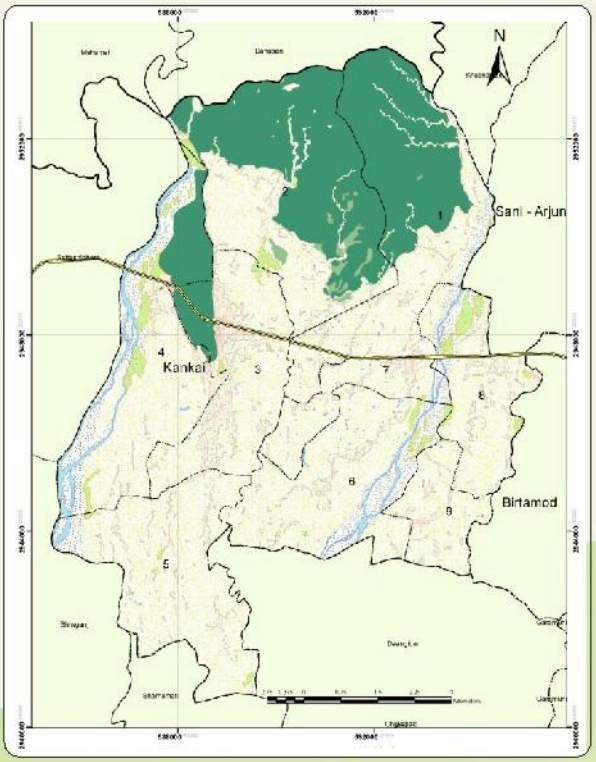
M T M P

Municipal Transport Master Plan (MTMP)

FINAL REPORT



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Kankai Municipality
Jhapa

VOLUME I

Acknowledgement

We would like to sincerely thank Mr Sunil Niraula, executive officer of Kankai Municipality, for his support throughout our stay in Kankai. We would like to express our gratitude to all the members of municipality road coordination committee (MRCC) for their input and guidance for the preparation of MTMP.

We would also like to present my gratitude to all the staff members of the municipality, all the members of the *wada nagarik manch,* the representatives from different political parties for their support and contribution for making the working environment easy and pleasant.

We would like to thank all the citizens for their patience and friendly environment who were directly and indirectly involved in the data collection process. We must thank the volunteers from Bright Future Higher Secondary School for traffic vehicle count on the major road linkages.

The study team

Declaration Letter

We hereby declare that we have conducted the study for Municipal Transport Plan (MTMP) of Kankai Municipality professionally using MoFALD guidelines and other acceptable standard methodologies. To the best of our knowledge, study findings are correct. Municipality Transport Master Plan has been prepared as per standard Engineering tools, norms and practices. Inventory of all the roads has been prepared. The visionary city development plan has been addressed in developing the road hierarchy network and has been approved by the MRCC and municipality along with the prioritization criteria. We would like to assure you that the MTMP is reliable, practicable and adequate to the overall development of municipality transport system. We shall be accountable for any misleading information in any part of this report in respective area of study.

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Acronyms and Abbreviations

DDC	District Development Committee
DOLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DTMP	District Transport Master Plan
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
HH	Household
IDPM	Indicative Development Potential Map
Km.	Kilometre
MIM	Municipal Road Inventory Map
Min.	Minute
MoFALD	Ministry of Federal Affairs and Local Development
MRCC	Municipal Road Coordination Committee
MTMP	Municipal Transport Master Plan
MTPP	Municipal Transport Perspective Plan
O-D Survey	Origin and Destination Survey
PCU	Passenger Car Unit
PT	Public Transport
ROW	Right of Way
Sq. km	Square Kilometre
SRN	Strategic Road Network
ToR	Terms of Reference
VDC	Village Development Committee

Executive Summary

Kankai Municipality is one of the many newly designated municipal area identified as potential growth centre. To develop these area rapidly in a sustainable way, proper planning is necessary. Preparation of municipal transport master plan is the first step in planned development process. The MTMP provides information on the existing status and proposes the necessary interventions for the comprehensive accessibility and mobility within the municipality and with the adjoining areas. It also gives the medium and long term framework and perspective plan considering the visionary plan of the municipality.

Kankai is an urbanizing area in the Eastern Terai of Jhapa district with growing market centre at Surunga and Laxmipur. The East-West highway passes through it. Kankai Municipality is spread over an areas of 79.1 square kilometre and has a population density of 507 people per square kilometres. The density is nearly equal to the density of the Jhapa district. Built up area is only about 6%. According to census of Nepal 2011, the literacy rate of Kankai Municipality is about 75%, the collected sample shows literacy rate of nearly 92% but the level of education above +2 is very low (only 16%). People involved in earning jobs i.e. business and service is also low (24%). Majority of people with higher education are involved in business and service sector. Although 25% of people are involved in agriculture, daily trips made to work in the field is low. Unemployment is also high (19%); most of them have education level below bachelors.

Ownership of bicycle and motorcycle is very high. Still, majority of trips are made on foot (nearly 58%). Share of motorcycle is only 16% and that of cycle is 11%. Public transport is used for only about 15% the trips. The trips are mostly for educational and shopping purpose. Motorcycle is mostly used for business, service and social trips. Use of public transport is highest for trips to office and educational trips. Lack of proper routes and services of public transport within the municipality is the reason for low public transport share. This has also reduced the mobility of the people as the time to reach the bus stop is more than 30 minutes for ward 6 and 9. Most of the trips made are of length 15 minutes or less. Walking is mainly done for time period of 6 to 10 minutes. 30 minute envelop encloses more than 90% of the trips by any means. Of all the roads in the municipality except the highway, 5% is metalled. The East-West Highway passes through the municipality. There is 10 roads of about 48 Km of district core road network (DRCN). The roads are mostly gravelled.

Being an urbanizing area proper road widths and network of hierarchy of roads are not developed. A network of roads supporting present settlements, potential expansion and the visionary development plan has been proposed with cross-sections addressing the need of all sort of road users. As the access to proper roads has reached to the majority of the settlements, the proposed road network increases the efficiency and thus mobility of daily trips. The proposed road network of class A and class B roads are robust and serves

large settlement area and population. Class D roads provide access to the property and Class C roads links these roads to higher hierarchy roads.

For proper allocation of budget to the roads, scoring criteria was developed and approved from the municipality and MRCC. The roads were prioritized and the budget was allocated accordingly. The proposed budget for five years for the roads of all class is NRs. 756,930,000 with 40%, 30%, 20% and 10% share of Class A, B, C and D respectively. It includes upgrading and construction of existing width of 19 Km Class A roads, 11.39 Km Class B roads and 10.90 Km Class C roads to black-topped standard with well-gravelled shoulders and sidewalk along with cycle tracks were space is available.

The current trend in investment in the road sector by the municipality and other agencies shows that there is a huge gap in the required investment and the actual investment. The trend in investment in road sector shows that every year the budget is increased by around NRs. 2,300,000. After being designated as a municipality, for the development of the road network and overall development of the municipality, the existing municipal budget in road sector is projected to increase by 20% every year. Similarly, the roads of Class D should be constructed with active user participation with about 40% in direct investment or labour. The roads A002 and A006 are DRCN roads classified as Class A roads and have highest score in prioritization so, these roads should be developed with the help of DDC to upgrade and construct.

Preparation of MTMP is the first effort for the planned development of the municipal area. This should follow preparation of other plans and their integration. This is an opportunity as well as a challenge for implementing a sustainable transport system in the municipality. The study being its first, should be periodically reviewed and revised along with integration with other plans. This will ensure efficient use of limited available resources and proper development of Kankai municipality.

सारांस

कन्काई नगरपालिका हाल नव गठित धेरै नगरपालिकाहरु मध्ये एक हो । यो नगरपालिकाहरु सम्भावित विकासका केन्द्रका रुपमा स्थापना गरिएका हुन । यी नगर क्षेत्रमा द्रुत विकास ल्याउन योजनाहरु तर्जुमा गर्न आवश्यक छ । यी योजनाहरु मध्ये नगर यातायात गुरुयोजना एक हो । नगर यातायात गुरुयोजना यस क्षेत्रको सडक तथा यातायातको योजना बद्ध विकासको पहिलो चरण हो । पुर्वधारहरुको पुर्वधार भनिने सडकको विकासका साथै अन्य क्षेत्रको पनि विकास हुन्छ । नगर यातायात गुरुयोजनाले हाल नगर क्षेत्र भित्र रहेको सम्पुर्ण सडकहरुको लागत संकलन गरी पहुँच र गतिसिलतालाइ ध्यानमा राखि सडक निर्माण तथा मर्मत संम्हारको भौतिक तथा आर्थिक योजना बनाउँछ । यसो गर्दा नगरपालिकाको सम्भावित आयश्रोत,लामो समयको सोच र Visionary plan लाइ पनि आधार मानिएको छ ।

कन्काई नगरपालिका पुर्वी नेपालको तराई भेगको झापा नगरपलिकामा अवस्थित छ । सुरुङ्गा र लक्ष्मीपुर मुल बजार क्षेत्रहरु पुर्व-पश्चिम राजमार्गमा अवस्थित छन । ७९.१० वर्ग कि.मि मा फैलिएको यस नगरपालिका को जनघनत्व झापा जिल्लाको घनत्वसगँ मिल्दो छ । जम्मा ६ प्रतिशत निर्मित क्षेत्र रहेको यस नगरपालिकाको साक्षरता ७५ प्रतिशत रहेको छ । अध्यनको क्रममा गरिएको घरधुरी सर्वेक्षण अनुसार साक्षरता धेरै भएतापनि १२ भन्दा माथि पढिरहेको वा पढेकाको संख्या न्युन (१६ प्रतिशत) रहेको छ । झन्डै २४ प्रतिशत व्यक्तिहरु आय आर्जन गर्ने व्यवसायमा संलग्न छन । उच्च शिक्षा हासिल गरेकाहरु सवैजसो व्यापार तथा सेवा क्षेत्रमा छन । झन्डै २५ प्रतिशत व्यक्तिहरु कृषिमा र १९ प्रतिशत बेरोजगार छन,जस मध्ये अधिकतम व्यक्तिहरुको शिक्षा स्तर स्नातक भन्दा कम छ ।

घरधुरीहरुमा साइकल र मोटरसाइकलको ownership उच्च भएता पनि झन्डै ५८ प्रतिशत दैनिक यात्रा पैदल तय गरिन्छ । दैनिक यात्रामा मोटर साइकलको प्रयोग १६ प्रतिशत साइकलको प्रयोग, ११ प्रतिशत र सार्वजनिक यातायातको साधनको प्रयोग १५ प्रतिशत रहेको छ । मुलतह यात्राहरु शैक्षिक संस्था जान र किनमेलको लागि गरिन्छ । मोटर साइकलको प्रयोग व्यापार ,सेवा र सामाजिक कार्यका लागी गरिने यात्रामा बढि हुन्छ । नगर क्षेत्र भित्र सार्वजनिक यातायातको पहुँच नपुगेकोले सार्वजनिक यातायातका साधनको प्रयोग न्युन छ । जसकारण सडकको पहुँच पुगे पनि गतिसिलता न्युन छ । वडा नं. ६ र ९ बाट औषतरुपमा सार्वजनिक यातायात चढ्न ३० मिनेट हिड्नु पर्छ । दैनिक गरिने यात्राहरुमा धेरैजसो यात्रा १५ मिनेट भन्दा सानो हुन्छ र ९० प्रतिशत भन्दा बढि यात्राहरु ३० मिनेट वा सो भन्दा कमको हुन्छ । यस अर्थमा travel time budget झन्डै ३० मिनेटको रहेको छ । हाल नगरपालिकाको ५ प्रतिशत सडक मात्रै कालो पत्रे गरिएको छ ।

हालको अवस्थामा कन्काई नगरपालका सडकहरुको चौडाई र तहको सञ्जाल विकसित भएको छैन । तसर्थ नगरपालिकाको हालको अवस्था र बस्ति विकास, र विकासको Vision को आधारमा चार तहको सडकहरुको सञ्जाल प्रस्ताव गरिएको छ । प्रस्तावित सडकहरुको पुर्ण सडकको रुपमा सवै प्रयोगकर्तालाइ समेट्ने गरी पुर्वधारहरु समेटिएको छ । प्रस्तावित सडक सञ्जालले पहुँच पुर्याउनु का साथै यात्रामा गतिसिलता पनि बढाउँछ । क र ख वर्गको सडक robust छन । र यसको सञ्जाललाइ

सार्वजनिक यातायातको रुटहरुको सञ्जालको रुपमा पनि विकसित गर्न सकिन्छ । ग र घ वर्गका सडकहरुले बसोवास क्षेत्रलाइ सेवा पुऱ्याउँछ ।

सडकहरुमा वैज्ञानिक तरिकाले बजेट छुट्याउन प्राथमिकिरणको आधाहरु तय गरी नगर सडक समन्वय समिति र नगरपालिका बाट पारित गरिएको छ । पाचँ वर्षको लागी प्रस्तावित बजेट न. रु ७५६,९३०,०० रहेको छ । जसलाई क,ख,ग र घ वर्गका सडकहरुमा क्रमश ४०,३०,२० र १० प्रतिशत गरी विभाजन गरिएको छ । यसो गर्दा क्रमस क,ख,ग वर्गका १९ कि.मि, र ११.३९ कि.मि र १०.३९ कि.मि सडक कालोपत्रे हुन्छ ।

नगर यातायात गुरुयोजना,कन्काई नगरपालिकाको योजना बद्ध विकासको पहिलो चरण हो यस्ता योजना तर्जुमा गर्ने क्रम निरन्तर हुनु पर्छ र साथै अन्य योजनासगँ नगर यातायात गुरुयोजना समायोजन गरिनु पर्छ । पहिलो योजना भएकाले,यस योजना तर्जुमा तथा कार्यन्वयन एउटा अवसरका साथै चुनौति पनि हो । यसको कार्यन्वयन र आवधिक अध्यावधिले पुरै नगरपालिकाको द्रुत विकासमा टेवा पुऱ्याउछ ।

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SECTION 1. INTRODUCTION

This section presents the context and concepts of MTMP. It also briefly states the objectives and scope of the study. The end of the section layout the contents of the later sections of the report.

1.1 Context and background

Life in cities-i.e., organized human settlements, which are mostly referred to as communities is only possible if people have mobility in daily basis. Residential area is separate from workplaces, major shopping is concentrated in identifiable centers, and larger entertainment and relaxation facilities are found at specific locations. They have to have accessibility. Unlike in a rural context, very few of these destinations are reachable on foot; at least, they tend not to be within a convenient walking distance for all.

Transport facilities help in developing access with the rural-urban linkages. Road accessibility can reduce isolation, stimulate crop production and marketing activities, encourage public services and help to transfer technology. Road building has been seen to bring about notable enthusiasm and visible changes in rural life. Road infrastructure is considered as "the infrastructure for infrastructure". However, in the absence of notable criteria and rational guidelines, road construction is carried out in adverse manner resulting in haphazard use and wastage of limited resources.

Ministry of Federal Affairs and Local Development stepped up to bring forward proposal to create 72 new municipalities in addition to 58 existing municipalities from those urban and semi-urban settlements by combining prevalent Village Development Communities in May 2014. Kankai Municipality is one among them. It was formed by combining existing Surunga and Ghailadubba Village Development Communities (VDCs).

