regarding future urban growth of Attariya.

5.2 Regional Bus Park

61. Attariya is a transportation hub for all hill districts of FWR. All vehicles coming from Dhangadhi and/or Bheemdatt pass through Attariya, as it is the intersection of the two major highways. The present Bus Park is located at the side of the Mahakali Highway (H14) and has inadequate capacity and is without any basic facilities. Illegal parking of vehicles including heavy trucks on the roadside have further exacerbated the traffic problem. Development of new Bus Park is essential.

62. The current Bus Park should be upgraded into a Regional Bus Park. There is sufficient land in the back side of current Bus Park, of more than 2Ha., although under the Forest Department. The land for required facilities seems sufficient and located at strategic location for Regional Bus Park development. However, it may take time to process necessary legal procedures to get land ownership from Ministry of Forest for the necessary municipal infrastructure development. Cost for development of the Regional Bus Park would be estimated as NRs.170 million ($1.7 million).

Figure 5-1: Location for Urban Development Facilities



5.3 Development of Godawari Area

63. The Godawari area has great potential as a tourist destination. A 51 feet high Hanuman figure and temple and other few infrastructure have been already constructed. This area could be developed as a multi-purpose tourist destination for religious, national and international adventurists. However, since this area is located just outside the municipal boundary the Ministry of Tourism, and private entrepreneur should develop this area.

6 Prioritization of Identified Components and Indicative Costs

64. Although five urban infrastructure components have been identified in Attariya Municipality, all the components will not be equally important for immediate investment. Through stakeholder consultation, site visits and professional judgment, the infrastructure components identified are ranked in the following order as shown in **Table 6-1**.

Table 6-1: Prioritization of the Infrastructure Components Identified

Priority	Component
1st	Municipal Roads & Drainage
2nd	Solid Waste Management
3rd	Water Supply
4th	Municipal Facilities/Infrastructures
5th	Wastewater Management & Treatment

65. The indicative cost estimates for Attariya Municipality based on the infrastructure components identified through extensive stakeholder consultation and site visits are summarized in **Table 6-2**.

Table 6-2: Attariya Municipality Identified Needs and Indicative Cost Estimates

Sector	Proposed Intervention				Indicative Cost		
	Description	Proposed Wards	Additional Popn	Popn. %	NRs. million	US$ million	%
Water Supply	Deep tube wells and distribution	5, 6 & 7	2,500	17%	400	4.00	20%
Wastewater Management	Small bore sewerage in centre	3, 4 & 13	2,000	14%	178	1.78	9%
Solid Waste Management	Integrated waste management system with landfill site	3, 4, 5, 6, 7 & 13	5,000	34%	362	3.62	18%
Municipal Roads and Drainage	Seal and develop municipal roads	5, 6, 7, 10 & 12	21 km.		800	8.00	40%
Municipal Facilities	1. Municipal building (cost shared with MoFALD)				70	0.70	4%
	2. Bus park				170	1.70	9%
Community Infrastructure	To be indentified during design				20	0.20	1%
Attariya Total					**2,000**	**20.00**	100%

66. The estimated cost of the identified investments for Attariya is NRs.2,000 million. However, this is only an indicative cost of the identified priority investments. The final scope of work and actual investments might change slightly following site investigations and further analysis during detail design.

7 Institutional Capacity for Municipal Infrastructure

7.1 Existing Institutional Arrangements for Municipal Infrastructure

67. As a recently created municipality, Attariya has not yet been able to recruit adequate technical staff to establish the required institutional framework for providing proper municipal infrastructure services. Presently there are only two sub-engineers and one assistant sub-engineer, transferred from the original VDCs, and one technical officer (architect) recently recruited by MoFALD under LGCDP. Consequently, the technical staff look after all the municipal level infrastructure activities whatever their training or capacity. The newly appointed technical officer has started to take over urban infrastructure activities along with other local governance activities without any specific job description. The overall organization structure of Attariya Municipality is provided in Discussion Note # 6.

68. Although water supply is one of the basic urban infrastructures to be provided by a municipality, Attariya municipality is not directly involved in the provision of this urban service. Thus, there is no institutional arrangement or staff involved in piped water supply.

69. The present city water supply system is managed and operated by the WSUC. Institutionally, it is headed by a chairperson elected by the water users. There is a total of 11 staff in the Attariya water supply users committee (AWSUC). Although AWSUC receives technical assistance from the Kailali water supply and sanitation division office (WSSDO), there is no in-house trained technical staff available to operate and maintain the water supply infrastructure regularly on a day-to-day basis.

7.2 Recommended Institutional Arrangements for Municipal Infrastructure

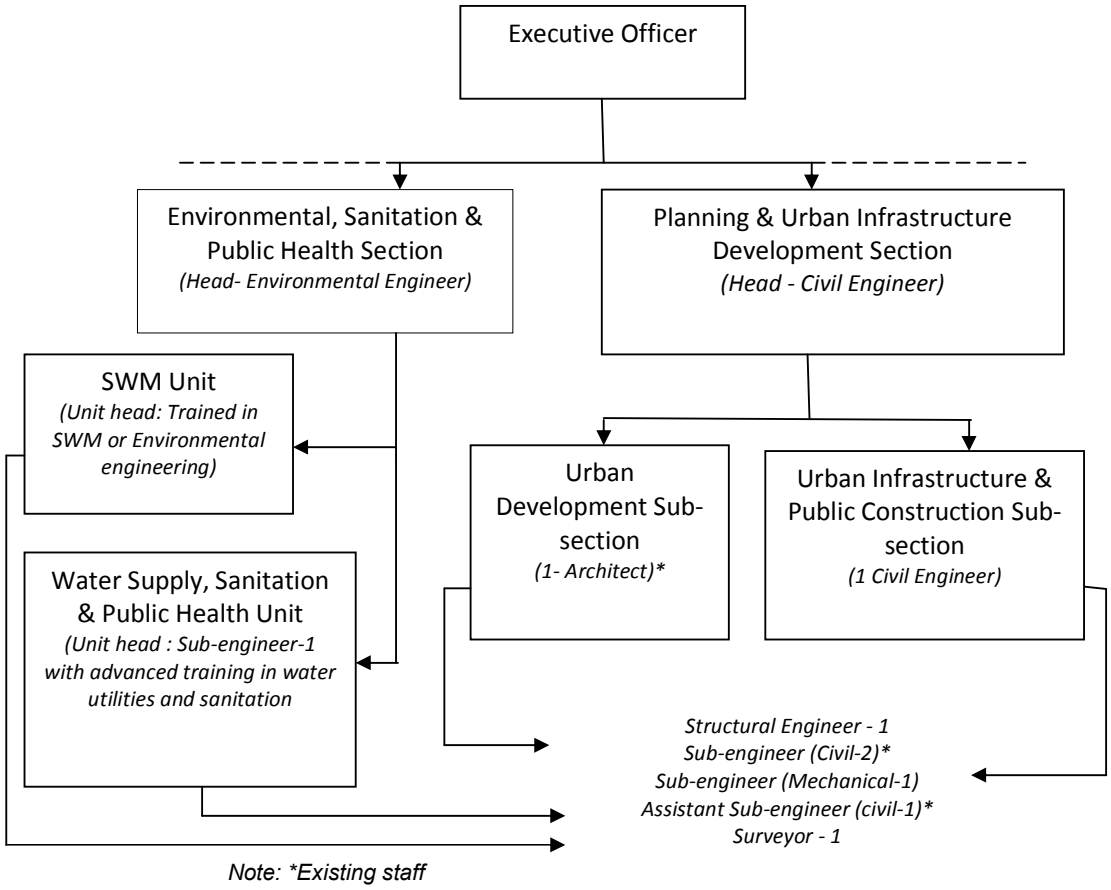
70. The municipality should have, in the medium to long term, in-house capability to independently develop, operate and maintain their infrastructure. The municipality should have planned asset management programs with the necessary resources and capacity to operate and maintain the municipal services provided.

71. Due to the nature of urban infrastructure services to be provided by the municipality, different divisions/ sections/ units should be established to operation and maintain the smooth delivery of each municipal infrastructure service. Competent technical staff in each division/ section must be recruited with clear job descriptions. The recommended institutional arrangement for Attariya municipality is given in **Figure 7-1**.

72. For the proposed expansion of the city water supply, DSC should evaluate different operational and management modalities and make recommendations. Currently, WSUC is one of the better models for water supply operation and management in many towns, including Attariya. However, existing institutional arrangement should be strengthened with recruitment of competent technical staff to ensure sustainable operation and maintenance.

73. The Institutional Development Consultant (IDC) to be engaged through the Project (see Discussion Note #7) will provide further analysis of municipal infrastructure management requirements and provide or arrange training as appropriate.

Figure 7-1: Recommended Institutional Arrangements for Municipal Infrastructure



Government of Nepal
Ministry of Urban Development

Second Integrated Urban Development Project

(IUDP2)

(PPTA 8817–NEP)

Draft Final Report

Discussion Note # 4

Municipal Urban Infrastructure – Part B : Bheemdatt

September 2015

Draft Final Report

Discussion Note #4 –

Municipal Urban Infrastructure – Part B : Bheemdatt

Contents

1. Water Supply

1.1 Principle Sources of Drinking Water

1. As the project town is located in an alluvial plane area, the easily accessible sources of water for drinking and other purposes are groundwater either from shallow or deep aquifers. No surface drinking water projects exists in this municipality. NWSC and other large water supply projects operated by Water Supply User Committees (WSUC) use deep wells for supplying water however, other individual households rely on shallow tube wells, dug wells and springs all of which can easily be susceptible to contamination.

1.2 Current Water Supply Schemes

1.2.1 Scheme Coverage

2. Of 20,684 households, 28% of the households have access to a piped water supply system. NWSC and three separate water supply user committees (WSUC) are providing piped drinking water to 5,963 consumers. The details are given in **Table 1-1** and coverage area is given in **Figure 1-1**. Further details are provided in **Annex 4B-A**.