After being designated as a municipal area, it will start to attract more population as socio-economic growth and other infrastructure development will gain pace. The municipality and its surrounding VDCs will see a rapid increase in housing, infrastructure and urban services demand. In this regard, under the coordination of District Development Committee, Morang and as per the decision of Infrastructure Development Division and its technical and Institutional support, the municipality has initiated the formulation of Municipal Transport Master Plan for assessing the present road and transport infrastructures and facilities within the municipality and the surrounding VDCs. So as to be presented as proper municipality or a city, it must have a very good mobility and accessibility by public or private means of transportation.

1.2 Objectives

The prime objective of this study is to prepare the Municipality Transport Master Plan (MTMP/MTPP) for Kankai Municipality. The planning approach is participatory and bottom-up from the settlement level. It includes a constructive plan to incorporate all the transportation needs and facilities for now and tomorrow. The specific objectives of the MTMP are mentioned below:

1. Prepare the Municipality Inventory (MIM) of all road networks.

2. Identify the major road networks linking the municipality with the surrounding areas.
3. Prepare Indicative Development Potential Map (IDPM).
4. Collection of demands for new/rehabilitation transport linkages from Municipalities/settlements based on city development plan.
5. Analyse the present mobility and accessibility situation.
6. Identify and prioritize the interventions based on mobility and accessibility situation.
7. Develop scoring criteria and its approval from Municipality.
8. Prepare the Perspective Plan of transport services and facilities (Municipal Transport Perspective Plan)
9. Prepare physical and financial implementation plan of prioritized roads for the MTMP period.
10. Prepare a five years Municipal transport master plan (MTMP).

1.3 Scope of work

The scope of this work for the project is given below:

a. Accessibility data Collection and Analysis

   The accessibility situation is evaluated from the settlement level and data is collected. Various surveys are carried out to gain such data including their travel patterns, questionnaire surveys and origin-destination survey.

b. Analysis of mobility status of the municipality

   Mobility status is studied. This is important especially because the road network has provided accessibility in Morang district to nearly 100% of the population (DTMP Morang, 2013). The question then arises on how efficiently; economically and safely the goods and passengers are transported, which is indicated by mobility.

c. Assessment of the condition of public transportation

   Data on different public transportation routes and their operation characteristics, which operate within the municipal area and to other adjoining area, is thus collected and studied.

d. Assessment of the safety status and issues

   Road safety status and issues is accessed. For this, roadside condition survey during road inventory survey and other accident data are reviewed. Possible interventions to make the roads safer are proposed and recommended.

e. Preparation of the Indicative Municipality Development Potential Map (IDPM)

   IDPM is prepared using topographical base maps and digitized GIS maps. In the IDPM, potential areas for development are identified and prioritized through ranking. IDPM is verified from the MRCC and Municipality.

f. Preparation of Municipal Inventory Map (MIM) of existing roads of the municipality

Municipal Inventory Map linking to strategic road networks such as national highways, district core road network, main trails and bridges is prepared. This is be done by walkover surveys using enumerators. The inventory map includes the road names, total length and breadth of the roads, surface type, existing condition, Right of way (ROW), vehicular traffic and pedestrian traffic flow etc.

g. Collection of demands for New/Upgrading/Rehabilitation transport Linkages from Wards/Settlements

Data regarding the construction, maintenance or rehabilitation of roads according to the existing condition and demand is done. Such data has been collected through ward meeting or community level discussion. The demand data has been collected in priority order for each ward. The roadside condition of all the linkages has been noted during the road inventory survey.

h. Scoring criteria

Scoring criteria to screen and prioritize all interventions potential interventions for proper allocation of limited budget is developed and approved by the MRCC and municipality.

i. Road classification and Nomenclature

Metric system of nomenclature has been used and applied the same classification throughout the data collection.

j. Preparation of perspective plan of interventions of services and facilities.

The data collected through accessibility survey, demand survey and inventory maps are used to prepare a perspective plan of interventions of services and facilities. All the identified interventions are screened and rated on the basis of approved criteria presented and discussed with MRCC and Municipality. The final perspective plan has been shown in GIS maps.

k. Preparation of a realistic physical and Financial Implementation Plan of Prioritised Roads for the MTMP period

Information on the resources that can be spent on the construction or rehabilitation of transportation infrastructures by the municipality is collected. Studies to project the resources to fund the transport infrastructures for next five years are done. From the total projected resources, discussion with the municipality is done to find out the appropriate proportion to be spent on ongoing roads and new interventions proposed. The projected resources are expected to cope with the total number of roads and new interventions proposed.

l. Preparation of the Municipal Transport Master Plan (MTMP) of Kankai Municipality.

Municipal Transport Master Plan (MTMP) is prepared with due consideration to the existing situation of: vehicular parking, travel routes, modes of transport, etc and future urban growth is proposed. A base scenario of the existing road and transport network and management based on the O-D survey and O-D matrix is

generated, and road inventory map is prepared and transport infrastructure network and management plan based on the travel demand forecast, population growth forecast, and growth rate of vehicular and transport infrastructure is prepared.

m. Medium term and long term planning

The scope of work demands a detailed work plan for five years period (short term). Forecast/estimate of the demand for medium term (10 years) and long term (20 years) is done and recommended a framework to guide future interventions and planning processes.

1.4 Organization of report

Section 1 presents the concept and context of MTMP and lists out the objectives and scope of the same.

Section 2 presents the basic profile of the study area through the available census data and sample data collected.

Section 3 briefly explains the method used to conduct the study, analyse the data and presentation of the findings.

Section 4 gives the existing scenario of the study municipality with reference to transport in the municipality.

Section 5 gives the comprehensive forecast of the population, transport and other development scenario. It also gives the picture of the implications that may arise and the transport infrastructure along with the road hierarchy necessary to meet the demand and accelerate the development. It also describes the short term, medium term and long term plan.

Section 6 is dedicated to the five year (short term) municipal transport master plan (MTMP). It gives the comprehensive strategic framework, perspective plan of the municipal roads, budget expenditure, financial institution, capital investment plan and the staging implementation plan.

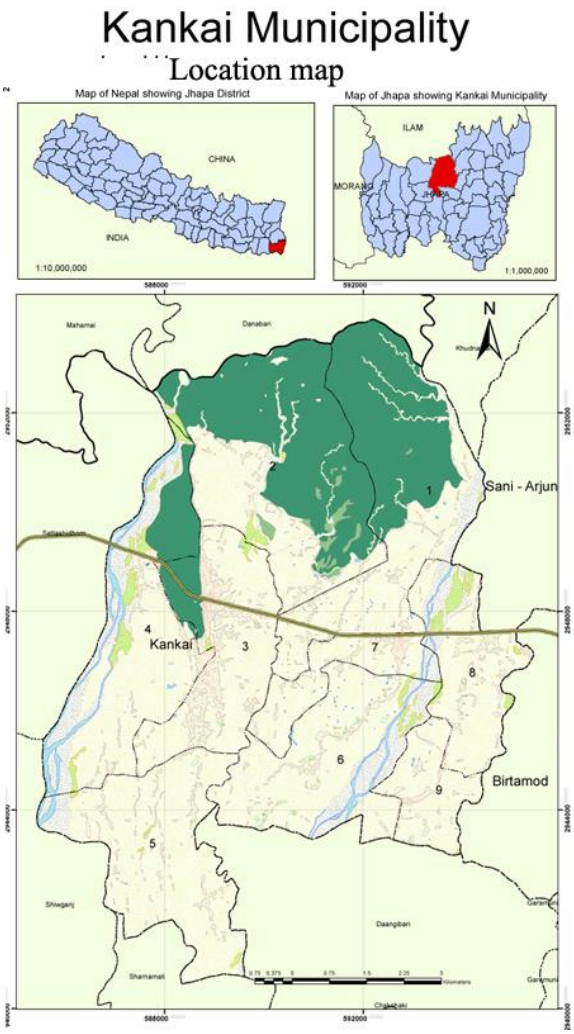
Section 7 summarizes the report and gives necessary recommendations.

SECTION 2. STUDY AREA-EXISTING CONDITION

This section gives the basic profile of Kankai Municipality based on the census data and sample data. It gives the picture of existing socio-economic and transport status.

2.1 Location

Kankai Municipality is located in Jhapa district in Eastern Development Region. It covers an area of 79.10 square kilometre. Surface (road) transportation is the major transport mode in Jhapa district. There is an airport at Bhadrapur. Surface transport is facilitated through SRN, DCRN, and other roads. Kankai municipality is surrounded by Birtamode municipality in the east, Satashidham in the west, Khudunabari to the North and Sharanamanti to the South. Surunga and Birtamode are a business centre for the surrounding area. Other close cities include Bhadrapur, Damak, Biratnagar and Mechinagar.



Map 1 Location map of Kankai Municipality

2.2 Socio-economic and demographic status

2.2.1 Population and population density

According to census of Nepal (2011), the population of Kankai Municipality is 40,141 with 9426 households. It is spread over an area of 79.1 sq. km. the population density of Kankai municipality is 507 people per sq. km. The population density of Jhapa District is 506 people per sq. km. As such, the population density of Kankai municipality is not high.

The age distribution of the collected sample is in close proportion with the census (2011) data. There is inconsistency in the age group of 0-15, this may be due to the fact that the sample of age group 0-4 do not generate specific trips and are not included in the study. The distribution is shown in the *Chart 1*.

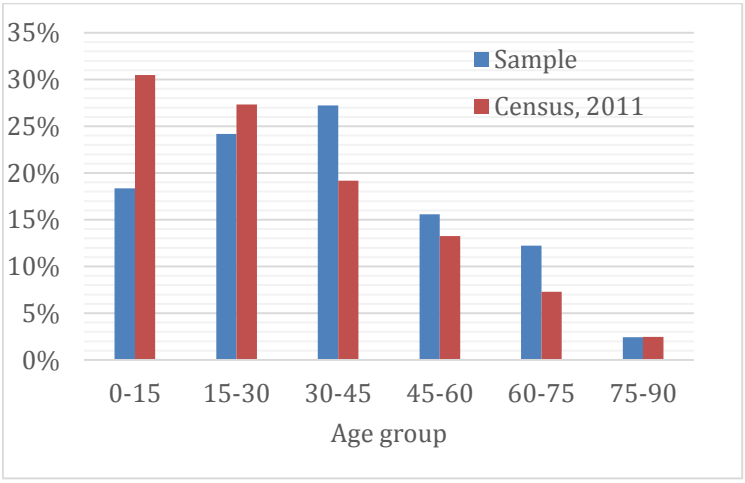


Chart 1 Age distribution of sample and census population

2.2.2 Household structure

The proportion of sample and census are accurate. According to census of 2011, 46% of the population is male. The data collected from households of Kankai municipality has a male proportion of about 51%.

The census data and sample data with respect to age distribution and structure are nearly equal. Thus, the samples collected are representative of the population and the conclusions drawn represents the population.

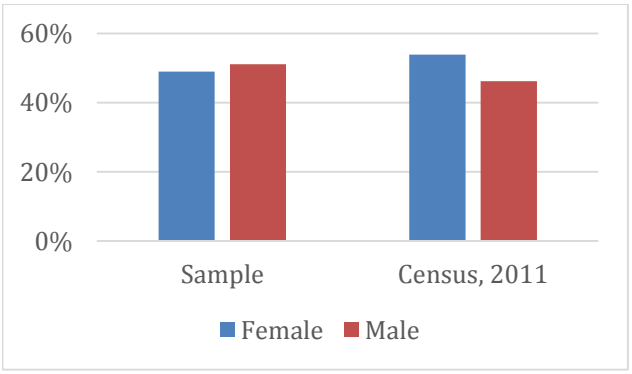


Chart 2 Proportion of male and female

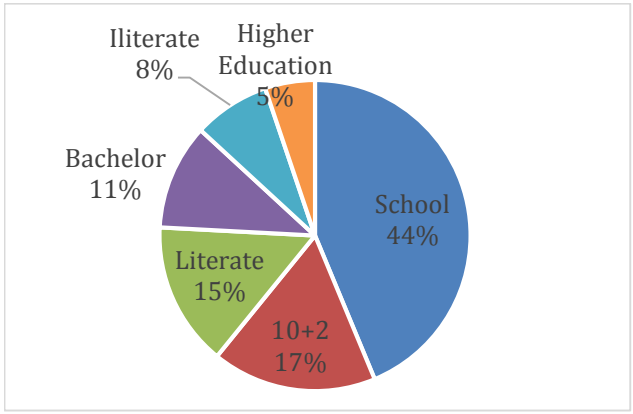


Chart 3 Education of sample

2.2.3 Education

Nearly 44% of the members of the surveyed households have completed or are perusing only school level education. About 17% are enrolled or are have completed higher secondary (10+2), 11% have bachelor's degree and only 5% have higher education. As such, literacy rate is high (85%) among the residents of the municipality (Ref. Chart 3).

2.2.4 Employment pattern and income

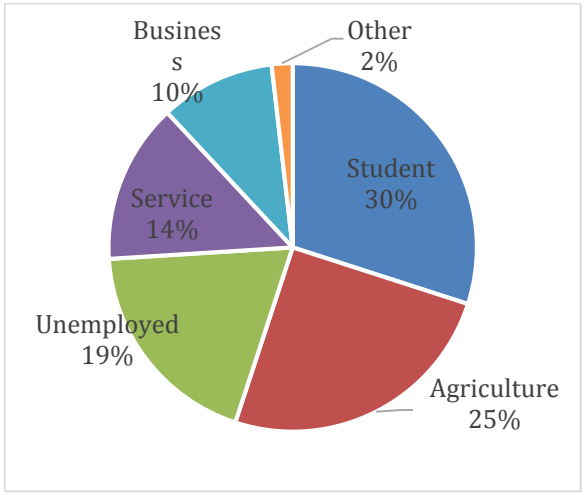


Chart 4 Occupation distribution of sample

Among the members of the interviewed households, 19% of the sample population were unemployed. About 30% of them are students and about 25% are involved in agriculture. Only 14% are employed in service sector and 10% have their own business (Ref. Chart 4).

Most of the respondents with higher education are involved in service sector. Illiteracy is highest among unemployed people followed by those involved in agriculture while school level education dominates all occupation. A majority (47%) of the household said that they have monthly family income of less than 20,000. About 15% of the households have their monthly family income of 20,000 to 30,000.

2.2.5 Vehicle ownership

Only 3% of the interviewed households owned a car. Among the surveyed households, only 17 households do not own any private vehicle. Nearly 60% of the households owns a motorcycle and 55% owns a bicycle. Bicycle ownership is about 18 per 100 sample population and the ownership of motorcycle is 15 per 100 sample population.

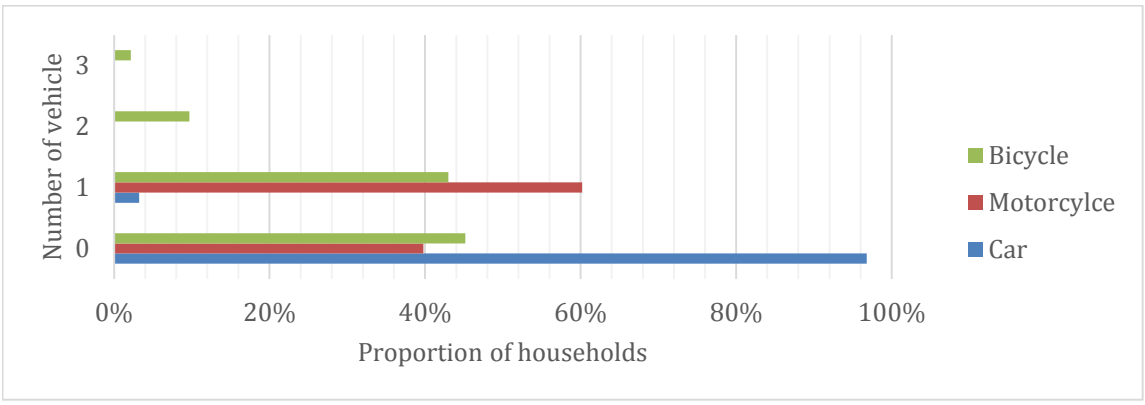


Chart 5 Proportion of households owing different vehicles

2.3 Land use pattern

The land use distribution of Kankai municipality shows that nearly 57% of the land area is cultivated. About 26% of land is covered by forest and bushes. And 6% of the land is covered by built-up area.

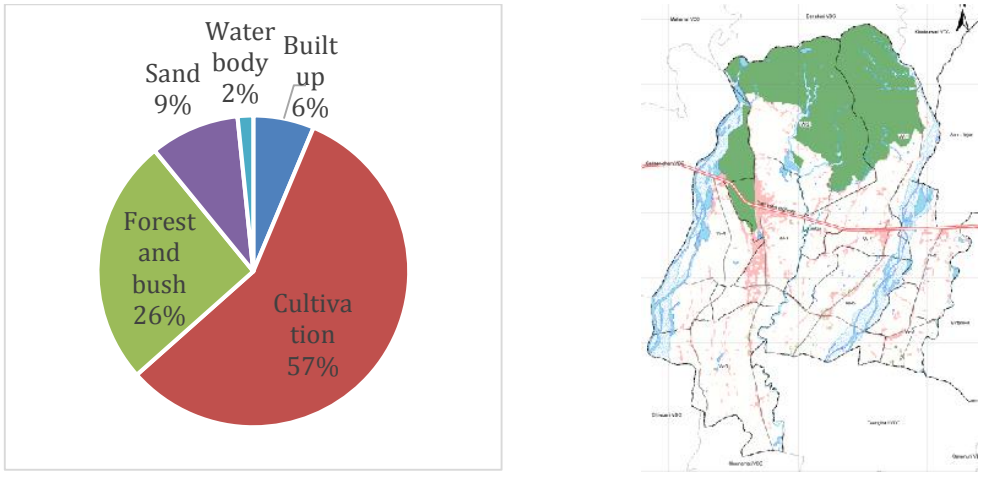


Chart 6 Land use distribution

2.4 Road and traffic

Surface transport is the only mode of transport in Kankai Municipality. East-West Highway is the backbone of the road transport in Kankai Municipality. Few roads close to the highway are paved, else most of the roads are gravelled or earthen. Highway is the only road that supports proper public transportation.

2.4.1 Road inventory

Road inventory survey of all the roads within the municipality has been done. The inventory collected shows a total of about 112 Km road of all surface type. Of the surveyed

roads, 37% are gravelled and 58% of the road length is earthen. Only about 5% of the road is metalled.

The total width of the roads vary form 5 m to 35 m. Roads with 5 m and 6 m total width are most extensive.

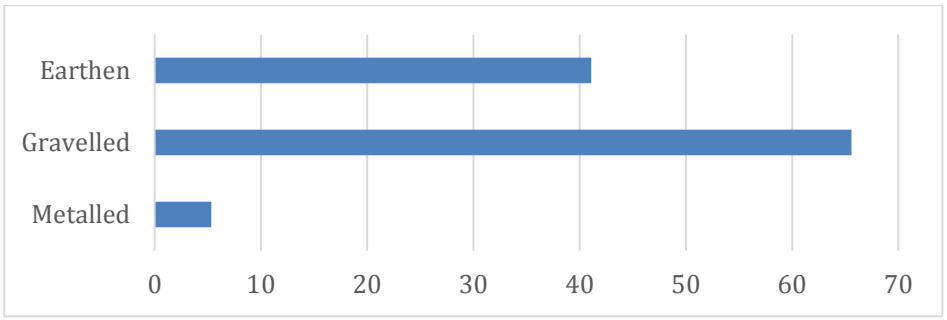


Chart 7 Length of different surface type roads

Of these roads, there is East-West Highway passing through the municipality along with two other DRCN as listed below:

Table 1 List of SRN and DRCN within the municipality

Name of Road	Road Type	MTMP road name	Length within municipality (Km)	Width (m)	Surface condition
East-West Highway	SRN	H			Metalled
A005	DRCN	A002			
	DRCN	A006			

2.4.2 Traffic vehicle count

Traffic vehicle count has been done at two stations along the highway. The composition of vehicle shows that the major vehicle that plies on the roads of Kankai Municipality is Motorcycle followed by trucks and buses. Other than these, bicycle and car/jeep/taxi also have a share above 10%.

Table 2 List of traffic vehicle count stations

S.N.	Name of road linkage	Station
1	East-West Highway	Surunga
2	East-West Highway	Laxmipur

The charts below shows that bicycle composition is about 11% at both stations. This is clear indication of higher use of bicycles by the local people. The composition of motorcycle is high in both stations along the highway. Use of motorcycle is high among the economically active road users.

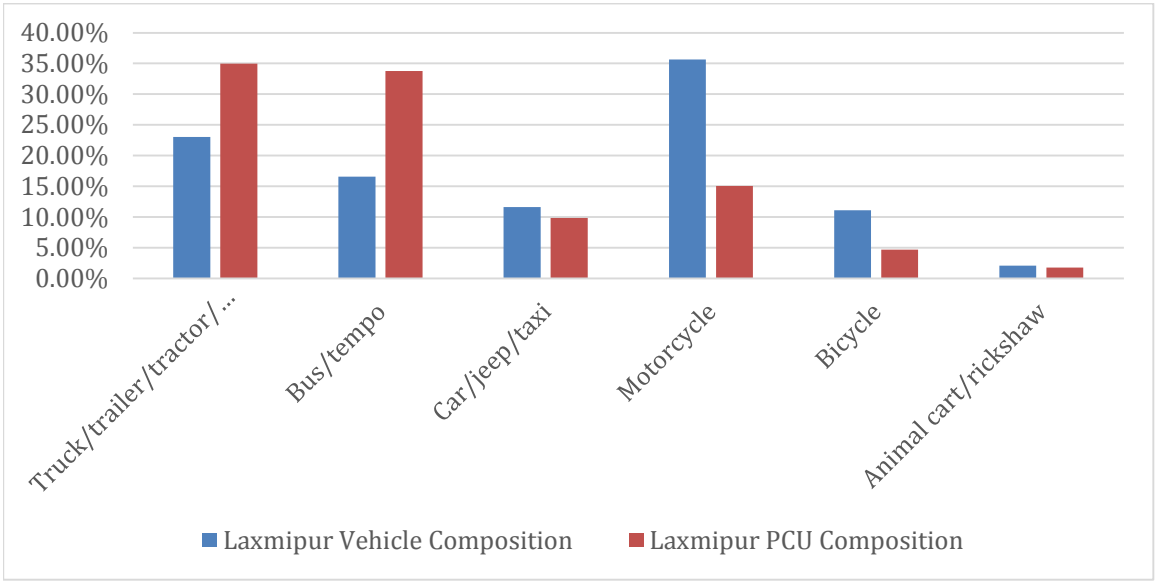


Chart 9 Vehicle composition and PCU composition at Laxmipur vehicle count station

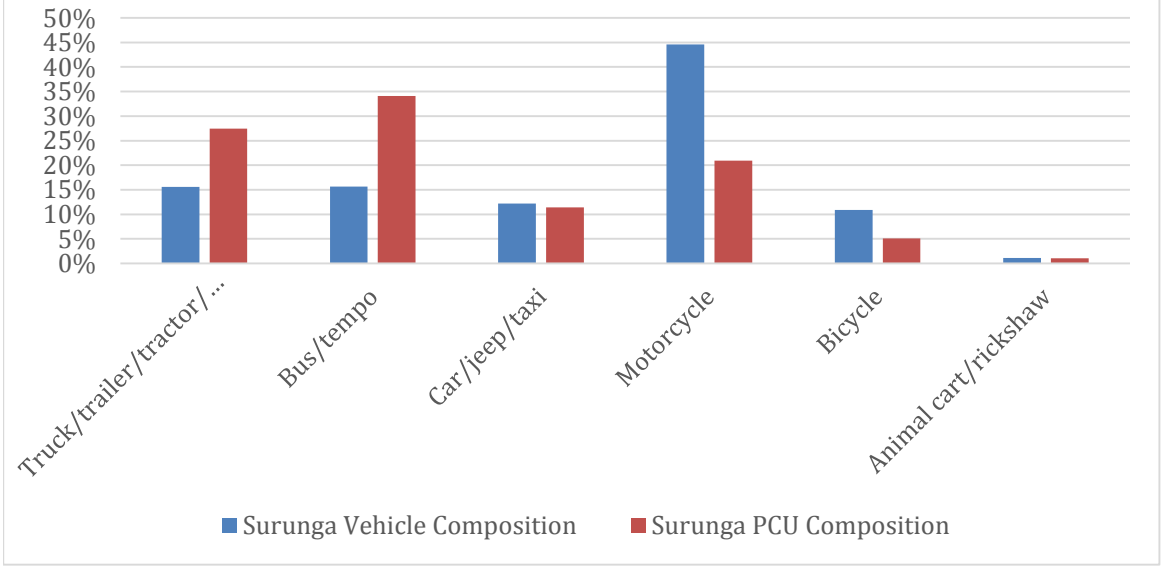


Chart 8 Vehicle composition and PCU composition at Surunga traffic count station

The composition of public vehicles is nearly same at both ends, this shows the service to nearby VDCs and municipalities is limited along the highway.

2.5 Summary and findings

The sample data shows that the literacy rate is high among the residents of Kankai Municipality but, people with higher education is very low. People with basic or no education are mostly either unemployed or are involved in agriculture. Service sector has employed most of the people with higher education. Thus, level of education has a crucial role in increasing the number of economically active people and thus increasing the size of the local economy.

Road transport is the only transport mode for movement in Kankai Municipality. Surface transport is facilitated through the national highway and district roads. Built up area is low in comparison to the usable area of the municipality. Vehicle ownership is high among the people of the municipality. The plain terrain has facilitated ownership of bicycle among the households. Relatively growing economy and well-connected roads has allowed ownership and use of motorcycle. Its use is high among economically active population. Motorcycle and bicycle has a major traffic share in the roads of the municipality.

SECTION 3. METHODOLOGY

Municipal roads are supposed to provide both access and mobility to all possible and potential areas. MTMP will prepare the plan of such roads to fulfil the stated objective. Better planning is incomplete without relevant quality data which can only be acquired by use of properly selected survey methods. This section gives the methodological framework adopted for data collection including survey methods conducted, sampling techniques, quality and quantity of data along with data processing, analysis and presentation methodology. Both primary and secondary data are collected based on participatory bottom-up approach.

3.1 Approach

Municipality Transport Master Plan has been prepared using participatory bottom-up approach and differs from conventional practices of trickle down approach. Techno-Political interface has been incorporated in the planning process, where active participation from representatives of political parties, line agencies, municipality officials is crucial. The Municipality Road Coordination Committee (MRCC) has been constituted as authorized legislative body of municipality. This body, comprising all political parties' representatives ward representatives, women and minority representatives and concerned technical officials, helps in necessary policy decisions during the MTMP preparation and implementation process. The local people are also involved in the initial stage of data and demand collection. Therefore, bottom-up participatory approach has been used in both data collection and planning process.

The detail methodology has been explained below. *Chart 10* gives the brief framework of the methodology.

3.2 Preliminary planning

Preliminary planning, or desk study, is the study of the information related to the project from the eyes of secondary data and information. It includes study of available literatures, reports on study area, and the objectives and scope of the work to be carried out. It is a very important step in the planning process because unclear objectives can result in misleading/unnecessary survey; which may render the process use less or expensive. The preliminary planning identified major surveys to be conducted to collect data and information necessary to meet the objectives of the study. Design samples were found, instruments for conducting the surveys were designed, method of administration has been decided, and computer coding for data entry has also been done. The details of the preliminary planning is given below:

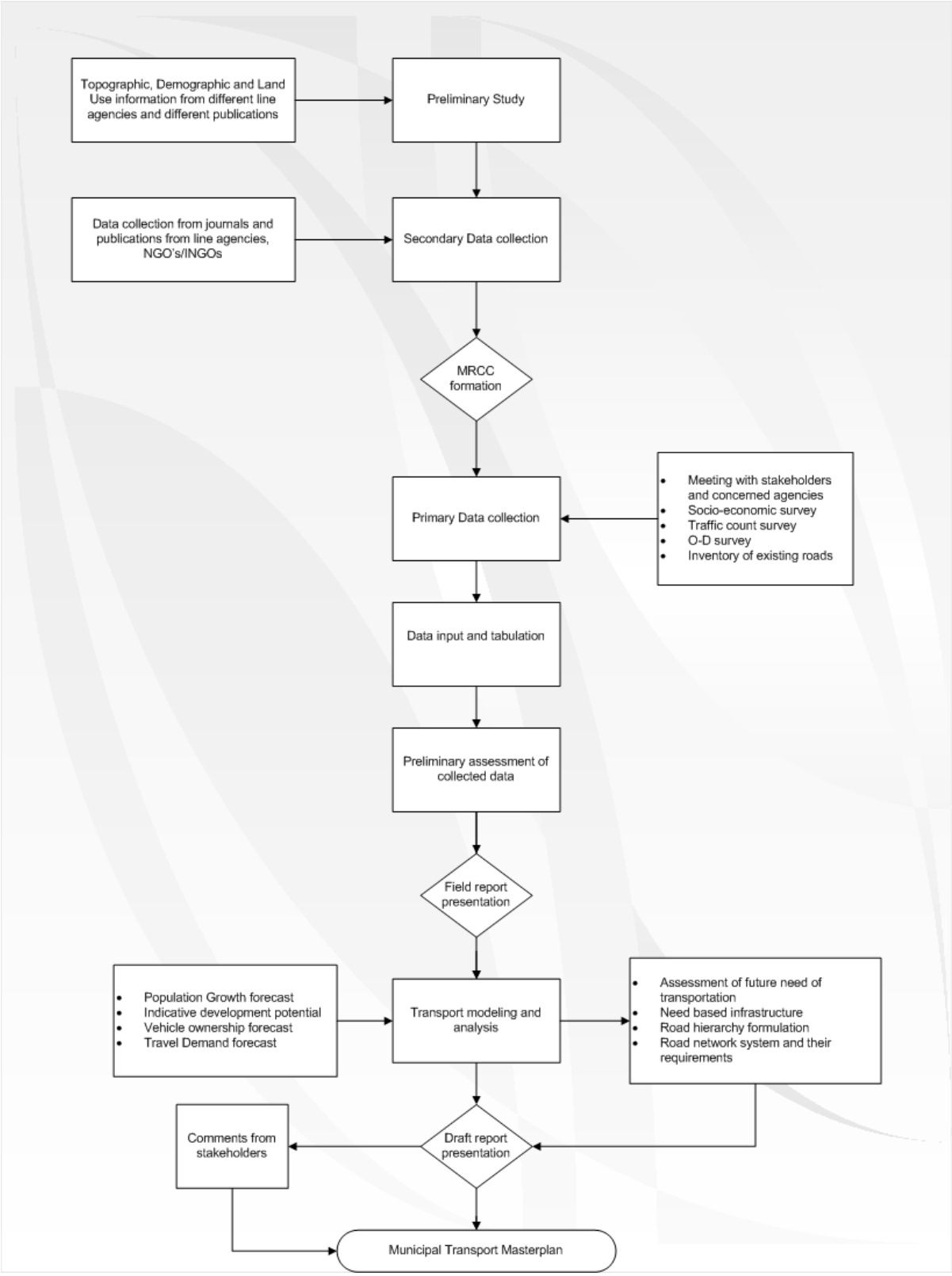


Chart 10 Methodology flowchart

3.1.1 Selection of survey methods

The task of selection of survey method is crucial for the efficiency and effectiveness of the overall survey effort. In general, data can be categorized into primary and secondary. Both, primary and secondary data are to be collected for the project. Pertaining to the specific objectives and overall objectives of the project, following specific surveys are identified to be conducted in the field.