Table 1-1: Bhimdatt Municipality Water Supply Schemes

Scheme	Area Served	Distribution Length	Household Beneficiaries
NWSC system	Core city area (Ward no.-3, 4, 6 & 18	36.0 km	1936
Bhasi Town Water Supply Project	Ward no.- 1, 2, 3, 4, 6 and 18 of plus ward no.-8 Suda VDC	46.4 km	1432
Tilachaur Water Supply Project	Ward no. - 7 (all), 3, 6 & 8	59.8 km	1555
Bhramadev Mandi Water Supply Project	Bheemdatt ward no. -9, Bhramahadev bazaar	3.5 km	495

1.2.2 Funding Water Supply Operations and Management

3. NWSC, an autonomous entity under Ministry of Urban Development, is not involved in design and construction of water supply projects but it manages and operates some of the city water supply system in the city core area. Other water supply schemes are managed and operated by WSUCs. The WSUC's also provided a share of the construction cost along with central government and development partners (See Annex 4B-A).

1.3 Proposed Interventions

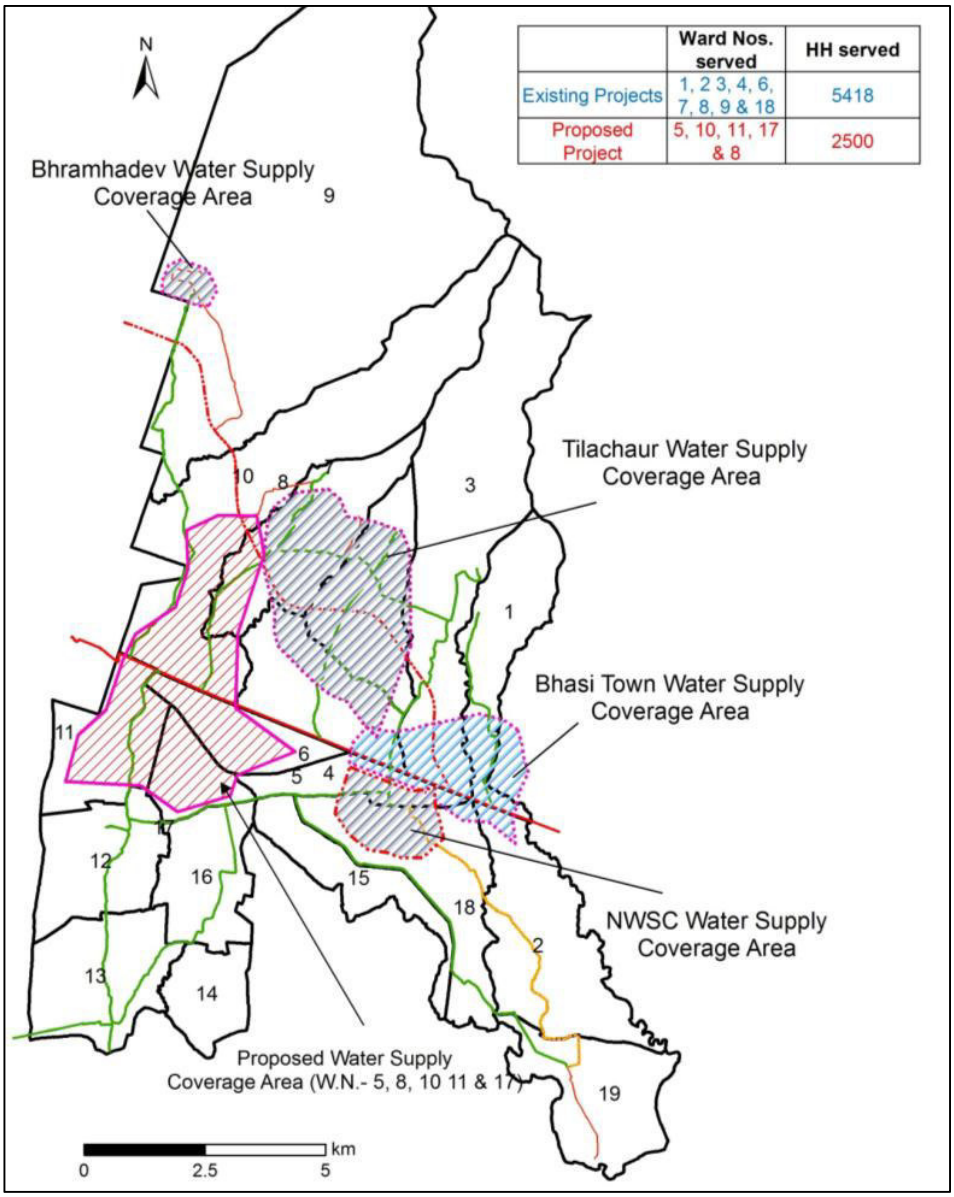
4. Less than 30% of households in Bheemdatt municipality obtain water from the present supply systems and there are no municipal proposals for developing further local area water supply scheme. However, the TA socio-economic survey indicated that piped water supply was the highest priority among households.

5. Consequently, based on the regional economic development vision and conceptual urban development plan, field assessment and consultation with municipal officials and other stakeholders, the project proposes a water supply scheme with a base population of 12,500 (2,500 households) (year 2015) and a design population of about 21,000 (3,350 households) by year 2030. A water supply scheme is proposed to provide drinking water to households of ward no. 5, 8, 10, 11 and 17. The coverage area and beneficiaries of existing and identified water supply scheme have been shown in **Figure 1-1**.

6. The indicative cost has been estimated based on reference from similar scheme in project municipalities such as Bhasi Town Water Supply Project in Bheemdatt and Shivanagar Water Supply project in Dhangadhi. The total estimated cost including boring, pump house, pump sets, transformers, reservoirs/OHT, water treatment and distribution would be about NRs.450 million ($4.50 million).

7. However, during field survey, one of the existing water supply systems had problems due to the presence of high levels of dissolved lime which blocked pipes and meters. Thus, proper hydrological and well testing studies must be undertaken in advance. An existing example of a good provision of ground water is in Bheemdatt Ward No.9, Bhramahadev bazaar. This is close to the Mahakali River, a perennial water source. The above mentioned estimated cost will also cover for the rehabilitation/upgrading of the existing water supply scheme. For O&M of this new scheme a similar arrangement to the present with a WSUC could be used.

Figure 1-1: Water Supply Schemes in Bheemdatt – Status and Identified Needs



2. Sanitation and Wastewater

2.1 Toilet Facilities

2.1.1 Domestic Toilet Facilities

8. The sanitation situation in Bheemdatt is not satisfactory though most of the houses have private toilets. Although, sanitation situation has greatly improved during last 10 to 15 years, 32% HHs still have no toilet facilities especially in the rural areas (CBS, 2011).

2.1.2 Public and Community Toilet Facilities

9. Public and community toilet facilities are provided at different locations in the city to reduce defecation in open spaces. There are four pubic in different place of Bheemdatt Municipality all have contract management as listed in **Table 2-1.**

Table 2-1: Public Toilets

Location	Constructed by	Operated / Managed
Gaddachauki, Ward-11	DDC Khanchanpur	Local management committee
Khulla Munch, Ward-4	Bheemdatt Municipality	Private party
Near Post Office, Ward-4	Bheemdatt Municipality	Private
Bus Park	Bheemdatt Municipality	Local Youth Club

2.2 Current Wastewater Collection and Treatment

2.2.1 Municipal Sanitation Systems

10. There is no sewerage system in Bheemdatt Municipality. The majority of premises in the denser areas of the municipality have septic tanks with soak pits. There is no municipal service offered for removing septage (septic sludge) from the septic tanks when they get full. Usually, households will contact a local contractor who will empty the tank manually. There is one contractor in Bheemdatt who uses a sludge tanker to empty septic tanks.

11. Frequently, the septic tanks are not properly maintained or are under capacity resulting in the septage flowing over into the soak pit. In many cases the soak pit does not work, or not constructed, and the septic tank overflows into the surface water road drainage network resulting in a public health risk.

2.2.2 Wastewater Treatment and Disposal Options

12. A detail study is required to determine the appropriate solution to improve the poor wastewater management within the municipality, as follows:

a) Identify areas where wastewater disposal or septic tanks are problematic, i.e. where septic tanks are overflowing onto land or into surface water drainage: e.g. due to i) high water table; ii) impervious ground; iii) no space for soak-pit; iv) septic tank needs frequent desludging; v) no space for septic tank; vi) seasonal flooding.

b) Identify areas in relation to phased urban development appropriate for on-site and off-site sewage treatment and disposal including staged development options: i.e. i) on-site septic tanks with soak-pit; ii) septic tanks with overflow to small bore sewerage; and iii) conventional sewerage.

13. A phased wastewater management plan should be prepared in relation to urban development plans by utilizing and upgrading the existing system as described above, taking into consideration appropriate methods for faecal sludge management (FSM).

2.2.3 STP Location Option

14. The general slope of the land from the city centre is towards the south-east; falling from 214m at the city centre (datum 0m) to 189m asl (-25m) over a distance of about 8km near the Chaudara Nadi at the edge of the Shuklaphanta Wildlife Reserve (SWR). Westwards, towards the Mahakali River the level rises slightly to 218m (+4m) over 3km near the old airport before dropping to 211m asl (-7m) near the river over a distance of about 4km. Northwards, towards the Bheemdat National Park, the ground rises steadily to around 250m asl (+~35m) over a distance of about 5km before entering the hills, see **Figure 2-1**.

15. The ideal location for sewage treatment and disposal is downstream of the city; i.e. towards the Chaudara Nadi. This would maximize the use of gravity for transporting the collected household wastewater (sewage) to the treatment facilities and reduce the need for sewage pumping and corresponding operation costs. However, due to the SWR there may be restrictions on discharge of treated sewage (both in quality and quantity) into any watercourse in close proximity to the reserve. In addition, the reserve's buffer zone may also restrict the construction of a sewage treatment plant (STP).

16. An alternative location is westwards near the Mahakali River as shown in **Figure 2-1**. Unfortunately, because of the natural slope of the land, considerable additional pumping of wastewater would be required, which would increase operational costs considerably. The initial capital cost would also be higher because of the need for sewers of deeper depth and more pumping stations.