- Road Inventory Survey
- Demand Survey
- Origin-Destination (OD) Survey
- Accessibility Survey
- Traffic/Vehicle Count Survey
- Other secondary data collection

To conduct these surveys, following survey methods will be applied:

- Field verification of base maps and GPS coding of the nodes and linkages
- Household Interview Method for Origin-Destination Survey and accessibility survey
- 12-hr two way classified vehicle count along major road linkages
- Collection of secondary data
- Interview of the municipality authority and other stakeholders

The scopes of the project require preparation of road inventory map, nomenclature and coding of the road linkages, and assess the condition of the road and road side furniture. This has been done via **road inventory survey**. It includes field verification of the base map and collection of data on its condition and required interventions. During the road inventory survey, the road safety status and issues has also been noted. The roads has been classified based on the field report and coded accordingly. To assess the demand of the local people, a **demand survey** has been conducted for every ward. Demand survey has been done by providing each ward a form (demand survey form) to be filled after a meeting of the *wada nagarik manch*. The form includes demand of new facility or interventions to improve existing roads along with priorities. Similarly, **household survey** has been done to access the trend of origin and destination of trips and the accessibility and mobility status of the people. It has been done by household interview method. The survey team was briefed on the questionnaire for household survey and mobilized to conduct the household interviews. To gather the information on traffic that uses different road linkages, a 12-hour **vehicle count** has been conducted at major road linkages. Classified traffic count of both directions at an interval of 15 minutes has been conducted. To collect the traffic flow characteristic at different linkages, local personnel were mobilized. The team organized a basic training session on a public holiday to inform the enumerators of the task. A team of two, equipped with the necessary field sheets and pen, were stationed at each vehicle count station. The study team member constantly monitored the data collection throughout the day. Information on the different routes of public transportation that operates via municipality or from the municipality has also been noted. This has been done by directly interviewing the route operators and local passengers.

The necessary secondary data includes population and demographic data, reports on previous studies, annual budget, projected budged (if any) and transport conditions (municipal level decisions related to transport). Other information on potential development and plans of the locals has also been noted which include existing and potential settlement expansion areas, open spaces, parks and recreational areas, religious places, forest and river encroachment. To gather information on available sources of fund and other information from secondary source, a discussion was opened for available sources of fund during the orientation program among the different stakeholders present during the program. Sources of such information were also noted and the document has been retrieved for study.

3.1.2 Sample design

Sampling is a means to select a subset of units from the population, whose characteristics and properties will represent the population characteristics and properties as a whole. Sampling can be done by non-probability method and probability method. Both these methods will be used to determine the sample size for different surveys. The interview of the ward representative and municipality authorities is a non-probability sample for demand survey. In case of OD survey, a probability method will be used, where households from each cluster will be selected at random for the interview. The number of household to be interviewed will depend on the total population and household characteristics of each cluster.

Sample size is determined using the following empirical relations:

For populations that are large, Cochran (1963:75) developed the Equation to yield a representative sample for proportions.

$$n_0 = \frac{Z^2 pq}{e^2}$$

Which is valid where n_0 is the sample size, Z2 is the abscissa of the normal curve that cuts off an area α at the tails (1 – α) equals the desired confidence level, e.g., 95%, e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p. The value for Z is found in statistical tables which contain the area under the normal curve.

Finite population correction for proportions

If the population is small then the sample size can be reduced slightly. This is because a given sample size provides proportionately more information for a small population than for a large population. The sample size (n_0) can be adjusted using Equation

$n = \frac{n_0}{1+\frac{(n_0-1)}{N}}$ Where n is the sample size and N is the population size.

3.1.3 Survey instrument design

The instruments used to conduct the field surveys are questionnaire and different forms. Other instrument is field verification of base map for road inventory and recording of road side condition. A base map along with the road inventory survey sheet has been used to collect necessary information on the road linkages and roadside conditions. GPS has also been used to locate any road linkages not present in the base map. Primary data collection

by recording the number of classified vehicles that passed the major road linkages has been done to collect data on existing road use and existing traffic conditions.

Similarly, direct interview with the authorities and Focused Group Discussion (FGD) of all the stakeholders has also been carried out. The ward representatives were asked to conduct a general meeting of its members and fill out the form provided to collect information on demand of the locality.

The instrument used to conduct the survey is mainly questionnaire. Questionnaire for O-D survey, demand survey, and accessibility survey is prepared. The questionnaires is filled by the interviewer. The questionnaires were designed to minimize writing by the respondents by defining possible answers. The questionnaire had clear and concise sentences to minimize confusion. It includes questions for information on respondents' demographic and socio-economic characteristics, trip characteristics and their accessibility and mobility condition.

Similarly, interview with the municipality authority and other stakeholders has been done to identify any source of fund available to implement future interventions.

The instruments have been selected to enhance survey efficiency.

3.2 Survey administration

The project team has been directly involved in designing of the survey instruments and has also been directly involved in carrying out and supervising the survey at field level. The team members ensured proper understanding of the purpose of the survey to the respondents by clearly stating the objectives and what the questions demanded. The direct involvement of the team members in the survey design, administration, data input and interpretation ensure minimal distortion of the information collected.

3.3 Data processing and editing

Once the data collection at the project area is completed, the filled questionnaire and field data had to be converted into useable information/results for its use. It involved initial editing, coding, data entry, and computer editing and data correction. The field data has been inputted in the excel spread sheets and processed as per requirement. All the questionnaires collected has been checked for their completeness and verified by the team members before entering them to excel sheets. The input has been done in standard forms so as to ensure uniformity, easy editing and analysis. After the data input has been done, a field report has been prepared with initial analysis and has been presented to the authorities and other stakeholders.

3.4 Data analysis and management

The input data has been properly stored in the Excel sheets and used as per necessity and requirements. Microsoft Excel and GIS software were used to analyse and manage the data. The analysis rendered the available data into valuable information. Data analysis involved calculation of different attributes for different clusters and for the project area. It includes basis analysis of average values such as average time to nearest bus stop, access to nearest all-weather road, percentage of respondents using specific type of

vehicle for daily commute, etc., forecasting the population and demand for transport infrastructures and furniture developing land use and transport models.

3.5 Use of GIS Software

GIS software has been used for the preparation of different maps and database of the municipal roads and other details. GIS maps prepared for Municipal Transport Master Plan (MTMP) can be summarized in the following points.

1. Preparation of map
   Shape files for Ward Boundary, VDC Boundary, District Boundary and Development Region Boundary was obtained from Department of Survey. Boundary for New Municipalities were generated by merging the previous VDCs using the Dissolve tool in Arc GIS. Ward Boundary of each municipality were also generated in similar manner. Satellite image of the respective municipality was obtained using Image Capture Software and Google Earth. A .kml file was used to obtain an enclosed area for image capture using Google Earth. The image was captured in spatial reference of WGS 1984. After the image was captured, layers for land use, road, buildings, etc. were digitized. Then, WGS 1984 was transformed into Modified Universal Transverse Mercator (MUTM) in three regions namely MUTM 81, MUTM 84 and MUTM 87.

2. Data Entry and field verification
   After Ward and Municipal Boundaries and other necessary data was obtained, data entry for roads and place name was done. For Roads, fields were added in attribute table for Total Width, Carriageway Width, Surface type, road name etc. Data obtained from field inventory and verification for roads, land use was manually entered for all roads using Editor Tool in Arc GIS. GPS was also used for recording place names, Buildings, Culverts and Bridges in the field. This GPS data was converted using "GPS Conversion tools" and then used in Arc GIS.

3. Cartography

   After field verified data was entered then map preparation was done. All the maps are prepared in Arc GIS version 10.2.2. MUTM 87 was used as projected coordinate system. All maps are prepared in a scale in the multiple of 1:25000. Symbols for Road classes have been used as described in Terms of Reference (ToR) provided by MoFALD. Other symbols are standard and are used so that the whole map expresses what it is intended to.

3.6 Formulation of MRCC

The municipal road coordination committee is responsible to assist and monitor the preparation process of the MTMP. Thus, the study team assisted in formulating the MRCC

for Kankai Municipality. The committee was formed under the chairmanship of Executive Officer of the municipality.

3.7 Preparation of Indicative Potential Development Map (IDM)

Development is simply the act or process of growing, progressing or developing. Transformation from a VDC into a municipality will certainly bring change in various aspects in the municipal area in the long run. Such changes should be predicted to the best possible accuracy so that the infrastructures that are being developed now can sustain the change. IDPM is basically the indication of the existing land use, concentration of facilities and service centres, market centres (key growth centres) and the areas having various development potentials such as high value cash crops, agro-based industries and tourism.

Preparation of IDPM is one of the scope of the project, for this secondary data was collected during various meeting. The data was used to find the indicative potential for development and a map was prepared accordingly. It also indicates the grading of various markets of the district thus providing the basis of network planning.

3.8 Developing scoring criteria

While developing any infrastructure we always have to face limitation of time and budget. It is not always possible to develop all roads at a time. Therefore, each road link needs to be identified for its necessity distinctly from others so that they can be prioritized. After developing a municipal level network, the cost estimate of the road is prepared. Existing width of road, total population served, settlement and road density served, demand by the wards, proposed road class, existing surface type, access to specific potential development areas such as recreation, agriculture, market and services, and access to marginalized and poor has been taken as the indicators for prioritization. The scoring criteria has been finalized after rigorous study and approved by the municipality.

3.9 Presentation of results

The results obtained can only be perceived well by the readers if presented properly. Presentation tools such as charts, graphs, maps and reports are used to present the analysis and results obtained. The specific presentations of results is summarized below:

- Reports: The analysed results are properly explained in the reports. Report of the analysis are presented at different levels as inception report, field report, draft report and final report. Any questions raised or clarification demanded after the submission of draft report will be included in the final report.
- Charts and graphs: Relevant type of charts, tables and graphs are used in the reports to present the information. Charts are especially useful to deliver the information more effectively.
- Maps: As the ToR demands, maps of road inventory, indicative development potential map, land use map and municipality transport prospective plan map are prepared.

- In addition to the reports, the obtained results are shared via presentation and electronic copy of GIS maps.

The analysed data and obtained results in the form of numbers/ tables and maps are collected in and presented as draft report in two volumes. The results are presented and discussed among the municipality authorities and other stakeholders before preparing the final report.

SECTION 4. EXISTING SCENARIO OF KANKAI MUNICIPALITY

This section gives the existing scenario of transport and land use with reference to different aspects of transport- accessibility, mobility, active and passive users, existing scenario of public transportation and safety status and issues.

4.1 Land use and transport

Transport is a service rarely in demand for its own characteristics (Cole, 2005). *Most individuals travel because they wish to benefit from the social, recreational, educational, employment and other opportunities which become accessible with movement. Similarly, freight transport opens up opportunities for greater efficiency in production and permits extensive geographical specialization with the accompanying benefits of increased division of labour* (Elgar, 2002). It is clear that demand for travel is derived from the demand to meet above benefits. The demand for travel depends on the spatial distribution and location of various infrastructures such as educational institutions, market and business centres, customer service outlets, etc. The trips made can be characterized by the reason for which it is made and the choice of mode.

At present land use with about 6% built up area has the road density of about 3.69 Km per Km^2 for the municipality as a whole. Considering the useable area only, the value is 3.88 Km per Km^2. Considering the useable area only, road density is highest in ward 3 (9.5 Km/Km^2).

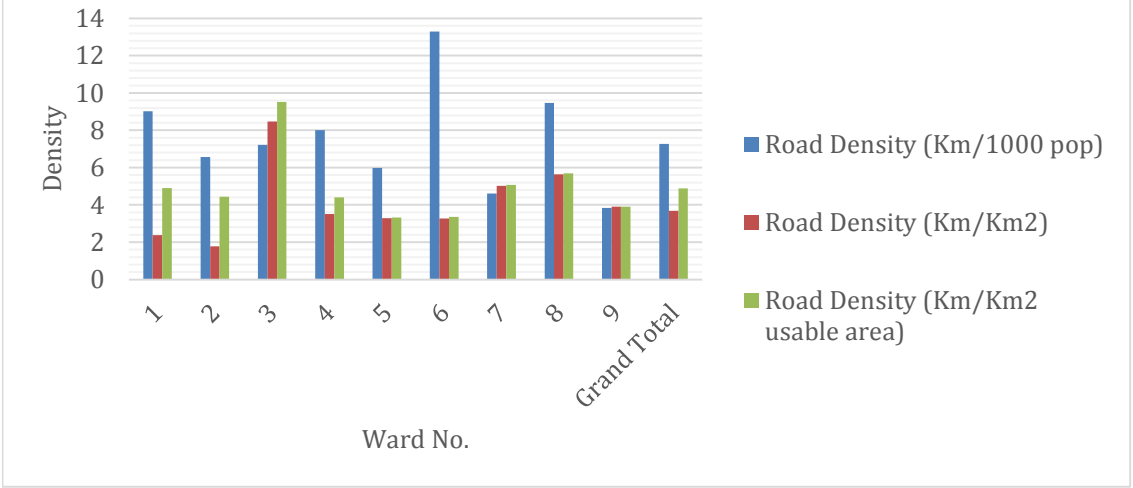


Chart 11 Road densities

4.2 Accessibility and mobility

The accessibility of all-weather and fair-weather road in Jhapa district as depicted by the DTMP (2013) expects to reach 100% through the interventions proposed by it. This is basic accessibility, i.e. all the people get to all weather road in 2 hours or less. Such conventional accessibility refers to access to the road itself and not the purpose of the trip for which the road is demanded.

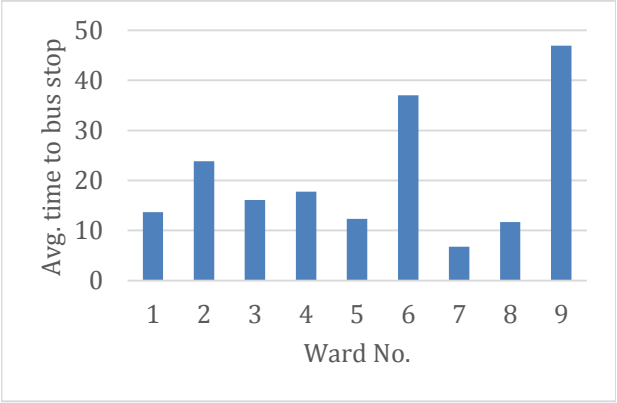


Chart 12 Average time to nearest bus stop for different wards

In modern concept, accessibility is defined as an access to the services and facilities, not the derived travel. Access to proper roads is not a problem in Kankai Municipality. But the access to the services and facilities is questionable in some areas. With an average travel time of about 19 minutes by any means, the average time to bus stop in some wards is close to twenty minutes and more. This hinders their mobility and thus renders the services and facilities inaccessible. The average time to reach the nearest bus stop is about 19 minutes. The value is highest for ward 9 (47 minutes) followed by ward 6. Thus people have to walk a long way to get on a public vehicle. Unreliability of public vehicles has hindered their mobility and increased dependence on privately owned bicycles and motorcycles.

The proportion of trips of specific length (in minutes) made by different means is shown in the figure below.

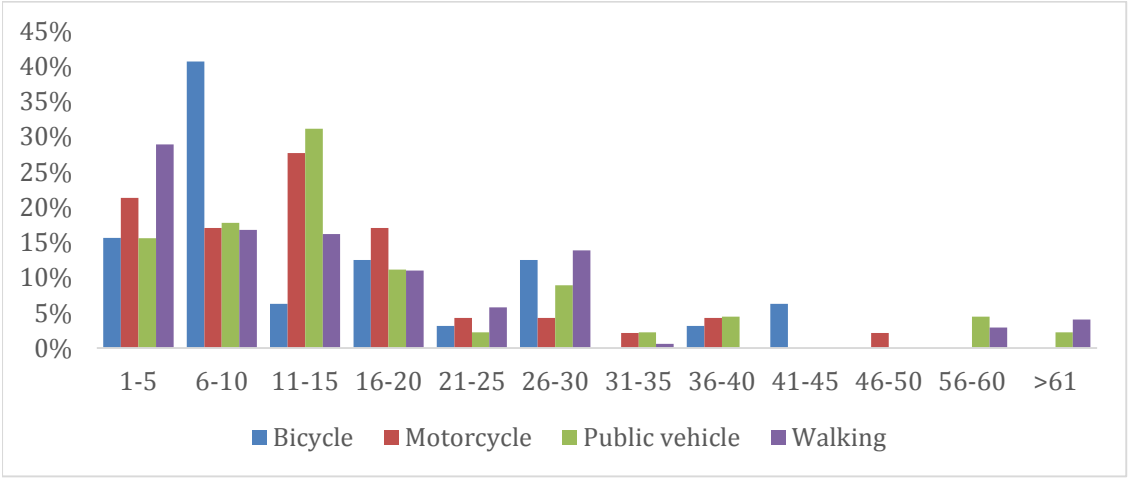


Chart 13 Proportion of people using specific vehicle for different trip length (minutes)

The figure shows that a majority of trips made via any means is of length 30 minutes or less. Except for the use of public vehicle, the share of trips less than 10 minutes is maximum. This shows the preferred distance of travel is variable based on the speed of the vehicle available. The travel time budget is about 30 minutes. Higher mobility (speed)

allows greater distance to travel in the same time interval. This brings wider range of facilities within the reach of the people.

4.3 Active and passive transport users

Active transport (also called non-motorized transport, NMT and human powered transport) refers to walking, cycling, and variants such as wheelchair, scooter and handcart use. It includes both utilitarian and recreational travel activity, plus stationary uses of pedestrian environments such as standing on sidewalks and sitting at bus stops (Litman, 2015). The sample household survey shows that nearly 70% of the daily trips are done via active mode of transport. Active mode of transport is beneficial in many aspects: this mode can be used by people of any age group irrespective of gender and economic status, it consumes human energy and does not depend on fossil fuel, and it is environment friendly and provides many health benefits to the user.

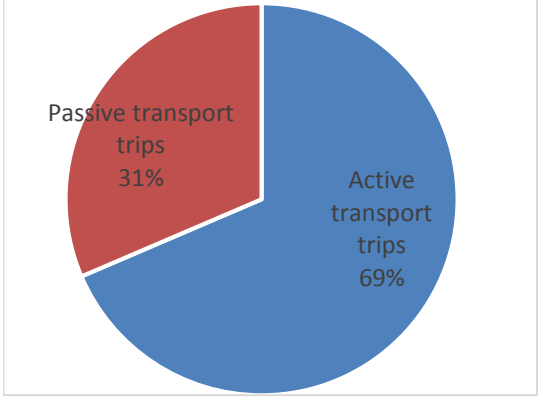


Chart 14 Proportion of active and passive road users

4.4 Public transportation

The use of public transportation for daily trips is limited to the East-West Highway and along the Birat Road. Public vehicles along the Birat road is not formal form of public transportation as it does not have defined time schedule and is not reliable. There is no public transport along other road sections of the municipality.

Mobility rely on the privately owned vehicles or walking. It is prime time to implement interventions to introduce proper public transport routes and services so that a sustainable proper public transportation can be established and increase in number of private vehicles can be controlled in the future.

4.5 Safety status and issues

According to the regional traffic headquarters, Itahari, Jhapa stands fourth for number of road accidents in the eastern region. The data provided by the office shows that majority of vehicles involved in the accidents is motorbike with negligence of the driver and over speeding as the major causes.

The municipal roads are mainly used by bicycle users and pedestrians. Use of motorized vehicles is very limited as the ownership of motor vehicles is low. Thus, with majority of slow vehicles plying in the municipal roads, the roads are safer. This situation has facilitated the use of bicycles in the municipal roads by children to go to school, women to go to shopping and others for all sorts of purposes.

But the situation is not very friendly along the highway which supports all sorts of high speed motor vehicles. The East-West Highway passes through the urban centre (core

market area) of Kankai Municipality. Expansion of market area alongside of the highway has exacerbated the risk. Road section along the bridge and highway section beyond the market area has limited carriageway width and is shared by all sorts of vehicles including the pedestrians. Cyclists and pedestrians are at highest risk along these section. Thus, proper urban road infrastructure should be provided along the highway as it is a part of an urban road network.

Low traffic volumes has allowed the use of paved surface by the pedestrians. The roads also lack proper zebra crossings. Traffic rules are not properly followed and enforced.

4.6 Summary and findings

The existing road network has provided access to most of the settlements in Kankai Municipality but, the motility is still dependent on the privately owned vehicles and walking. Use of active mode of transport for any purpose is dominant. But the current trend of development of road and its infrastructures do not support these road users. Thus, protection of this group of users is also vital in the planning process. Access to public transport is limited to highway and few internal roads. The network of public transport is very poor.

SECTION 5. FORECAST AND PLANNING

This section basically deals with future projection of population and vehicle along with allocation of future potential development areas. It also formulates the of hierarchy of roads with various proposed right of way for different class of roads along with relationship of future oriented land use and transportation planning. It also deals with various infrastructure planning and how they will help to enhance the mobility and accessibility scenario. Finally it covers the aspect of short term, medium term and long term transportation planning.

5.1 Population and Traffic Projection

The population and population density of the municipality is expected to grow rapidly after designation as a municipality. Higher migration rate is witnessed in desire for better economic opportunities, desire for better living or housing conditions, movement for reasons of health, education, or retirement etc. For sustainable supply of transport infrastructure, it is pertinent to forecast the population in the future so that the infrastructures can be planned and constructed accordingly. Population forecast is considered simpler for areas showing stability in the size of their populations for several decades, change in the economic and social conditions; whereas it becomes an extremely difficult and complex for areas having sharp fluctuations in the direction or rate of population change. Population can be forecasted via various methods, which includes arithmetic, geometric, arithmetic incremental method, logistic curve method and so on. Among various method, geometric growth factor method is one of the widely used method of forecasting, which is based on the following formula,

$$P_n = P\,(1+ I_g/100)^n$$

Where, I_g = geometric mean (%)

P = Present population

P_n = Population at the end of 'n' year.

Census data were used to calculate the growth rate of each VDC's, which has been further used to estimate present year (2015) population with assumption that the growth factor remains the same till 2015, as the VDC's are just declared municipality. (Refer Table 1).

Table 3 Analysis of Population Growth Rate and present day (2015) population

Old VDC	Population of year		Growth rate (%)	Present Estimated population
	2001	2011		
Surunga	21,616	27,470	2.43%	30,234
Ghailadubba	11,185	12,671	1.26%	13,319
Total	32,801	40,141	2.04%	43,518

After estimation of present year population, next task is to forecast the population to be used for short, medium and long term planning process. The population are calculated on basic three assumption, first if population goes on increasing at the present rate, i.e. at average growth rate, which reflects the minimum possible population growth rate. Second case use the highest growth rate among the two VDCs' and population is forecasted on that particular rate. The third calculation assumes that population increases at present growth rate for next five years, i.e. up to that point until road and other infrastructure are developed. Then it is expected to gain the rate of same as that of maximum rate in existing VDCs. This is taken for the year 2021 to 2025. After that, a reference growth rate is taken from the neighboring developed area or a higher value is assumed for possible growth rate to consider maximum possible population at the end of 20 years.

Table 4 Growth rates for different basis

Basis of forecast	Growth rate		
	Up to year 2020	2020-2025	2025-2035
Total growth rate	2.04%	2.04%	2.04%
Maximum growth rate	2.43%	2.43%	2.43%
Incremental growth rate	2.04%	2.43%	3.50%

Chart 15 Forecasted population under different basis

Transportation forecasting is the process of estimating the number of people or vehicles that will use a specific transportation facility and hence providing benchmarks for developing overall transportation policy, planning, design and operation for efficient transportation system. At the same time, the transport infrastructure and facilities paves the path for the development of the area. Thus, the existing trend in the development of the economy and change in land use along with the planned development and land use are considered to plan the transport facilities requirements in the future. In the planning process of the transport infrastructures, projection of the traffic is the most crucial factor. Traffic forecasting for planning projects determines the required number of lanes and road width to meet the future anticipated traffic demands. Future transportation demand will depend upon demographic and geographic factors, including population size and age, economic and employment growth, transportation network and operating conditions and transportation and land use policy, including cost of travel. Lack of proper city development plan and land use plan further restricts the use of complex models for reliable traffic forecast. Thus, the use of primary data collected during the study is used to forecast the traffic.

Present day traffic can be interpreted based on OD survey. To forecast the trips it is assumed that about 75% of the population make the daily trips. The projected traffic is based on extreme case of population among the three methods, i.e. third case as highlighted in table 10 above.

The motorcycle contributes about 16% trips and hence assuming 9% increase in bike ownership in 20 years, we can use the growth factor of about 3% in trips making. The increase in trips of motorcycle reduces the trips of cycle and walking. Assuming the same trips get reduce from cycle use, we can come up with the following table. Without any intervention in public transport routes, public transportation usage level will more or less remains the same. But interventions during first five year should demand for public

vehicles during the medium term plan. Assuming increasing in the trips by 1%, we will come up with the following fact. There will be increase in car ownership, but the sample collected on car ownership cannot be used to forecast its use so, we are not in a state to forecast them. At the same time, there will be slight decrease in walking trips, which are taken up by bike and car trips, though its usage remains close to initial one as people has to walk to the nearest bus stops and so on. And, provision of pedestrian facilities will help to maintain the same proportion.

Table 5: Traffic volume projection for worst case scenario of extreme population growth

Year	Population	Trip maker	Mode share			
			Motorcycle	Bicycle	Public transport	Walking
2015	43,518	25,388	7,109	19,803	8,632	15,233
2020	48,141	27,618	9,390	19,885	9,390	16,571
2025	54,270	30,655	11,649	19,619	13,488	18,393
2035	76,553	40,208	16,887	18,496	20,908	24,125

This high percentage of walking trips and public transportation need to be addressed properly in future. Thus, considering the future, wide roads are proposed. At the same time significant cyclist volume is also high, provision of bicycle tracks will support these trips and help to retain them, and this is the basis behind proposing adequate and separate cycle track.

5.2 Visionary city development plan

Visionary development plan of the municipality gives a brief picture of the potential areas of growth that will bring social and economic prosperity in the municipality. It identifies the potential areas of economic growth and helps guide other planning efforts to compatibly support those areas and help bring rapid development of the municipality. The discussion with different stakeholders of the municipality during the municipal level programs and the locals at the ward level meetings highlighted mainly tourism, agriculture, market and residential area as major lead sectors of development of Kankai Municipality.

The Jamun Khadi Simsar, Kankai Dham, are major potential tourism area. The Jamun Khadi master plan has been formulated to develop the tourism area. Similarly, the southern area is cultivated. With major market centre at Birtamode, the area of Kankai can be developed as residential area. The market at Surunga and Laxmipur are potential local market areas.

The proposed road hierarchy and their network are designed to support the growth of these potential lead sectors of the municipality. Through robust/ well-connected roads

these sectors will have proper access to the market and other places in neighbourhood of the municipality.

5.3 Indicative development potential

Indicative Development Potential (IDP) is basically the indication of the existing and potential market center/service centers (key growth centers) and the areas having various development potentials such as agro-based industries, high value cash crops and tourism. Thus, IDP shows high value cash crops, tourism area, and area of service centers such as hospital, post office, telecommunication, school, campus, bus parks, security offices and large settlements, important historic and religious places.

The development of built up area and thus facilities is concentrated along the East-West Highway that passes through the municipality. This shows a huge potential for the development of local market area and other facilities in other areas. Surunga is the main market center, Laxmipur has a potential to grow into a major market as well. Similarly, Ghailadubba area and Khaireni area can be developed into local market area so that access to local services is increased and trips generated is limited.

The major roads of the municipality has been highlighted and identified as Class "A" roads. These roads directly links the old VDC offices to the highway and to the municipality office. They also provide direct access from highway to all the wards. These area have high potential for development of built up area and traffic.

5.4 Formulation of road hierarchy

Roadways serve a variety of functions, including but not limited to the provision of direct access to properties, pedestrian and bicycle paths, bus routes and catering for through traffic that is not related to immediate land uses. Many roads serve more than one function and to varying degrees, but it is clear that the mixing of incompatible functions can lead to problems. Thus it is important to distinguish road in different class or type based on various criteria. A road hierarchy is a means of defining each roadway in terms of its function such that appropriate objectives for that roadway can be set and appropriate design criteria can be implemented. It is an important tool of road network and land use planning to asset management.

Road hierarchy restricts or reduces direct connections between certain types of links, for example residential streets and arterial roads, and allows connections between similar order streets (e.g. arterial to arterial) or between street types that are separated by one level in the hierarchy (e.g. arterial to highway and collector to arterial.) These hierarchical distinctions of road types become clearer when considering the recommended design specifications for the number of through lanes, design speed, intersection spacing and driveway access.

A well-formed road hierarchy will reduce overall impact of traffic by concentrating longer distance flow onto routes in less sensitive locations, ensuring land uses and activities that are incompatible with traffic flow are restricted from routes where traffic movement should predominate and preserving areas where through traffic is discouraged.