2.2.4 Preliminary Wastewater Improvement Cost

17. Until a comprehensive study is undertaken on wastewater management in the municipality it is only possible to provide indicative costs for comparison.

On-site wastewater improvements

18. The main investment cost is the provision of a septage treatment plant. An anaerobic digestion technology is suggested, which generates biogas as well as produces hygienic quality compost fertilizer. In case of septage sludge treatment, anaerobic digestion technology also seems better socially and environmentally acceptable option than aerobic composting technology based on past experiences from municipalities of Nepal. Even if biogas is not utilized fully, at least a quality compost product is produced. This could be included as part of a bio-degradable component for solid waste management improvements.

19. Other costs would include the provision of sludge vacuum tankers. Although these could be provided by the private sector, as is present practice and the service paid for by the property owner. Operation of the septage treatment plant could be assisted by the sale of compost fertilizer and utilization of biogas.

Component Description		**Cost Estimate** (NRs. million)
Septage Treatment Plant (40 cu.m per day)		30
Equipment:- Three gulley bowzers (4,000 l)		25
	Total NRs.	55
Operations and Maintenance (Annual)		NRs.3 million

Small bore sewerage

20. In areas where the on-site soak pits do not function properly, small bore sewerage could be installed to prevent the septic tanks overflowing into the open drainage network.

Only the settled wastewater which sometimes includes some light floating matter is discharged into the small bore sewer. Consequently, the sewer pipes can be laid at shallow gradients. However, some pumping might be necessary depending on the ground contours to lift the settled wastewater up to a simple treatment plant before discharge to the river. The following costs are dependant of extent of system.

Component Description		**Cost Estimate (NRs. million)**
Small bore sewerage		350
Septic tank effluent pumping station		40
Septic tank effluent treatment plant (lagoon / reed beds)		80
Other miscellaneous costs (land / buildings / power)		170
	Total NRs.	540
	US $	5.40 million
Operations and Maintenance (Annual)		NRs.12 million

21. In the main commercial or high density residential areas the most economical solution might be to install small bore sewerage to collect septic tank overflows connected to a small decentralized effluent treatment (DEWATS) plant.

22. With this option, on-site wastewater management improvements as described above would still be required since property septic tanks would still be utilized.

Conventional sewerage and sewage treatment

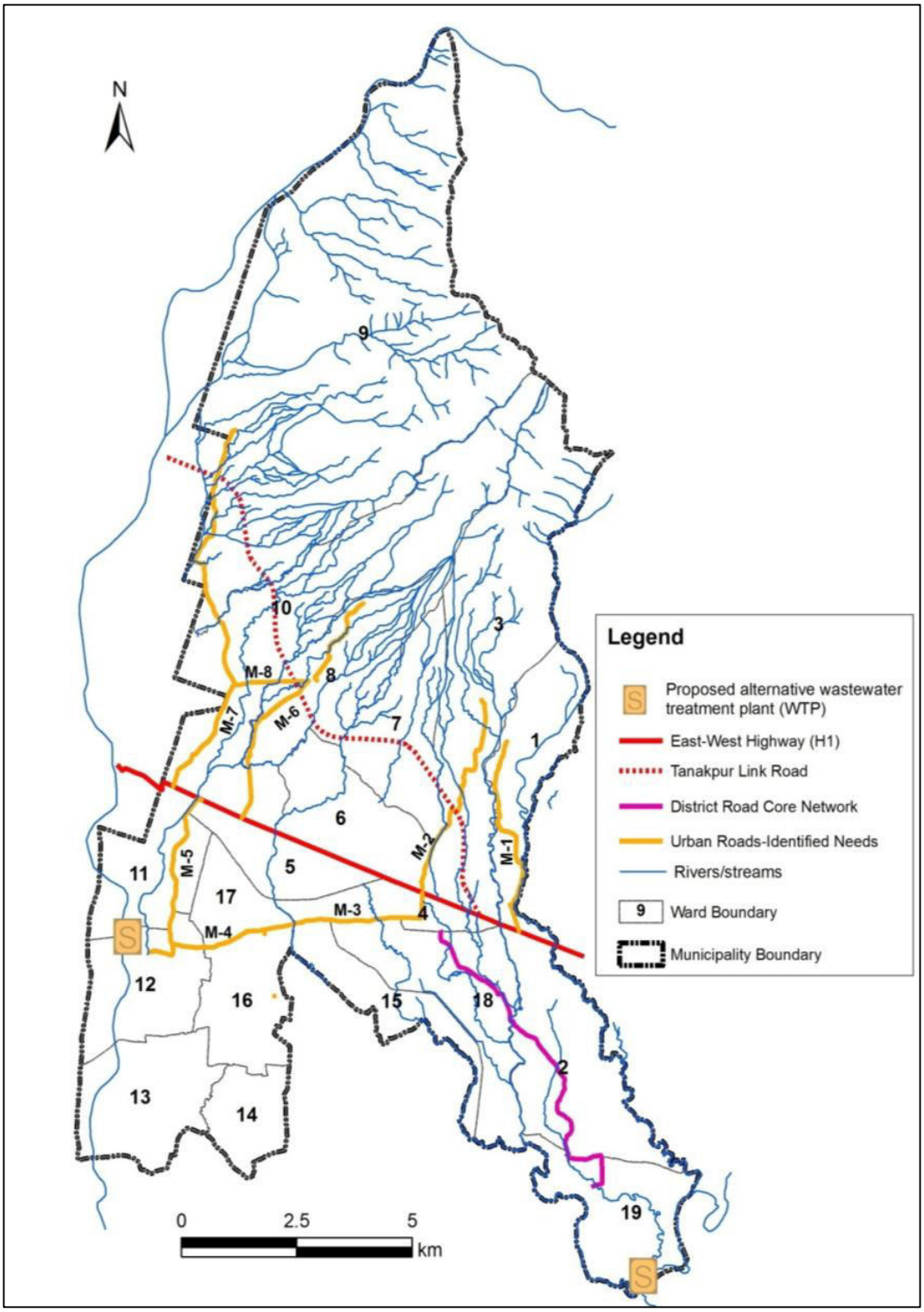
23. Conventional sewerage will only operate if there is a regular 24-hour water supply system that provides an excess of 100 lcpd (litres-per-head-per-day) plus a guaranteed power supply and skilled maintenance staff.

24. The sewers must be constructed with adequate gradient to maintain cleansing velocities in the sewerage system to prevent blockages. As a result, in flat terrain such as in Bheemdatt, sewers can easily exceed 4m deep and pumping stations will be required to lift the sewage up to the surface for treatment.

25. Costs based on construction of sewerage and sewage treatment plant for an Indian city with a present population of 90,000 increasing to 270,000 in 30 years. However, this option is NOT recommended for the present project.

Component Description		**Cost Estimate (NRs. million)**
Sewerage (trunk and collectors plus house connections)		900
Sewage pumping stations and rising mains		100
Sewage treatment plant (USAB + ASP)		250
Other miscellaneous costs (land / buildings / power)		300
	Total NRs.	1,500
	US $	15.00 million
Operations and Maintenance (Annual)		NRs. 70 million

Figure 2-1: Alternative locations for wastewater treatment plant



3. Solid Waste Management

3.1 Existing Solid Waste Management Practices

3.1.1 Waste Type and Generation

26. In general, municipal solid waste (MSW) covers the waste generated from households, commercial and institutional establishments. Medical and industrial wastes containing hazardous and infectious waste should be treated separately. The average daily municipal solid waste (MSW) generation is given in **Table 3-1**.

Table 3-1: MSW generation and collection efficiency in Bheemdatt Municipality[1]

Average per capita HH waste (kg/capita/day)	Total HH waste generation (ton/day)	Average per capita MSW waste (kg/capita/day)	Total MSW generation (ton/day)	Collection rate (%)
0.108	11.5	0.215	23	22 %

3.1.2 Solid Waste Composition

27. The waste obtained from the household, commercial and institutional waste is categorized into seven different types, as listed below.

Organic waste	Rubber and Leather
Plastics	Metals
Paper and paper products	Glass
Textile	Others (inert materials etc.)

28. The characteristics of MSW collected from any area depends on various factors such as consumer patterns, food habits, cultural traditions of inhabitants, lifestyles, climate, and economic status. Composition of MSW is changing with increasing use of packaging materials and plastics. Based on field survey conducted in Bheemdatt Municipality in 2012[2], the composition of different types of MSW in Bheemdatt Municipality is shown in **Table 3-2**.

Table 3-2: Composition of HH, commercial, institutional MSW in Bheemdatt

S.N.	Type of waste	Organic waste	Plastics	Papers	Glass	Metals	Textile	Rubber / leather	Others
1	Household waste	48.17	8.16	5.99	4.92	1.13	2.3	0.0	29.32
2	Commercial waste	34.41	21.71	19.46	2.26	1.51	7.31	0.89	12.45
3	Institutional waste	24.3	12.05	32.63	0.42	0.41	0.92	1.19	28.08
4	Average MSW	40.63	14.31	13.58	3.47	1.25	4.39	0.46	21.9

3.1.3 Street Cleaning and Primary Collection

29. Municipal waste is presently placed either on the roadside in front of the owner's property or put directly into the municipal tractor-trailer when the municipality comes for collection. This service is limited to main roads stretching about 1km from the city centre.

[1]ADB, 2012; http://www.adb.org/publications/solid-waste-management-nepal-current-status-and-policy-recommendations
[2]ADB, 2012; http://www.adb.org/publications/solid-waste-management-nepal-current-status-and-policy-recommendations

The sweepers clean the main city streets once daily in the morning and load the waste dumped on the streets into the trailers manually using shovels. No protective equipment such as gloves, boots, helmet or apron is used. The current waste collection rate is about 22%; i.e. municipality is able to collect about 16m^3 (~5 ton) of waste per day from an estimated total of 23 tons of waste generated[3].

3.1.4 Waste Transportation

30. There are no transfer stations in Bheemdatt municipality, and the waste collected by the municipal vehicles is directly taken for final disposal. There are two tractor-trailers (capacity ~ 4m^3) and a few rickshaws (No.9 of 0.12m^3 capacity) used to collect, transport and finally dump the waste an the open space of city near the municipality office and other open land without any sorting or processing.

3.1.5 Organic Waste Composting

31. There is no municipal level organic composting in Bheemdatt Municipality. Few households in urban area practice household composting so most of the waste is placed in the street for municipal collection and disposal. However in some rural areas, organic household waste is feed to domestic animals such as cows or pigs. Occasionally the organic waste is composted at the domestic level.

3.1.6 Recycling

32. There is no formal recycling practice in Bheemdatt Municipality and it has not initiated or promoted any recycling program. However, at the household level, wastes that can be sold to the waste pickers are stored separately. The waste pickers collect reusable and recyclable materials from the households like paper and paper product, plastic, metals, glass bottles, which are then transported to Nepalgunj or India.

3.1.7 Treatment of Hazardous (Industrial / Clinical) Waste

33. There is no separate system in the municipality for collecting and managing medical waste or any other type of special waste. There are 35 health institutes in the municipal area, including hospitals, clinics and pharmacists. Hospital waste, industrial waste, construction and demolition waste are mixed and discarded with municipal waste. Hospital wastes (general waste + hazardous wastes) are mixed in the MSW stream despite the government regulation, requiring every hospital to properly dispose of waste (The Solid Waste Management Act 2011, states: “the responsibility for processing and management of hazardous waste, medical waste, chemical waste…under the prescribed standards shall rest with the person or institution that has generated the solid waste”). Hazardous waste of the zonal hospital is managed by the hospital. None of the health institutions, including hospitals, have proper facilities to dispose of hospital waste that is hazardous, which presents a risk to municipal waste workers, the general public health and the environment.

3.1.8 Final Disposal

34. There is no proper environmental-friendly and socially acceptable final disposal site in Bheemdatt Municipality. The collected waste is disposed of in temporary open piles at open spaces and river side dumping. Due to crisis management, the municipality continues to dispose of waste in the Eco Park area located close to the municipal building. Waste is frequently burnt in the open air. Earlier, the garbage was dumped in ditches around the

[3] Personnel communication with Bheemdatt Municipal Engineer, April, 2015

market and the municipality started to dump the garbage in the hospital road after all the ditches in the market and office compound had been filled.

3.2 SWM Institutions

3.2.1 Municipal Authorities

35. The municipality has separate unit for SWM called the Environment and Sanitation Unit under Social Development Section. However the unit is headed by a non-grade officer (supervisor) without any adequate knowledge in waste management. The unit also has 2 drivers and 30 sweepers involved in SWM.

3.2.2 Private Enterprises

36. Private enterprises, except informal rag-pickers, are not involved in SWM in the municipality.

3.2.3 NGO and CBO Initiatives and Informal Sector

37. There are some local community and women groups involved in different activities for the management of solid waste. A women's group called Nari Chetana Samaj and a TLO[4] called Ekata Tol Sudhar Samitee have been involved in clean up campaigns as well as waste management at household level since 2001[5]. Although no formal connection with municipality, the informal sector like waste pickers and a few scrap dealers are involved in collecting and selling reusable and recyclable fractions of MSW.

3.3 Future Waste Generation

38. From experience, it is noted that there is a relation between the unit waste generation (kg/capita/year) and socio-economic situation in an area. The gross domestic product (GDP) is considered the most important indicator for the forecast of future waste generation. Although there is no empirical relationship between GDP and the waste generation rate. Therefore, a constant unit waste generation rate over the planning period is considered. Using the projected population over the period of 2011 to 2041 and the average per capita MSW generation (kg/capita/day) given in Table 3-1, total daily waste generation in Bheemdatt Municipality has been projected as shown in **Table 3-3**.

Table 3-3: Projected daily MSW generation in Bheemdatt Municipality over 2012-2041

Description	Planning Period						
	2012	2016	2021	2026	2031	2036	2041
Population	104599	120172	138063	162512	191291	230667	278148
MSW (ton/d)	23	26	30	36	42	51	61

39. Similarly, based on current average municipal waste composition data, estimated projection of each component of municipal waste is given in **Table 3-4**.

[4] TLO Abbreviation for Tole Lane/Development Organizations. Usually between 30 to 60 households are represented in one group organization. They are mostly involved in drinking water, health, environment and sanitation issues of their community.
[5] SWM strategic and Action plan of Bheemdatt Municipality, SWMTSC, 2012

Table 3-4: Projection of various MSW component over time frame (2012- 2041)

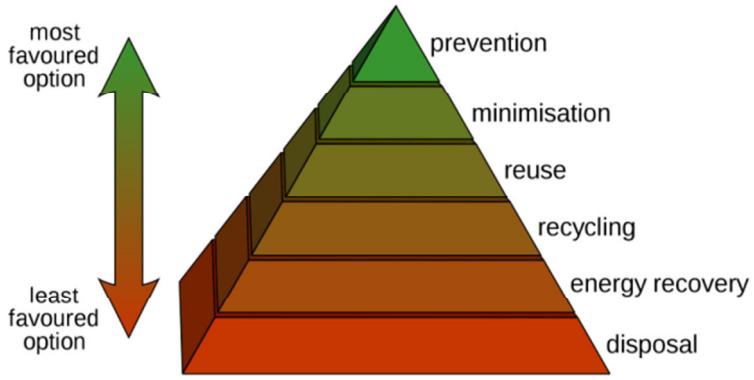
Waste type	Planning Period						
	2012	2016	2021	2026	2031	2036	2041
Total waste (ton/yr)	**8399**	**9650**	**11086**	**13050**	**15361**	**18523**	**22335**
Organic waste (ton/yr)	3413	3921	4504	5302	6241	7526	9075
Plastics (ton/yr)	1202	1381	1586	1867	2198	2651	3196
Papers (ton/yr)	1141	1310	1506	1772	2086	2515	3033
Glass (ton/yr)	291	335	385	453	533	643	775
Metals (ton/yr)	105	121	139	163	192	232	279
Textiles (ton/yr)	369	424	487	573	674	813	981
Rubber/Leather (ton/yr)	39	44	51	60	71	85	103
Others (ton/yr)	1839	2113	2428	2858	3364	4056	4891
Total reusable & recyclable fraction (ton/yr)	**3146**	**3615**	**4153**	**4888**	**5754**	**6939**	**8367**

3.4 Proposed SWM Improvement and Costs

3.4.1 SWM Development Strategy

40. The guiding principles of SWM strategy of Bheemdatt Municipality is in line with SWM act 2011, Local-self Government Act, 1999 and other relevant environmental related Acts. The following guiding principles for SWM strategy and approach will be considered. The strategy ensures that the focus is on waste prevention (preventing the generation and minimizing the waste that is being generated) as a first priority. If the first option is neither insufficient nor practical or technically or sociologically feasible, then other solutions have to be considered. The strategic approach applied for the development of strategy is based on the internationally recognized waste hierarchy is shown in **Figure 3-1**.

Figure 3-1: Waste Hierarchical Structure



41. The following are the guiding principles:

- Zero waste target: This shall be the ultimate target to be achieved through practicing the concept of reduce, reuse and recycle and extended producers' liability in a concerted manner. Not more than 25% of waste shall be landfilled by 2030.
- Provisions of Solid Waste Management Act 2011 (2068), which has fundamentally incorporated the basic principles mentioned above.

- Ensuring People Participation – Municipality alone cannot meet the challenge of keeping the city clean. To change peoples' attitude on solid waste and to minimize the waste produced including plastic waste and facilitate sustainable waste management peoples' participation must be ensured. To change their attitude and behaviour on solid waste, information, education and communication (IEC) programs throughout the municipality will be needed.
- Participation of communities, TLOs, private sector enterprises and other stakeholders. - One of the best model for waste management in Bheemdatt could be involvement of private sectors and TLOs, where one of the private organization had been already involved on SWM in contract basis and a few TLOs are working for SWM in their locality independently.
- SWM services to be made self-sustaining. - service shall be made self sustaining within a period of 5 years by resource recovery and cost recovery approach such as levy of user fee charges and revenue from reusable and recyclable products.
- Maintaining strong communication and dissemination of information

42. In addition to MSW processing, septage (septic tank sludge) could also be treated and included in the composting stream. Thus, Integrated Waste Processing Sites (IWPS) could be developed. These do not necessarily have to be in one location. Small IWPS could be scattered around the municipality depending on waste sources plus environmental and social acceptability.

43. For septage sludge treatment, an anaerobic digestion technology would be socially and environmentally best option since it generates biogas as well as producing quality hygienic compost fertilizer. Only the by-products (reject waste) of the IWPS would be transferred to the final disposal site.

44. It is expected that the fully functional requirements for integrated solid waste management (ISWM) system may be difficult to implement in the project municipalities during the first phase of the project. Gradual improvement in waste management with associated public awareness, education and enforcement of laws is suggested for the planned transformation from open dumps to sanitary landfills.

45. The final disposal site (engineered landfill site / sanitary landfill site) will only accept rejects from the compost plant and residue from recycling plant / facilities and other unwanted wastes.

46. Based on preliminary field visit and stakeholder's consultation meetings, a number of locations have been identified for waste sorting / processing sites and landfill site to be developed by Bheemdatt Municipality. Locations and brief descriptions of possible waste sorting / processing and landfill sites are shown in **Figure 3-2** and **Table 3-5**.