There are different levels of hierarchy around the globe. Some are:

- *UK's Overseas Development Association (ODA) published a book on the planning and design of road works, called "Towards safer roads in developing countries" suggests 5 levels in a road hierarchy i.e. Primary distributors, District distributors, Local distributors, Access roads and Pedestrian streets.*
- *Road Hierarchy of Brisbane has six level of hierarchy that includes: Motorway, Arterial Route, Suburban Route, District Access, Neighborhood Access and Local Access*
- *USA's Federal Highway Administration (FHWA) defines three level of hierarchy: Arterial, collector and local.*
- *Indian Road Congress (IRC) has classified urban roads into four class: Arterial, Sub-Arterial, Collector and Local Street.*
- *NRS 2070 has classified road in four types that includes Class A, B, C and D roads based on technical/functional classification, and highlight the fact that these class are almost equivalent with expressways, arterial roads, collector roads and local roads respectively.*
- *NURS 2068 (Draft) has classified urban roads into five categories, i.e. Expressway, Arterial, Sub-Arterial, Collector and local roads.*

The road hierarchy principles will assist planning agencies via orderly planning and provision of public transport routes, pedestrian and bicycle routes. It also identifies the effects of development decisions in and on surrounding areas and roadways within the hierarchy and also facilitates urban design principles such as accessibility, connectivity, efficiency, amenity and safety. Further, it also identifies treatments such as barriers, buffers and landscaping to preserve amenity for adjacent land uses.

Complete streets accommodate all modes of transportation by planning, designing, and building facilities for pedestrians, bicyclists, transit riders and vehicle drivers (City of Boulder, 2014). Thus, a proper plan should accommodate all the users of the urban streets in planning, designing and construction of the road infrastructure and furniture.

This study also formulates the road hierarchy for the various roads. After going through large number of literature, the study has proposed four level hierarchy roads namely Class A, B, C and D. Class C and D basically provides access while Class A and B provides mobility and accessibility to higher services.

Table 6: Comparison of various class of roads based on various criteria:

Criteria	Class A	Class B	Class C	Class D
Purpose	Mobility	Mobility and control access	Access and mobility	Access
Function	Through and long distance movement	Connection between Class A and C roads; and also Provide alternative connection routes between Class A	Connects higher order roads and mobility to local trips	Connect local trips to higher level roads
	High network coverage	Support through movement of traffic	Access to property	direct access to property
	Segregated NMT facilities and Bus laybys	Segregated NMT facilities and Bus laybys	Segregated NMT facilities	Local NMT movement
	Complete access to public transport	High access to Public transport	Limited access to public transport	
Maintenance Responsibility	Municipality	Municipality	Municipality & Community	Community
Design Speed (Kmph)	80	60	50	30
Radius (m)	210	110	40	20
Minimum Right of Way(m)	30	20	10	6*
Extra width at curve (m)	3	2.5	1.5	1
Setback distance (m)	6	6	4	4
Access Control	Applicable	Applicable	Not Applicable	Not Applicable
Public transport services	Mass Transit facilities	Mass Transit, Local Public transport	No public transportation	No public transportation

**For cul-de-sac of depth less than 25 m, road width of 4 m is also allowable*

Class 'A' Road

All major roads which connect one or more major Growth Centres (market, tourism Centre, industry, etc.) or several Wards with any one of the following:

- High network coverage
- The right of way is at least 30 m.
- Directly or through the National Strategic Road Network, district road.
- Complete access to public transport with segregated NMT facilities.
- The Accessibility in Terai region is 20 min.

Some of the recommended cross-sections for Class "A" roads are shown in Annex I-A.

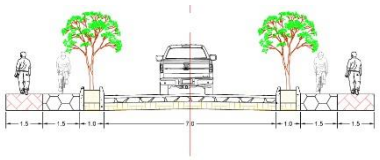
Class 'B' Road

All roads which connect to a major road network and other roads of similar hierarchy with any one of the following:

- A road connecting major Growth Centre of the same or neighbouring wards which provide access between Class A and class C road.
- The right of way is at least 20 m.
- Access to public transport with segregated NMT facilities.
- The Accessibility Terai region is 10 min.

Some of the typical cross-sections for Class "B" roads are shown in the Annex I-A.

Class 'C' Road



All roads which provides connection to higher order roads with any one of the following:

- All agricultural roads which connect a farm with a mini-market Centre or a agro-based production Centre
- The right of way is 10 to 15 m.
- Roads for mobility of local trips.
- May or may not be NMT facilities.
- The Accessibility in Terai 5 min.

Some typical cross-sections for Class "C" roads are in the Annex I-A.

Class 'D' road

All minor roads which provides access to a tole with any one of the following:

- The right of way is less than 10m.
- Road for connection to higher level road.
- Provides direct connection to the property

The road of Class A and B serves as a robust road network (skeleton) for greater mobility of goods and people. Class C and D are roads that serves in settlement areas. Class D serves as local road and class C roads connects these local roads to higher hierarchy roads for travel to greater distance at convenient speed and safety. The roads that passes through the settlement areas should be at least 6 meter wide for the easy access by fire fighting vehicles.

The proposed road RoW and hierarchy are different than that given by the ToR. After a rigorous study of existing standards, above formulated road hierarchy was proposed. The comparison and reason for different hierarchy level is presented below.

Table 7 Road hierarchy and RoW based on ToR

Class of road	RoW
Class A – Main Collector Road	14 m
Class B – Other Collector Road	10 m
Class C – Main Tole Road	6 m
Class D - Other Road	4 m

All the roads of Class C and D as per ToR are of Class D in proposed road hierarchy. Similarly, the roads of Class A and Class B as per ToR falls under Class C of proposed hierarchy. Higher hierarchy of roads is proposed because of following reasons:

- Roads of width 4 m or less are not accessible by fire fighting vehicles. Each municipal building should be accessible by fire fighting vehicles.
- Kankai Municipality has fixed the lower limit of 6 m width of road for investment in road. Thus the minimum RoW of the municipal roads is 6 m.
- The urban roads should have proper road infrastructures such as pedestrian way, cycle tracks and green belt (including median strip). The minimum width for these infrastructure are given in NRS 2070 and NURS 2068 (draft) as shown in the table below:

Reference document	Pedestrian way (minimum)	Cycle track	Median strip
NRS, 2070	2 m on both side	2 m on both side	5 m
NURS, 2068 (Draft)	1.5 on both side	2 m on both side	5 m

- The given hierarchy lack arterial roads which are necessary in context of urban road network. Especially the roads that serves large settlements and opens at the highway should be arterial roads. Necessity of such roads is spelled out by the planning norms and standards, 2015 and NURS 2068 (draft) as given below:

Table 8 Road hierarchy and RoW based on planning norms and standards, 2015

Type of city	Population criteria	RoW of the road (m)				
		Expressway	Arterial	Sub-arterial	Collector	Local
Sub-city	10,000-40,000	-	-	30	20	10
City	40,000-100,000	-	50	30	20	110
Sub-metro city	100,000-300,000	50	30	20	10	10

Source: Planning Norms and Standard 2015, GoN, DUDBC

Table 9 Urban road hierarchy based on Nepal Urban Road Standard

RoW of road (m)				
Expressway	Arterial	Sub-arterial	Collector	Local
-	50-60	30-40	20-30	10-20

Source: Nepal Urban Road Standard 2068 (Draft)

The above road hierarchy of roads for Kankai Municipality was presented to the municipality and MRCC, and was approved by them. The approved road width for class A road is 30 m, class B roads is 20 m, Class C roads is 10-15 m and Class D roads is less than 10 m.

The summary of road lengths of different classes within each ward is given in the table below.

Table 10 Length of different class of road in each ward

	Length of road (Km)				
Ward No.	**Class A**	**Class B**	**Class C**	**Class D**	**Total**
1	5.81	9.14	6.86	9.08	30.90
2	3.48	9.45	7.99	5.53	26.46
3	9.89	8.42	11.15	40.09	69.55
4	7.20	3.97	10.18	18.09	39.44
5	7.86	9.24	8.53	7.80	33.43
6	7.83	7.01	8.18	8.80	31.83
7	2.64	3.98	3.15	6.94	16.71
8	5.25	1.07	8.64	17.71	32.67
9	3.51	0.36	4.93	3.77	12.57
Total	**53.48**	**52.64**	**69.62**	**117.83**	**293.57**

Discussion on road hierarchy and proposed RoW

During the preparation of MTMP, a series of discussions were held with different stakeholders on different matters related to MTMP. One of the major issue was road hierarchy and RoW. The matter was discussed during field report presentation and draft presentation. It is an obvious fact that people welcome any possibility of investment in their locality. But when the people's contribution demanded especially with their own land and house for the road, they tend not to support such plans. With existing road width of about 10 m or less, the proposed road network with 20 m and 30 m RoW roads was not welcomed whole heartedly. The necessity of road infrastructures such as pedestrian way and cycle tracks with green belt was accepted as necessary road side infrastructures by all the people at both ward level meetings and at the municipal meetings. The main issue was the possible social, economic and emotional loss due to loss of only plot of land/house owned by individuals along the proposed wider roads.

As such comments could divert the discussion, Class of roads with their function and purpose were first introduced during the discussion with all the representatives in the field report presentation. It was followed by proposed road network of class A and class B. All the participants had a common consensus on the necessity of the proposed road sections with proper pedestrian way, cycle tracks, green belt and road space. After the consensus on the road network was met, the proposed minimum RoW of the roads was explained to accommodate the proposed infrastructures. The proposed RoW of 30 m for class A and 20 m for class B roads was not easily accepted. The necessity of such wider roads were clarified with the examples of developed cities of Nepal such as Kathmandu, Biratnagar, Butwal, etc. where with urbanization, wider roads were enforced at the loss of huge built-up infrastructures including houses. With time, number of people with small plot of land and house along the major roads will increase making expansion socially more unacceptable. The necessity of minimum RoW of 6 m was also emphasised through examples of fire in Taplejung. There was slight change in road network during the initial discussion and final discussion at the municipality.

As the necessity of road infrastructure and the RoW accommodating those infrastructure was accepted necessary for the sustainable development of all sectors, the main issue was as to how the loses (social, economic and emotional) would be addressed. To address this issue a number of possible tools were put forward. Such tools are direct compensation (by the municipality or through other sources) which will ensure economic security to the people whose land and house are located along the road. Such compensation cannot ensure protection of social and economic loss. The best way to ensure minimum loss of all sort is through land pooling; where all the land and population that uses the road are identified in a buffer/catchment zone; all those in the buffer zone contribute for the road. In such provision, all the land owners in the buffer zone contributes certain percentage of his/her land for the development of the road so that the person whose land is located directly along the road do not suffer the all the loses and is shared by all those who use the road. After explaining such possible provisions to address loses, the participants agreed on the proposed RoW.

It is clear that, all the representatives and people understand the need and necessity of wider roads and proper road side infrastructure. But without proper compensation to those land/house owners along the roads, implementation of wider roads will be challenging.

Neither such compensation nor the land pooling at the local level is not a common practice in Nepal, expansion of such roads in a built up area is only possible if proper compensation is ensured for those who lose their property. But, it is not completely new (foreign) tool. Land acquisition has been an issue in many major projects in Nepal. So, proper policies and working plans should be prepared by the central level institution to implement these tools. It is utmost necessary as the amount of possible physical loss of property increases as the policy and regulations to enforce them is delayed.

The details of the road linkages within the municipality are given below:

B.P marg (04M04A001):
The road passes through wards 3, 4, 5 and serves an approximate population of 2300. The total length and average width of the road are about 8.5 km and 6.00 m respectively, out of which 3.55 km is earthen. 4.95 km is gravelled. Out of total length, 4.95 km upgrading, 3.55 km periodic maintenance needs to be done.

Surunga Dhanuskoti Sadak (04M04A002):
The road passes through wards 2, 3, 4, 5 and serves an approximate population of 3100. The total length and average width of the road are about 11.7 km and 5.36 m respectively, out of which 11.70 km is gravelled. Out of total length, 8.94 km upgrading, 2.77 km periodic maintenance needs to be done.

Jukeculbert-simsar-dhanuskoti (04M04A003):
The road passes through wards 1, 2 and serves an approximate population of 300. The total length and average width of the road are about 1.92 km and 11.80 m respectively, out of which 1.35 km is gravelled, 58 km is metalled. Out of total length, 1.92 km upgrading needs to be done.

Durgapur Champapur Sadak (04M04A004):
The road passes through wards 6, 7 and serves an approximate population of 1200. The total length and average width of the road are about 5.1 km and 9.00 m respectively, out of which 5.10 km is gravelled. Out of total length, 5.10 km upgrading needs to be done.

durgapur-danabari sadak (04M04A005):
The road passes through wards 1, 7, 8 and serves an approximate population of 1300. The total length and average width of the road are about 4.64 km and 8.50 m respectively, out of which 2.32 km is earthen. 2.32 km is gravelled. Out of total length, 2.32 km upgrading, 2.32 km periodic maintenance needs to be done.

Himali Marga (04M04A006):
The road passes through wards 8, 9 and serves an approximate population of 1500. The total length and average width of the road are about 4.54 km and 8.96 m respectively, out of which 4.54 km is gravelled. Out of total length, 4.54 km upgrading needs to be done.

Birtabajar-Ghailadubba-Champapur Road (04M04A007):
The road passes through wards 3, 4, 6, 9 and serves an approximate population of 2200. The total length and average width of the road are about 8.42 km and 5.20 m respectively, out of which 6.50 km is earthen. 1.92 km is gravelled. Out of total length, 8.00 km upgrading, 42 km periodic maintenance needs to be done.

Sahid Laxmi Pandey Marga (04M04B001):
The road passes through wards 3, 4, 5 and serves an approximate population of 1700. The total length and average width of the road are about 8.19 km and 9.70 m respectively, out of which 3.51 km is earthen. 4.68 km is gravelled. Out of total length, 8.19 km upgrading needs to be done.

Surunga-sukedangi community forest (04M04B002):
The road passes through wards 2, 3 and serves an approximate population of 700. The total length and average width of the road are about 3.28 km and 5.10 m respectively, out of which 3.28 km is gravelled. Out of total length, 59 km upgrading, 2.70 km periodic maintenance needs to be done.

Panchayat Marga (04M04B003):
The road passes through wards 1, 3, 4 and serves an approximate population of 1000. The total length and average width of the road are about 6.03 km and 10.77 m respectively, out of which 6.03 km is gravelled. Out of total length, 6.03 km upgrading needs to be done.

jukeculbert-bhrikuti marg (04M04B004):
The road passes through wards 1, 6, 7 and serves an approximate population of 800. The total length and average width of the road are about 3.08 km and 7.12 m respectively, out of which 3.08 km is gravelled. Out of total length, 2.15 km upgrading, 93 km periodic maintenance needs to be done.

Mathillo Chapramari-Targhera-Laxmimarg (04M04B005):
The road passes through wards 5 and serves an approximate population of 400. The total length and average width of the road are about 1.47 km and 10.87 m respectively, out of which 1.47 km is gravelled. Out of total length, 1.47 km upgrading needs to be done.

(04M04B006):
The road passes through wards 5, 6 and serves an approximate population of 900. The total length and average width of the road are about 5.34 km and 6.00 m respectively, out of which 5.34 km is gravelled. Out of total length, 5.34 km upgrading needs to be done.

(04M04B007):
The road passes through wards 4, 5 and serves an approximate population of 900. The total length and average width of the road are about 3.54 km and 8.38 m respectively, out of which 2.11 km is earthen. 1.43 km is gravelled. Out of total length, 3.54 km upgrading needs to be done.