Figure 3-2: Location of proposed waste processing and final disposal sites

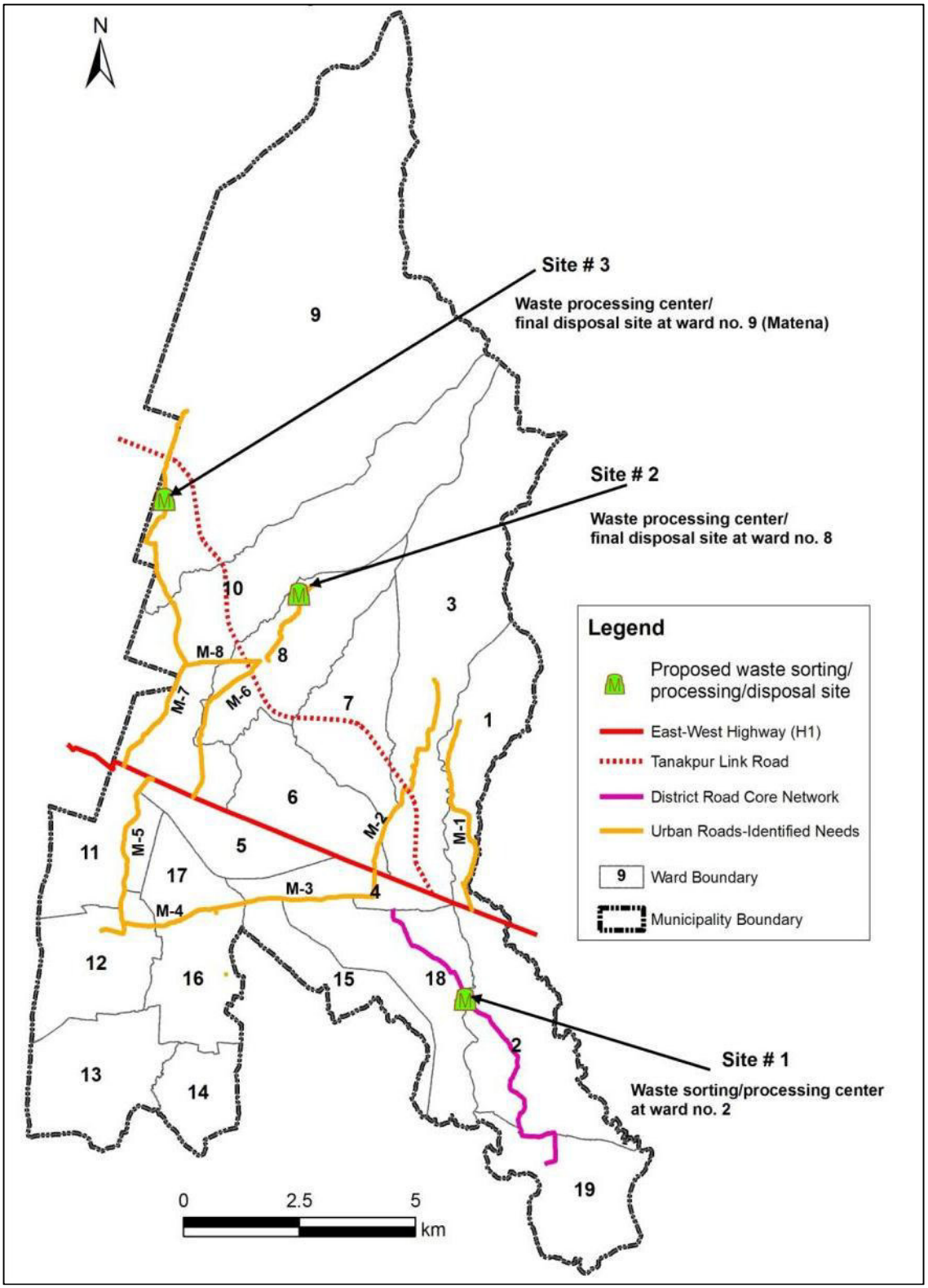


Table 3-5: Description of waste sorting/ processing and final disposal sites

Site No.	Description
Site # 1	• Located about 2.5km south from Bheemdatt city area at ward no. 2 (border of ward no. 2 & 18) of Bheemdatt, called Kholti area • Private land but old brick factory site and directly connected all-weather district road core city i.e. no needs of improvement of access road • Site is appropriate for waste sorting, establishing recycling facilities and small scale compost plant but not use for final disposal site • No risk from future flooding as embankment was already constructed at the upstream of this site • Needs to be acquired prior to detail design
Site # 2	• Site is identified for the development of waste treatment and final disposal site, which is located at ward no. 8 of Bheemdatt Municipality, called Ghadighach area • It is located about 8 km north from East-West highway and a few km of access road needs to be developed to connect site directly with existing road • It is public land; a barren area and would be developed as waste treatment and final disposal site for several years • No apparent risk of flooding but has to be developed protecting structure at north-west side for rare monsoon-based debris flow
Site # 3	• Located about 10km North from Gaddachauki (Nepal-India border of East-West highway) and site is directly connected by Gaddachauki (H1)- Bhramadev road • The site lies in ward no. 9 of Bheemdatt Municipality, near from India-Nepal border • Flat land with high groundwater table and also near from funeral site of typical group of people, called *Nath* • The proposed site is also located nearby human settlement. It is reported that the settlement was established by encroaching public land

3.4.2 Indicative SWM Component Packages and Cost

47. Costs based on construction of Integrated SWM system for Nepalgunj (IUDP-1) with a similar geographical condition and waste generation pattern.

Component Description		Cost Estimate (NRs. million)
Sanitary Landfill Site development		150
Other development works (internal service road, weighbridge, power supply, water supply, administrative building etc)		40
Compost Plant for bio-degradable fraction (5 ton/day windrow composting plant) with Septic drying bed		20
Equipments/Vehicles/Tools		50
Recycling facilities		5
Community development program/3R promotion activities		10
Miscellaneous costs including land, access road etc.		100
	Total NRs.	375
	US $	US$ 3.75 million
Annual operation cost (first year cost)		NRs. 15 million

4. Urban Roads and Surface Water Drainage

4.1 Municipal Roads

4.1.1 Current Status of Municipal Road

48. Based on analysis of the GIS map of Bheemdatt Municipality[6] there is a network of 966km roads including Strategic Road Networks (SRNs), District Road Core Networks (DRCNs) and municipal earthen track/trails. The total length of road network is given in **Table 4-1** and location indicated in **Figure 4-1**.

49. **Table 4-1** provides the total road networks in Bheemdatt Municipality[7] and their surface type. The majority of roads in the municipality (70%) are earthen surface tracks/trails. It indicates that 26% (254km) are gravel roads and only 4% (40km) of roads are blacktopped including the East-West highway.

Table 4-1: Length and status of road networks in Bhemdatt Municipality

Road Type	Total Length (km)	Blacktop (km)	Gravel (km)	Earthen (km)
Strategic Road Networks (SRNs)	24	11	13	0
District Road Core Networks (DRCNs)	8	0	8	0
Municipal Road (MR) including earthen track and trails	934	29	233	672
Total	**966**	**40**	**254**	**672**

4.1.2 Road Network Responsibility

50. The strategic road networks such as highways, feeder roads are maintained by the Department of Roads (DoR) and the District Development Committee (DDC) maintains all the local rural networks. The municipality is responsible for the maintenance of all the other roads within its boundary. However, as per new DTMP guidelines, DDC will be mainly responsible to plan, upgrade and construct District Road Core Networks (DRCNs)[8]. However, DoR is upgrading small sections of a few urban roads even though they are not directly their responsibility. In addition, 8km length of road is being upgraded/maintained under World Bank funded project by DTO/DDC within municipal boundary.

4.1.3 Problems and Issues

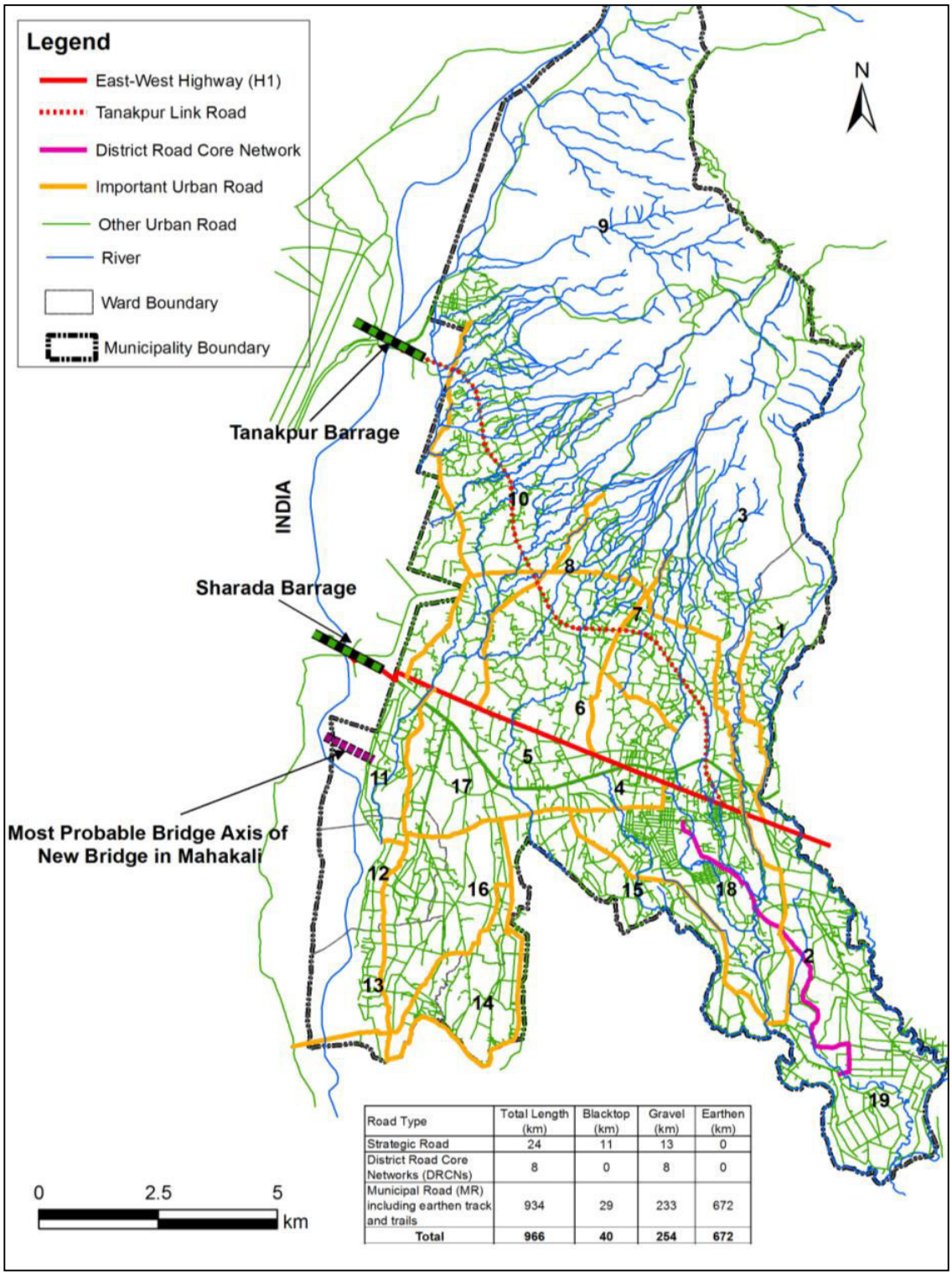
51. The major problems and issues related to urban linkages, as well as cross-border linkages, are summarized as follows;

a) Although the core city is developed in a planned manner with grid pattern of road, most of these road/lanes are in a poor state due to lack of regular maintenance and lack of adequate drainage.

b) Access to settlements within the municipal limits outside the city core is very poor. New road construction and/or upgrading of existing earthen tracks are essential.

[6] GIS map of Bheemdatt Municipality, Draft Final Report, DUDBC/ Bheemdatt Municipality
[7] Field assessment and personal communication with Municipal Engineer, Bheemdatt Municipality, 2015
[8] DTMP Guidelines 2012, http://rtiswap.gov.np/dtmp_guideline.php

Figure 4-1: Road Networks in Bheemdatt Municipality



Road Type	Total Length (km)	Blacktop (km)	Gravel (km)	Earthen (km)
Strategic Road	24	11	13	0
District Road Core Networks (DRCNs)	8	0	8	0
Municipal Road (MR) including earthen track and trails	934	29	233	672
Total	**966**	**40**	**254**	**672**

c) Lack of vehicular bridge across the Mahakali river is the main cause for the lack of development in the the region, and especially Bheemdatt. However, DOR is identifying the line for a new bridge over the Mahakali River. This is likely to be about 1.5km downstream from existing crossing over the Sharada barrage. A national consulting firm is engaged by DOR for survey, investigations and detail design.

d) A link road is under construction between the East-West Highway and Tanakpur Barrage, in India, near Bhramahadev bazzar in Bheemdatt Municipality. The barrage was designed to provide road access between India and Nepal across the Mahakali River. But recent reports indicate that the Indian authorities are unable to allow vehicular traffic across the barrage due to instability of the structure. However, this link road could also form part of the municipal northern ring road and assist the city to expand towards the north-west.

e) Three or four main North-South Corridors which connect both East-West Highway and Tanakpur Link Road and provide access to a few tourist attractive spots in the northern part of municipality need to be improved and upgraded with necessary footpath and drainage satisfying minimum condition of urban road. These roads would also allow the city to expand and develop based on the regional economic development vision and conceptual urban development plan and field assessment.

f) Development of roads in the South and South-East part of the municipality might be restricted for urbanisation due to the Shukla Phata Wild Reserve Park. However, the buffer zone area can be developed for agricultural purposes with the road network improved appropriately.

4.2 Drainage Adequacy and Key Issues

4.2.1 Municipal Surface Water Drainage

52. There is no proper surface water drainage in the municipality except about 2.5km of open drains in the main roads around the market area. The size of the existing drains is not adequate and they are frequently filled with garbage and silt due to lack of maintenance.

4.2.2 Fluvial (river) Flooding

53. During series of stakeholder's consultation meetings, river flooding was reported to be a common problem during the monsoon. In the dry season, the rivers originating from Chure in the north of the municipality have no water flow at all. However, due to high intensity of rainfall over short periods, flash floods from these rivers are very common which inundate the city area. Further, flooding from Mahakali canal and its tributaries also overflow during monsoon which also floods the city and surrounding agricultural land.

4.2.3 Sustainable Drainage Systems

54. Surface water drainage systems (SuDS) objectives are to minimize the impacts from development on the quantity and quality of the runoff, and maximize amenity and biodiversity opportunities. Their characteristics include natural features such as ponds, wetlands and shallow ditches called swales. Hard engineered elements are often used in high density, commercial and industrial developments. These include permeable paving, canals, treatment channels, attenuation storage and soakaways.

55. SuDS should be developed in-line with the ideals of sustainable development. The system should be designed to both manage the environmental risks resulting from urban runoff and to contribute wherever possible to environmental enhancement[9].

56. The primary purpose of SuDS is to mimic the natural drainage of the area prior to development. This is achieved by capturing rainfall, allowing as much as possible to evaporate or soak into the ground close to where it fell, and then conveying the remainder to

[9] For detail information on visit http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

the nearest watercourse. Along the way any pollutants, such as metals and hydrocarbons from roads and car parks, are reduced. Water entering a local watercourse is therefore cleaner. If the water is kept on the surface as much as possible the SuDS can provide valuable amenity asset for local residents and create new habitats for wildlife.

57. SuDS will become increasingly important to control surface water as rainfall increases because of climate change. It can also provide other benefits in developments such as passive cooling, which will again help mitigate any increase in temperatures due to climate change.

4.3 Proposed Roads and Drainage Improvements

4.3.1 Components and Benefits

58. Of total municipal roads mentioned in previous section, very few roads have good pavement condition often because they have not been constructed as per urban road standards (two lane road 7.5 m to 10 m pavement width) with storm water drainage and footpaths on each side of road. Thus, almost all municipal roads within Bheemdatt need to be improved and upgraded. Nearly 90km urban roads including a 41km municipality ring road were identified as important urban roads in the municipal periodic plan.

59. However based on the regional economic development vision and conceptual urban development plan, plus meetings with municipal officials and the stakeholders 36.5km of priority roads were selected for possible inclusion in the project. In addition, about 5km storm water drainage in the core city area needs to be developed to drain out monsoon floodwater. The length is only indicative and subject to further analysis. The names of roads identified for possible intervention within the project have been listed in **Table 4-2** and indicated in **Figure 4-2.**

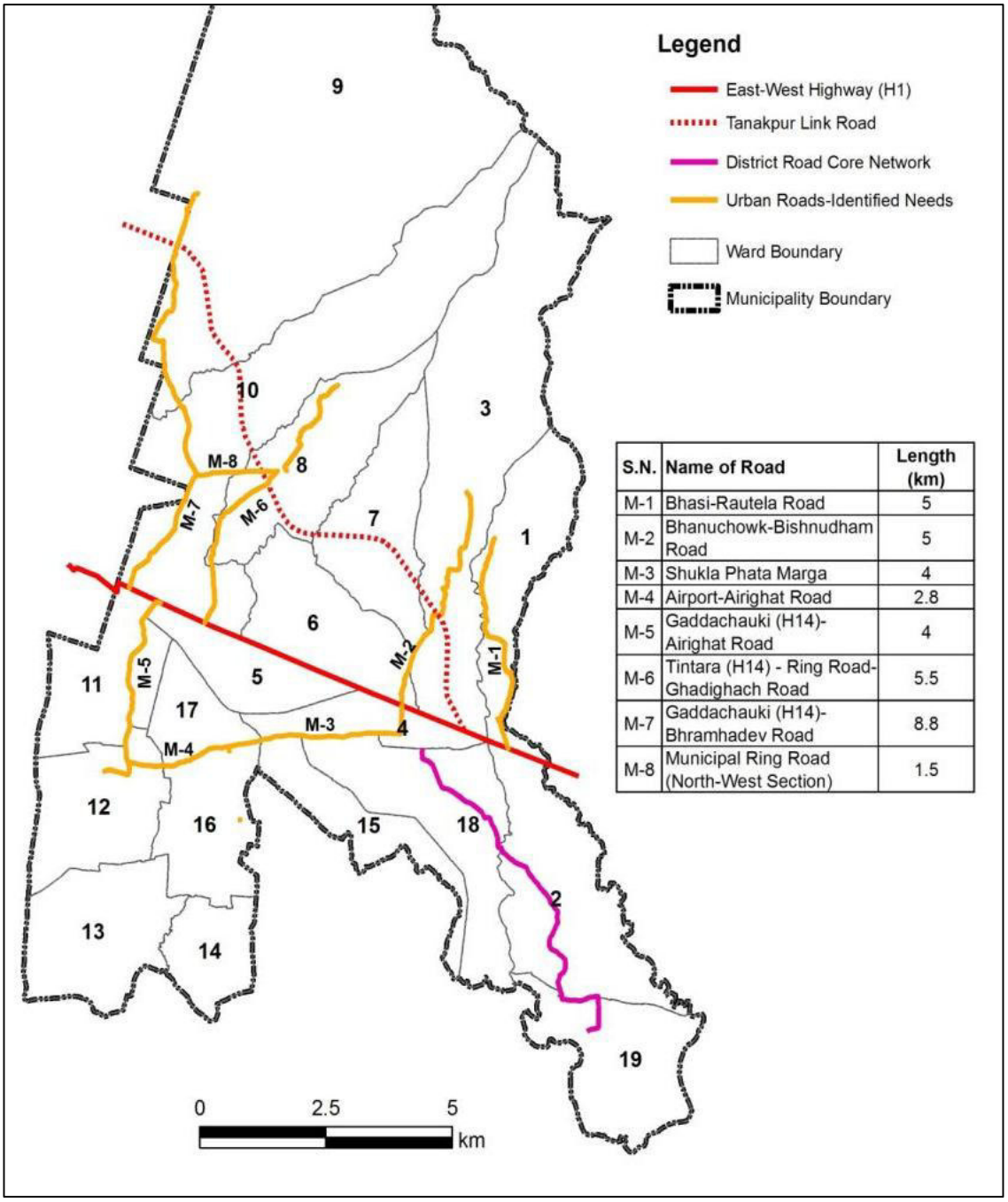
Table 4-2: Roads Identified for Possible Intervention

Code	Name of Road	Length (km)	Proposed Road Width (m)
M-1	Bhasi-Rautela Road	5	15
M-2	Bhanuchowk-Bishnudham Road	5	5
M-3	Shukla Phata Marga	4	20
M-4	Airport-Airighat Road	2.8	20
M-5	Gaddachauki (H14)- Airighat Road	4	20
M-6	Tintara (H14) - Ring Road-Ghadighach Road	5.5	15
M-7	Gaddachauki (H14)- Bhramhadev Road	8.8	15
M-8	Municipal Ring Road (North-West Section)	1.5	20
Total		**36.5**	

4.3.2 Roads and Drainage Improvement Indicative Cost Summary

60. For the estimation of roads and drainage improvement cost, the unit rate was adopted from Department of Road. The recent cost for improvement/upgrading of urban road with varying width under Kathmandu Valley road improvement/extension program is about NRs.9 million to NRs.38 million with an average NR.23.5 million/lane/km. The cost for just widening, upgrading and providing drainage and minimum footpath is around NRs.40 million/km. Based on this reference rate, the estimated cost for the improvement of 36.5km road in Bheemdatt Municipality would be NRs.1,460 million ($14.60 million).