(04M04B009):
The road passes through wards 2 and serves an approximate population of 700. The total length and average width of the road are about 1.99 km and 5.00 m respectively, out of which 1.99 km is earthen. Out of total length, 3.24 km upgrading, 81 km periodic maintenance needs to be done.

(04M04B010):
The road passes through wards 2, 3, 4 and serves an approximate population of 800. The total length and average width of the road are about 4.05 km and 10.59 m respectively, out of which 4.05 km is gravelled. Out of total length, 4.49 km upgrading needs to be done.

(04M04B011):
The road passes through wards 1, 2, 7 and serves an approximate population of 900. The total length and average width of the road are about 4.49 km and 5.31 m respectively, out of which 1.04 km is earthen. 3.45 km is gravelled. Out of total length, 2.21 km upgrading, 83 km periodic maintenance needs to be done.

(04M04B012):
The road passes through wards 6, 7 and serves an approximate population of 800. The total length and average width of the road are about 4.57 km and 8.39 m respectively, out of which 4.57 km is gravelled. Out of total length, 2.89 km upgrading, 1.86 km periodic maintenance needs to be done.

(04M04B013):
The road passes through wards 6, 8, 9 and serves an approximate population of 400. The total length and average width of the road are about 4.75 km and 6.18 m respectively, out of which 1.86 km is earthen. 2.89 km is gravelled. Out of total length, 93 km upgrading, 85 km periodic maintenance needs to be done.

(04M04C001):
The road passes through wards 2, 3 and serves an approximate population of 400. The total length and average width of the road are about 1.78 km and 7.04 m respectively, out of which 1.78 km is gravelled. Out of total length, 2.05 km upgrading needs to be done.

(04M04C002):
The road passes through wards 3 and serves an approximate population of 300. The total length and average width of the road are about 2.05 km and 5.00 m respectively, out of which 2.05 km is earthen. Out of total length, 98 km upgrading needs to be done.

(04M04C003):
The road passes through wards 2, 3 and serves an approximate population of 300. The total length and average width of the road are about 0.98 km and 10.00 m respectively, out of which.98 km is earthen. Out of total length, 1.12 km upgrading needs to be done.

(04M04C004):
The road passes through wards 3 and serves an approximate population of 200. The total length and average width of the road are about 1.12 km and 5.00 m respectively, out of which 1.12 km is earthen. Out of total length, 49 km upgrading needs to be done.

(04M04C005):
The road passes through wards 1 and serves an approximate population of 300. The total length and average width of the road are about 0.49 km and 12.00 m respectively, out of which.49 km is earthen. Out of total length, 1.05 km periodic maintenance needs to be done.

(04M04C006):
The road passes through wards 1, 7 and serves an approximate population of 300. The total length and average width of the road are about 1.05 km and 14.00 m respectively, out of which 1.05 km is earthen. Out of total length, 1.12 km upgrading needs to be done.

(04M04C007):
The road passes through wards 4, 5 and serves an approximate population of 300. The total length and average width of the road are about 1.12 km and 10.00 m respectively, out of which 1.12 km is gravelled. Out of total length, 1.20 km upgrading needs to be done.

(04M04C008):
The road passes through wards 5 and serves an approximate population of 200. The total length and average width of the road are about 1.2 km and 11.57 m respectively, out of which 1.20 km is gravelled. Out of total length, 82 km upgrading needs to be done.

(04M04C009):
The road passes through wards 3 and serves an approximate population of 300. The total length and average width of the road are about 0.82 km and 5.00 m respectively, out of which.82 km is earthen. Out of total length, 1.32 km upgrading needs to be done.

5.5 Land use and transport

Land-use potential is a measure of the scale of socioeconomic activity that takes place on a given area of land. A unique property of land use is its own ability to generate traffic. The connection between transportation and land use is a fundamental concept in transportation. Everything that happens to land use has transportation implications and every transportation action affects land use. Actions by transportation agencies shape land use by providing infrastructure to improve accessibility and mobility. Planning of any land-use and transportation system is to ensure that there is an efficient balance between land-use activity and transportation capability. Trip generation provides the linkage between land use and travel as depicted in the below cycle.

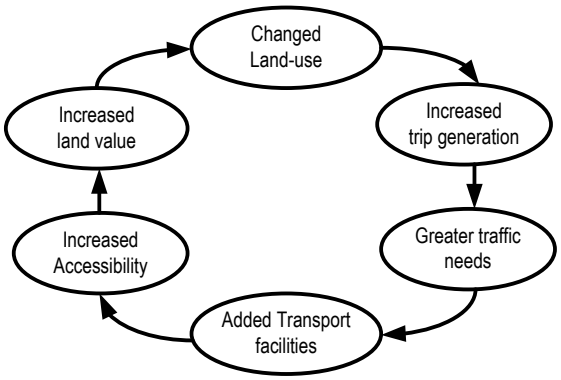


Figure 1 Interaction between Land Use and Transportation

Due to the lack of relevant land use policy in the municipality in the present condition, we use the basic land use pattern with discussion in the grass root level the land use pattern. The proposed hierarchy of roads, forecasted population assumes increase in population and thus density of settlement in the municipality. The road networks proposed thus, supports high density core area and sub-urban area through interconnected roads.

5.6 Accessibility and mobility scenario

Transportation system most often needs to trade-off between accessibility and mobility. Need of travel is a derived demand, not being end in itself but a means. Accessibility is the ease with which goods, services, people and opportunities can be reached. In the context of newly formed municipalities with core market centres as epicentre of all goods, services and facilities, people lying on the peripheral regions need accessibility. Mobility is efficient movement of goods and people. Mobility is more focused on trips and distance covered. Mobility values transportation as end rather than means, but still in outlying areas accessibility require a lot of mobility, while central population need smaller trip lengths. While we provide space for active mode users and public transits as a means of enhancing accessibility, we are trading a part of road space from the mobility sector, and when we provide more road space for private vehicles to move efficiently we trade part of road space associated with accessibility.

Present scenario of access of road from settlement is little more, which needs to be reduce for better access. Similarly, the time taken to reach the bus stop is also slightly high, which need to be reduced for better mobility. Class “C” roads that serves dual function of access as well as mobility are designed in such a way that people doesn’t need more than 5 minutes. People will have access to either Class “B” or Class “A” roads designed for more mobility within 10 minutes or 20 minutes on an average walking distance that are designed for greater mobility. Planning work have focused on reducing access directly to highways, subsequent developments are recommended for national authority to develop required infrastructures.

5.7 Transport infrastructure planning

Land use and transport, developed road hierarchy, accessibility and mobility scenario are the policy level guidelines for development and planning of transport infrastructures. Then the question arises, “What are the supporting transport infrastructures?” Many of us only think about construction of roads. Road infrastructure planning refers to design and implementation plan for sustainable accessibility to the goods, services, people and opportunities needed to promote human welfare, while preserving and restoring the environment. Thus it also includes construction and provision of roads, cycle tracks, footpaths, road side furniture, and green belt and so on.

A majority of households owns a bicycle and has a major share in daily trip making. Similarly, the population without privately owned vehicles are dependent on walking for daily trips. This is reflected by high active transport users. These users should also be given due consideration in the planning process.

As population is expected to increase rapidly, there will certainly increase in economic size and have better income scenario. This will inspire people to buy private vehicles of their own to increase mobility, requiring greater road space width which will be provisioned by class A and class B roads but the aim of sustainable transport and accessibility policy will be to check private ownership of vehicles under control.

Class A and Class B road would have provision of bus-bay to facilitate public transit riders. Green belts would be developed for aesthetic purpose and noise reduction purpose as well as segregation of pedestrians from road traffic. Road side furniture would be installed as deemed necessary.

Integration of other facilities with road infrastructure is an integral part of road infrastructure planning. With the existing trend of use of road space to provide facilities such as drainage, electric poles, water supply pipeline, etc., the same is considered for integration with proposed road networks. For this, drainage master plan will guide the necessity of drainage structures. The NMT facility space can be used for covered drains in the urban area for drainage and open drains in sub-urban area. The green belt in Class A and B roads can be used for ground water recharge during monsoon, which will reduce overall size of drainage required. The same space can be used for water supply pipelines and electric poles.

5.8 Short term Municipality Transport Master Plan (Five years)

The short term municipality transport master plan has been developed to guide the municipal investments on road infrastructure through 2019-2020. The plan will advance the municipality towards the medium and long term plan as outlined in the later topics.

Short term planning elements generally known as transportation system management (TSM) are basically meant for efficient use of existing and proposed infrastructure (Verma & Ramanayya, 2015). Short term MTMP refers to maintenance and upgrading of the existing road networks to the proposed standards to support the present and future (5 years) transport demand paving the demand for the implementation of medium term and long term plan. It also includes construction of new road linkages which are necessary to support the current road network and the envisaged road network for the future. The interventions are applied to the road sections based on their priorities (based on the developed scoring criteria) and the annual budget. The transport infrastructure envisaged at the end of five years plan is for the development and maintenance of access road linkages and collector roads that maintains a road hierarchy (as formulated above) and justifies the construction and development of higher hierarchy roads in the medium and long term (in short term if justified). This period should also address the immediate need of NMT facilities within the municipal area along the highway.

The short term plan focuses on upgrading and maintenance of the existing road infrastructure to an all-weather standard. This follows upgrading of Class A roads along the urban area with the limited allocated budget. The roads A002, A005, A004, B001, B003, B009 and 11 Class C roads will be completely black topped.

As such, short term plan focuses on the accessibility of all the settlements, moving towards mobility to increase the access to wider services, thus paving the way for development of proper sustainable public transport services within and around the municipality. The strategy and investment plans for short term municipality transport master plan is elaborated in the next section.

5.9 Medium term Municipality Transport Master Plan (Ten years)

Medium term (year zero to year ten) and long term (year zero to year twenty) municipality transport plan gives the layout for the development of higher hierarchy road corridors with higher mobility and limited direct access. During the short term (first five years) development of local access roads and collector roads develops the concept and culture of wide roads among the locals. This facilitates in creating the demand for expansion of the roads to their designated class width during the medium term (five to ten years). Medium term plan continues the development and maintenance of the access roads and, expansion and maintenance of collector roads to their respective standard layout. Class "B" roads will also be constructed and expanded during the medium term plan depending upon the necessity/demand of road hierarchy.

All the roads of Class "C" will be constructed and maintained at their designated standard layout at the end of medium term plan. Class "B" and Class "A" roads will also be constructed wide enough to address the demand generated during this period. Few Class "B" roads will be constructed to their full width with designated pedestrian paths and cycle tracks. For other Class "B" roads, the medium term time period will allow opening of the track by shifting the existing structures and stopping further construction of other structures within the designated ROW.

The development of the road network in medium term plan includes opening of the track and clearing the right of way along the Class B roads. The period of short term plan controls the encroachment and urban sprawl growth along the ROW of the Class B roads.

5.10 Long term Municipality Transport Master Plan (Twenty years)

Long term municipality transport master plan envisages the development of the roads of all hierarchy within the municipality as depicted by the perspective plan whose demand is set out by the indicative potential development of the municipality.

Short term period (first five years) identifies the higher hierarchy roads necessary for the municipality in the long run and set necessary bylaws. It also implements those higher hierarchy roads in the policy level by controlling the development of other structures within the proposed ROW and shifting of the existing structure away. It will facilitate clearing of the ROW and track opening during the medium term time period (five to ten years). During medium term plan, these roads will be developed to certain level as per the existing demand.

This time period (first ten years) is critical in developing proper implementation policies, tools and plans for the construction and implementation of the standards of these roads in the long term time period of ten to twenty years. Plans to integrate other service facilities such as electricity, drainage and drinking water pipes should be developed during this period. Other plans such as land use plan, city development plan (if not developed), drainage network master plan should be developed in compliance with the municipality transport master plan. Depending upon these plans, MTMP may also be revised.

During the long term plan of ten years to twenty years, the higher hierarchy roads will be constructed in full phase. The development of Class A roads is necessary in the long run of the municipality for the structured development of the road network hierarchy and

thus the proper development of the trips and the municipality as a whole. The period of short term and medium term plan controls the encroachment and urban sprawl growth along the ROW of the Class "A" roads.

The implementation of MTMP will have great impact in the overall development of Kankai Municipality. Every activity between two spatially separated facilities requires access first and then mobility. That is, access connects the origin of demand to its destination. As the access is met, people tend to look for mobility for easy access within limited time. The proposed road network fulfils these demand in the long term with the implementation of MTMP. The current trend in trip making shows most of the trips destination concentrated in Surunga and Laxmipur for all purpose. The implementation of MTMP roads will facilitate efficient movement to these destinations along with promotion of local market and services bringing the facilities to the people. The roads connected to lead sectors will strengthen their growth strategies. The proposed roads with pedestrian way, cycle tracks and green belt will make the roads safer, greener and user friendly. All these supports greater mobility and trip rates which ultimately add up the economic activity supporting all sector growth.

SECTION 6. MUNICIPALITY TRANSPORT MASTER PLAN

This section sets out the strategic frameworks which are necessary for the implementation of municipality transport master plan in Kankai Municipality. The perspective plan is explained and the implementing strategies necessary to achieve the plan are also detailed. The section then gives the budget expenditure plan and financial institutions whose role are crucial for development of various classes of roads.

6.1 Strategic Framework

6.1.1 Hierarchy of road

In any urban area, provision of proper hierarchy of roads at proper spacing helps to reduce traffic congestions and increase the mobility along the roads. A well-formed road hierarchy and its network of roads will reduce overall impact of traffic on the land use and at the same time guide the planned change of the land use. Thus, a proper hierarchy of road networks should be provided at proper spacing so that their purpose and functions can be justified.

Hierarchy should be maintained according to the major SRN road (national highway, feeder road) that passes through the municipality or is closest to the municipal area. Urban/municipal roads that open into these SRN should be have proper ROW and spacing so that the traffic that enters the SRN is justified and the purpose of the road is also preserved. The NRS (2070) gives the provision of parallel service (frontage roads) at the spacing of at least 750 meters. Larger spacing creates bottlenecks while closer spacing may be unnecessary.

Well-formed networks of Class “A” and “B” roads creates blocks of 1 sq. km. to 2 sq. km. in the urban area and bigger blocks in the sub-urban areas. The hierarchy also provides well-connected cycle tracks and pedestrian way.

6.1.2 Segregation

The expressway and the urban roads should be segregated in terms of their function and thus their use. Expressway (highway) are meant for long route thorough traffic. Long distance mobility is the sole purpose of such roads. Development of core market centres of the municipalities along the Highway has hand devoured their mobility functionality and also made road safety questionable at those sections. Thus it is necessary to segregate such roads via direct property access control along with proper spacing of other road that links the settlements to these roads.

Urban roads are used by all sorts of users including pedestrians, cyclists, motorists and pubic vehicles. Their speed of travel varies significantly. Pedestrians and cyclists move slowly while other motorized vehicles travel at greater speed. Sharing of common roadway by all these users is very unsafe and unpleasant, especially for the active users. Their volume are also very significant and thus cannot be ignored. Thus, proper road infrastructure should be provided to ensure their safety by segregated pedestrian facilities and bicycle tracks. Such segregation can be achieved by level difference in those

facilities and construction of green belt between the facilities. Such segregation should also be maintained along the highway section that passes through the municipal area.