Figure 4-2: Indicative Main Roads and Drainage Improvements



S.N.	Name of Road	Length (km)
M-1	Bhasi-Rautela Road	5
M-2	Bhanuchowk-Bishnudham Road	5
M-3	Shukla Phata Marga	4
M-4	Airport-Airighat Road	2.8
M-5	Gaddachauki (H14)-Airighat Road	4
M-6	Tintara (H14) - Ring Road-Ghadighach Road	5.5
M-7	Gaddachauki (H14)-Bhramhadev Road	8.8
M-8	Municipal Ring Road (North-West Section)	1.5

5. Urban Development Facilities

5.1 Tourist Information Center

61. The Far-west Region (FWR) has great potential to attract many types of tourist, providing factual and detail information of these tourist hot spots is essential. When border access across the Mahakali River is improved, Bheemdatt would be an international gateway for FWR. As the Tourism Board has already established small facilities in the Gaddachauki (a border point located at East-West Highway), the same location would be used for further improvements/development of Tourist Information Center along with other minimum required urban facilities.

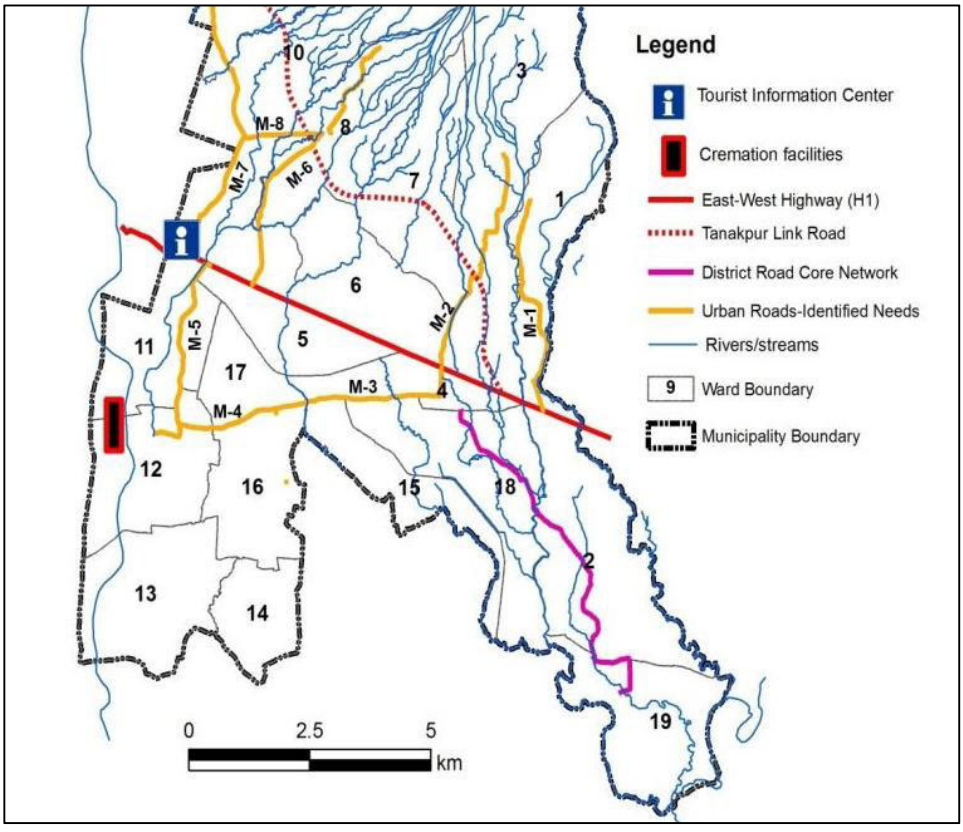
62. The Tourism Board under Ministry of Tourism and Culture or TDS should establish a tourist information centre. Part of municipal funds would be shared. However, management and operation of this centre will be in the involvement of private sector to make more efficient management.

63. The tentative cost for establishing a Tourist Information Centre and other basic urban facilities including IEC materials would be about NRs. 6 million.

5.2 Cremation facilities

64. During stakeholder's consultation meeting, many demanded the development of a Cremation Facility on the banks of the Mahakali River. Even in Bheemdatt Municipality Physical Development Plan, the development and management of such facility has been proposed. Cost for management of cremation ghat in Mahakali is about NRs. 4 million

Figure 5-1: Location of Potential Urban Development Facilities



6. Prioritization of Identified Components and Indicative Costs

65. Although five urban infrastructure components have been identified in Bheemdatt Municipality, all the components will not be equally important for immediate investment. Through stakeholder consultation, site visits and professional judgment, the infrastructure components identified are ranked in the following order as shown in **Table 6-1**.

Table 6-1: Prioritization of the Infrastructure Components Identified

Priority	Component
1st	Municipal Roads & Drainage
2nd	Solid Waste Management
3rd	Water Supply
4th	Wastewater Management & treatment
5th	Municipal Facilities/Infrastructures

66. The indicative cost estimates for Bheemdatt Municipality based on the infrastructure components identified through extensive stakeholder consultation and site visits are summarized in **Table 6-2**.

Table 6-2: Bheemdatt Municipality Identified Needs and Indicative Cost Estimates

Sector	**Proposed Intervention**				**Indicative Cost**		
	Description	Proposed Wards	Additional Households	Popn. %	NRs. million	$ million	%
Water Supply	Deep tube wells and distribution	5, 8, 10, 11 & 17	2,500	12%	450	4.50	16%
Wastewater Management	Small bore sewerage in centre	4, 6, & 18	2,000	10%	595	5.95	21%
Solid Waste Management	Integrated waste management system with landfill site	1, 2, 3, 4, 6, 7, 8, 9, 10 & 18	10,000	48%	360	3.60	12%
Municipal Roads and Drainage	Seal and develop municipal roads		35.5 km		1,460	14.60	50%
Municipal Facilities	1. Tourist Information Centre				6	0.06	0%
	2. Crematorium				4	0.04	0%
Community Infrastructure	To be indentified during design				25	0.25	1%
Bheemdatt Total					**2,900**	**29.00**	100%

67. The estimated cost of the identified investments for Bheemdatt is NRs.2,900 million. However, this is only an indicative cost of the identified priority investments. The final scope of work and actual investments might change slightly following site investigations and further analysis during detail design.

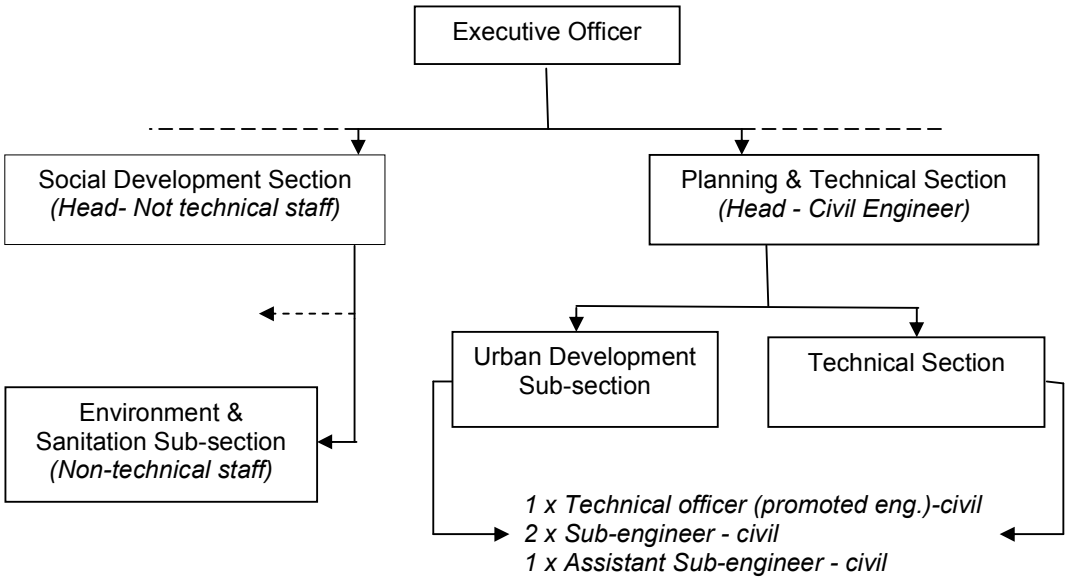
7. Institutional Capacity for Municipal Infrastructure

7.1 Existing Institutional Arrangements for Municipal Infrastructure

68. Though Bheemdatt is a well established municipality, it does not have the necessary divisions/ sections and required qualified and skilled technical staffs for providing basic municipal infrastructure services. According to existing municipal organization structure, planning and technical section exists with section head (Civil Engineer). Under this section, two separate sub-section; urban development sub-section and technical sub-section are established. Beside section head, one technical officer (promoted engineer-civil), 2 sub-engineer (civil), and 1 assistant sub-engineer (civil) take over urban infrastructure activities.

69. Beside this, there is a separate sub-section under social development section to look after SWM and sanitation components, however, it lacks technical and trained staff. The overall organization structure of Bheemdatt Municipality has been given in Discussion Note # 6. The institutional arrangements and staff responsible just for municipal infrastructures is given in **Figure 7-1**.

Figure 7-1: Existing Institutional Arrangements for Municipal Infrastructure



70. Although water supply is also one of the basic urban infrastructures to be provided by a municipality, Bheemdatt municipality is not directly involved for the delivery of this urban service. Piped water in Bheemdatt is provided in the main city area by NWSC. Unfortunately, NWSC branch office lacks sufficient trained and competent technical staff.

71. In addition to NWSC, there are piped water supply schemes managed and operated by water supply users committees (WSUC). Institutionally, they are headed by a chairperson elected by the water users. Each WSUC has a few staff who use a basic management information and computerized billing system. However, competent skilled technical staff is not available and they have not received any technical assistance from government and other organizations. In-house competent technical staffs are therefore required to be able to operate and maintain their water supply infrastructure effectively and efficiently. In the meantime, WSSDO could provide technical assistance when required.

7.2 Recommended Institutional Arrangements for Municipal Infrastructure

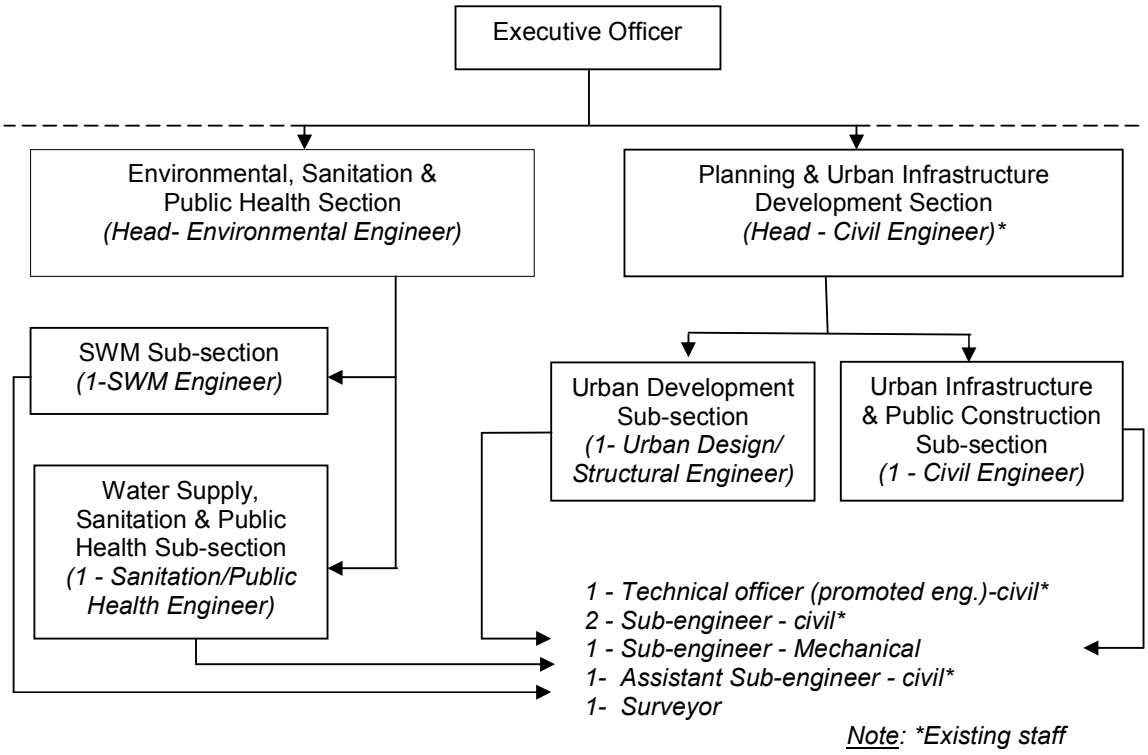
72. The municipality should have, in the medium to long term, in-house capability to independently develop, operate and maintain their infrastructure. The municipality should have planned asset management programs with the necessary resources and capacity to operate and maintain the municipal services provided.

73. Due to the nature of urban infrastructure services to be provided by the municipality, different divisions/ sections/ units should be established to operation and maintain the smooth delivery of each municipal infrastructure service. Competent technical staff in each division/ section must be recruited with clear job descriptions. The recommended institutional arrangement for Bheemdatt municipality is given in **Figure 7-2**.

74. For the proposed expansion of the city water supply, DSC should evaluate different operational and management modalities and make recommendations. Currently, WSUC is one of the better models for water supply operation and management in many towns, including Bheemdatt. However, existing institutional arrangement should be strengthened with recruitment of competent technical staff to ensure sustainable operation and maintenance.

75. The Institutional Development Consultant (IDC) to be engaged through the Project (see Discussion Note #7) will provide further analysis of municipal infrastructure management requirements and provide or arrange training as appropriate.

Figure 7-2: Recommended Institutional Arrangements for Municipal Infrastructure



ANNEX 4B-A

Current Water Supply Scheme Details and Coverage in Bheemdatt Municipality

Annex 4B-A: Current water supply scheme details and coverage in Bheemdatt Municipality

S.N.	Description	Current Water Supply Scheme				Remarks
		NWSC system	**Bhasi Town Water Supply Project**	**Tilachaur Water Supply Project**	**Bhramadev Mandi Water Supply Project**	
1	Project Area	Core city area (Ward no.-3, 4, 6 & 18	Ward no.- 1, 2, 3, 4, 6 and 18 of Bheemdatt Municipality and ward no.- 8 of Suda VDC	Ward no. - 7 (all), 3, 6 & 8	Bheemdatt ward no. - 9, Bhramahadev bazaar	In NWSC system, no whole ward coverage, mainly city area
2	Number of beneficiaries	Total = 1936 (1509* metered connection; 400 non-metered & 27 public tap)	Total HHs = 1432; Metered HH=1032, Public tap = 11	Initially 1555 tap, no increase to 2100	Total Tap = 495	In NWSC system of 1509 metered HH, 100 HHs have been already cut off due to not paying tariff, Non-metered are generally government office which pay fixed tariff rate
3	Type of source/borehole information	Groundwater, deep boring with depth 100m, No. of borehole = 5	Groundwater, deep boring with depth 100m, No. of borehole = 2 including test well, safe yield capacity = 20lps	Groundwater, deep boring, Borehole - 1 with depth 87m and borehole-2 with depth 93 m	Groundwater, deep boring	In NWSC system, out of 5 borehole one bore is not in function, only 4 wells are in function
4	Water storage Tank (No., capacity)	RCC OHT = 180 cu m; Steel OHT = 200 cu m	RCC OHT = 450 cu m	RCC OHT = 450 cu m	RCC OHT = 225 cu m	
5	Production (mld)	6	NA	-	NA	
6	Distribution (mld)	1.9	NA	-	NA	Each HH installs shallow tube well/hand pump to abstract water for using various domestic purposes. NWSC supply is used only for drinking so, demand is too low as compared to production

S.N.	Description	Current Water Supply Scheme				Remarks
		NWSC system	Bhasi Town Water Supply Project	Tilachaur Water Supply Project	Bhramadev Mandi Water Supply Project	
7	Losses	< 25%	Not calculated, newly operated system	High losses, about 1100 meters are damaged due to excessive lime	NA	In NWSC system, losses are not generally from leakage/meter mishandling, but due to 27 no. of public tap. (2) In Bhasi water supply project, no losses have been recorded because of newly operated system (3) In Tilachaur, losses is too much high due to block of meter but losses from leakage is negligible
8	Distribution line	36 km	46.37 km	59.8 km	3.5 km	
9	Water Treatment System	Rapid Sand Filter (2700 cu m per day)/chlorination (Use of standard dosage of bleaching powder)	Pressure Filters plus Water Softening by zeolite process (one of the new method introduced in Nepal)	Filter sand (No.-2, 33 lps size), Chlorination has been stopped	Only chlorination	
10	Water quality issues	High hardness but not severe, about 30% Ca is removed by rapid sand filter	Advanced treatment system (no quality issues)	Excessive lime	No water quality problems (Lime is not high as compared to other municipal areas.	In Mahendranagar water supply scheme, Tilachaur, efficiency of water supply system has been drastically reduced due excessive lime. Because of intermittent water supply system, in presence of air lime converted into hydrated lime (very hard form) and ultimately block pipes, meter etc
11	Pipe materials and size	GI, DI, CI & HDPE, size vary from 1.25" to 8".	DI = 2.51 km (15 to 20 cm dia.); GI = 4.1 km (4 to	GI (1/2"); HDP (1/2" to 3/4")	HDP (4 - 10 kg per cm pressure)	

S.N.	Description	Current Water Supply Scheme				Remarks
		NWSC system	**Bhasi Town Water Supply Project**	**Tilachaur Water Supply Project**	**Bhramadev Mandi Water Supply Project**	
			12.5 cm dia) and HDPE = 39.76 km (4 to 12.5 cm dia)			
12	Supply hour per day	9 hrs (Morning = 4 hr; Mid-day = 1.5 hr; Evening = 3.5 hr)	continue supply system (24 hr) but due to low demand, supply for only 4 hr	8 hr	8 hr (3 times)	
13	Tariff per month	Minimum charge NRs. 110 (up to 10kl); > 10 kl= +NRs. 25	Minimum charge NRs. 180 (up to 8kl); 8-15 kl= +NRS 33; 15-25kl =+NRs. 53; 25-35kl =+83 & >35kl = +NRs. 120)	Minimum tariff = NRs. 100 for 8kl; 9-10 kl = +NRs. 15; 11-15kl=+NRs. 20; >15kl=+NRs. 20	Minimum tariff = NRs. 100 for 10 kl; 10-15 kl= +NRs.1; >15kl = +1	NWSC charges NRs 560 per month to non-metered users
14	Construction, management and operation	Generally city water supply system, which is managed and operated by NWSC, an autonomous entity under Ministry of Urban Development	Constructed by DWSS with 50% government grant, 45% ADB loan through TDF and 5% WSUC; manage and operate by WSUC	Constructed by DWSS with 50% government grant, 45% ADB loan through TDF and 5% WSUC; manage and operate by WSUC	Constructed by DWSS with 50% government grant, 45% ADB loan through TDF and 5% WSUC; manage and operate by WSUC	
15	Project Cost	NA	NRs. 128, 397,649.00			