6.1.3 Green belt

Urban area is characterized by dense population and high built up area. Unplanned urbanization has rendered many cities unliveable because of the growing pollution and lack of green/open spaces. Road space is most frequently used public space. Provision of green belt along the urban roads creates safer and pleasant walking spaces, and acts as median to separate motorists from each other and from the NMT users. It also reduces the road side air temperature and absorbs more pollutants generated from the motor vehicles on street than other distant trees. Green belts can absorb precipitation and reduce the size of required drainage. The trees also act as screen and results in attenuation of air, noise and light pollution alongside the urban roads. Thus, green belt between the motorists and NMT users, and in the median strip is a compulsory infrastructure in the urban roads. The green belt can also be used as space to integrate other facilities such as drainage, water supply pipeline and electric poles.

6.1.4 Public transport

Public transport is a means for enhancing mobility of local people. High proportion of active transport users justifies the necessity of public transport to increase their mobility and thus access to wider services and facilities within the perceived travel time budget. Proper structured public transport routes is vital for sustainable transport development. The existing economy and travel pattern may not sustain on its own. Development of proper roads to facilitate access and (through access) mobility to various services and facilities will create more trips and thus demand. Strategic development of such roads will not only create demand for public transport (greater mobility) but also develop proper road network where public transport vehicles can ply.

As the demand increases, before well-structured and formal transport is justified economically, the local government should introduce **city buses**. City buses are government run public vehicles. Their sole purpose is to provide greater mobility to the local people even when the demand is not economically justified. Such provision adds fuel to the overall development of the local economy. It also captures the potential public transport users and retain those users. This is a “pull factor” to increase public transport users in the future and creates an environment to introduce formal public transport services.

6.1.5 Principle guideline of road planning

Change in land use and transport are cause and effect of each other, as depicted by the land use cycle in previous section. Thus, current land use and the predicted/planned change in land use in the future is the basic guideline for transport planning. Development of compact settlements and corresponding development scenario has been considered for road planning. The municipalities are urbanizing area whose population is expected to rise in the coming years. As the population is added, the settlements grow both horizontally and vertically. Horizontal expansion increases the built up area while vertical expansion increases the population density. With higher road densities, the required

width of the transport facilities also increases locally and along the major roads. Increase in built up area demands bigger network of local and collector roads which ultimately demand wider roads of higher hierarchy.

6.1.6 Hierarchy of settlement

A proper hierarchy of settlement should be developed to segregate the commercial and business centres from settlement areas and industrial area. A hierarchy of the market centres should be developed as main market centre and local market centres. Promotion of bi-nuclear or multi-nuclear city is necessary for even development of the settlements within the municipality. This brings many services and facilities closer to the demand and reduce the need to travel to the main market centre.

6.1.7 Introduction of basic road and road side infrastructure

There is a need to redefine the term “road way” among the local people who perceive only paved road surface for motorized vehicles as proper road way. Although, the proportion of active transport users is very high, the road infrastructure necessary to support these users do not fit within the defined road by the locals. Such perception and construction of road infrastructure accordingly will lead to high rate of motorization which creates problem to manage the generated traffic, pollution and other externalities.

Road side marks, signs, markings and signals are also an integrated part of the road infrastructure. Their use assists in proper operation and management of the roads and other road side infrastructures. As the road development proceeds, the use of these markings, signs and signals should also be upgraded. The use of signals is necessary after the higher hierarchy roads are completed and high volume of traffic ply on those roads. These signs and signals also assists in enforcing the road discipline.

In the present context, with very high active users, proper networks of pedestrian way and cycle tracks should fit in the basic road width. It should be planned and implemented as basic road side infrastructure. Similarly, the landscaping of the road sections with proper greenbelt increases the greenery in the city, provides shade to the active users, segregate different users and a pleasant travelling environment for all the users.

Proper laybys are necessary elements for proper public transport system. Bus stops should have proper sheltering furniture, seating benches, lighting system, trash boxes, information boards and displays of routes and schedule of buses and proper connected pedestrian ways and zebra crossings. Proper turning radius should also be maintained at the intersections to support mast transit vehicles.

6.1.8 Urban road discipline

Obeying of proper discipline and enforcement of it is equally important as the provision of the urban road infrastructure itself. Proper discipline not only makes the use of the facility efficient, it also creates a sense of comfort and safety. Segregation of the pedestrian way and cycle track from the main carriageway enforces certain level of discipline among the users. Provision of proper NMT crossing facilities and control of jay walkers is necessary to maintain proper flow of traffic in the main street and safety. Proper use of road markings, signs and signals assists in enforcing the road discipline.

6.1.9 Intersection design

The intersection plays a crucial role in overall efficiency of the developed road network. Thus, intersections should be critically designed and upgraded periodically as required by the traffic. Due consideration should be given to turning radius, set back and sight distances, islands, markings and signals.

6.1.10 Vehicle parking

As the development proceeds, the trend of increase in private motorized vehicle ownership is high in Nepalese cities. Such, increase in private vehicles demand space for parking both at the origin and destinations. Proper management of such parking demands is also necessary. Origin level parking should be provided by the application of community (common) parking space rather than individual household parking. This supports the access control requirements of the higher hierarchy roads. Similarly, parking at the major destinations such as business and market centres, industrial and commercial areas should be managed by the private sector.

6.1.11 Integrated service planning

Integrated service planning is a very important factor for damage minimization during construction and expansion of various facilities. As the road follows, settlement also expands which demands other facilities such as electricity, drainage and drinking water. All these facilities are provided along with road infrastructure, mostly within the ROW of road. Proper integration of these services with road planning is necessary to minimize multiple investment in the individual infrastructure and the damage to other infrastructure during maintenance and/or expansion.

6.1.12 Development phase of roads

The proposed roads cannot be directly implemented at a glance. Proper phases of development of roads of all hierarchy should be envisaged and planned. The first phase is simply the formulation of necessary hierarchy and identification of road sections that serves/ can serve as different hierarchy roads. During this phase, bylaws as demanded by the formulated road hierarchy along the identified roads should be enforced. The next phase is to develop necessary policy and implementation plan for expansion and construction of the road. The phases of construction total road width should also be worked out as development of full road width as demanded by the respective road hierarchy may not be possible. As such, implementation of road hierarchy starts from roads in lowest hierarchy and stage wise expansion of the roads according to the demand and necessity of wider roads and facilities to the higher hierarchy roads.

6.1.13 Grass root institutions

The grass root institutions/committees should be empowered with the provision of local technicians in such institutions. Such institutions include consumers' groups, ward level committees, MRCC and others. The municipality should increase its capacity as the plans

proposes higher level roads and bigger budget projects. Further planning of land use, drainage, building by laws, etc. will require better management and technically sound team of skilled staffs to advocate and inform the locals of the proper plan and implement them. A separate section within the municipality may be required to integrate the planning efforts and implement them.

6.1.14 Use of highway

The East-West highway is a SRN and it varies in function and importance with respect to the municipal roads. The highway has different function and a national level importance, but the section that passes through the municipal area is also used by the local commuters. The traffic vehicle count survey shows a significant proportion of bicycle users along the highway. Similarly, the household survey shows that a majority of trips made through walking and cycling is attracted by the market areas of Surunga and Laxmipur which lies along the highway.

Although the function of SRN is different from that of municipal roads, their passage through the municipality demands proper urban road infrastructure. Thus, proper pedestrian way, cycle tracks, zebra crossings, etc. should be provided within few years. Their provision in the short term period informs the locals on the need and importance of such facilities and thus justifies their construction in higher hierarchy roads of the municipality as proposed by this MTMP.

6.2 Perspective plan of municipal road network

Perspective plan of municipal road network includes the maintenance of the access and collector roads and development of higher hierarchy road corridors supporting mobility of the roads. First five years should focus on development of existing access roads and their maintenance. It also incorporates construction of new road linkages to provide basic access to the settlements. Roads of Class “C” will also be widened to its functional width providing proper cycle tracks and pedestrian ways where permitted by the available road space. During this period formulated road hierarchy will be implemented in terms of policy and enforcement of bylaws. Within 2 years other complementary plans of land use and city development will be developed. In the third year, the MTMP and its perspective plan should be revised in coordination with the other plans formulated and changes captured during this period.

Year five to ten will then implement the higher hierarchy roads in stages of clearing of the required ROW road space and construction of necessary infrastructure. Proper development stages of roads should be planned (construction of Class “A” roads to the standards of Class “C”, then gradually upgrading to Class “B” and then to Class “A”). Other implementation strategies should also be developed and finalized at the end of this period. The road network developed during this period shall complete construction of Class “C” roads. This will demand higher class roads to support the local road networks. Gradual upgrading of the higher hierarchy road networks during year ten to twenty will be justified by the traffic generated and level of mobility demanded to support the emerging economy.

6.3 Staging implementation plan

6.3.1 Mid period review

In light of present context without proper land use and city development plans of the municipality, the formulated municipal transport plan for five years and long term perspective plan cannot be complete. Comprehensive drainage plan and layout also guides the placement of cross drainage structures along the roads. Therefore, a mid period review is necessary. This review follows the formulation of comprehensive city development plan and land use plan. These plans will bolster the transport master plan and also suggest necessary deviations and revisions. The surveys conducted to prepare this MTMP are baseline survey for future planning. In reference to these survey, the mid period review will track the changes and its effect on the formulated five year plan and long term perspective plan. Based on the recommendations of land use and city development plan, and the changes during the first two years in the road infrastructure and road traffic the mid period review will guide MTMP in the later stages.

The next MTMP will be prepared in the sixth year which will create a void in continuity of transport infrastructure development during the sixth year. The mid period year shall also formulate implementation and investment plan for that period which will be carried over the next MTMP.

The transportation master plan is a living document accommodating changes from other planning efforts (City of Boulder, 2014). This intention of the City of Boulders help integrate small planning efforts which can make the transportation master plan a better plan. Integration to such level may not be possible in our context, but integration of major plans should be periodically done so that, the plan is more realistic in every aspect.

6.3.2 Yearly maintenance plan

According to the yearly progress of transport infrastructure development and construction, yearly maintenance plan should be prepared. This maintenance plan addresses the recurrent maintenance, specific maintenance and emergency maintenance requirements of the municipal roads.

6.3.3 Stages of development of roads

Visualization of stages of development of roads is very important aspect of long term municipality transport master plan (perspective plan). Current land use and road side development may not allow immediate implementation of wider roads. These restrictions should be addressed in various stages. The stages can be visualized in reference to various variables.

The prime stage is the formulation of policy and plans. This stage formulates the hierarchy and their geometric and physical characteristics, purpose and functions along with necessary ROW. With the formulation of road hierarchy, road bylaws will be enforced. It should be followed by formulation of proper implementation strategies for/and use of various tools for land acquisition and compensation, method and stages of construction of roads and road side infrastructures and enforcement of road discipline and right of users. Development of such policies will support continuous development of the roads.

The next stage is to clear the total right of way so that other infrastructures integrated with road can be developed. Until the end of clearing of proper right of way, the policies should be strong and well-informed. This will mark the entry to the next stage which is construction of full phase of all hierarchy roads.

Construction of higher hierarchy roads should be done in stages according to the necessity as guided by the developed lower hierarchy roads and corresponding demand of higher hierarchy roads they generate. The first stage should connect the pedestrian path and cycle tracks along with double lane carriageway for all higher hierarchy roads. The development of Class "A" roads should follow construction of road space to the standard of Class "C" then gradually expanding to Class "B" and finally to Class "A". Class "B" roads should also follow the same development stages. Construction of well-connected pedestrian way, cycle tracks and green belt along the edges of the ROW restricts any possible encroachment of the road space.

6.4 Financial institutions and capital investment plan

To determine how much of the proposed work can be carried out in the 5-year MTMP period, it is necessary to estimate the budget available in this period. This is done by estimating the amount of money available from different sources based on the actual amounts of the current or last financial year, assuming certain growth rates for each funding source.

Firstly, the total budget for the current or last financial year needs to be determined. This information has been obtained from the municipality account and planning section or the Annual Budget Book published by the municipality, indicating the different sources of funding and the amount of funding from each source allocated to the road sector. Sources of funding has been clarified as much as possible to avoid confusion and duplication. In writing up the budget of the last financial year, the wording of the funding sources below has been used to facilitate understanding and comparison with other municipalities. Additional funding sources may be included where relevant.

The most common sources of funding which includes many government and other financial organizations for the municipality are as follows:

- User's participation
- Municipality Office
- District and division line agencies
- DoLIDAR
- Donor agencies, NGO, INGOs etc.

Planning of the investment is essential to support local government in developing good and best practice in construction, upgrading, overall asset management and especially operation and maintenance the road project.

The grass root level involvement in the development of the road sector helps to create an informed and responsible citizens in the society. Thus, it is important to have local people's participation in the construction works of the local access roads. A majority (if not all) the local access roads should be constructed by the local people in coordination

with the municipality. People's participation can be achieved in plantation alongside of the roads, cleaning of the road area and other activities.

Municipality has a major role in developing the roads. It has the responsibility of preparing the necessary framework and implementing policies and strategies for the planned development of the municipal roads and thus the municipality as a whole. Major share of the municipal budget should be used to maintain the roads and construction of wider roads to meet the planned class and ROW. The annual program should address the local need and the need of emergency and specific maintenance. Specific roads should be constructed as a whole and not in parts for longer period of time.

Other institutions are district and division line agencies. These institutions are responsible for the development of road corridors that are important to the district or a larger area as a whole. Their contribution may or may not invest in the roads within the municipality, but wider roads of the municipality that extends to the boundary to other VDC/districts may draw investment beyond the municipal boundary. This will ultimately help in the development of the local municipal market centre.

The development of higher hierarchy road corridors cannot be directly developed by the municipality's annual budget alone. This needs bigger investments. This is where the central government or the ministry might want to invest as these higher hierarchy roads are meant for mobility and can provide greater coverage beyond the municipality in the future. These roads can be upgraded to expressways.

6.5 Prioritization of roads

A network consists of several links. It is not possible to construct all roads at a time due to resource and time constraint. Therefore, each link in a network needs to be prioritized and various intervention need to be taken based on the prioritization. After developing a municipal level road network and the required interventions, the cost estimate of the road is prepared and benefit of each link in the network is assessed. There might be various criteria of prioritization, which may differ from place to place. The basic criteria that can be used for prioritization includes existing population within the zone of influence, present road demand, future potential route, accessibility situation, land use pattern, environmental and social safeguard, proximity to the market/service centers, religious and tourism places. These criteria are given various weightage and weightage average of all the criteria is summed up to come with a priority of intervention. All type of intervention are provided with same scoring criteria. The finalized scoring criteria based on rigorous study is set in front of municipality and MRCC for its approval.

Each road link is allocated the number of points corresponding to the fulfillment of the particular criteria. The weighted average of score that each intervention receives leads to a ranking/prioritization of the intervention options. The following criteria were used as prioritization indicator.

Table 11 Approved scoring criteria

S.N.	**Scoring criteria**	Unit
1	Priority by Ward	
2	Road Class	A/B/C/D
3	Total Width	Metre
4	Population Served	Number
5	RAMS	Number of facilities served
6	Settlement Density	Population per unit usable area
7	Road Density	Total road length per unit area
8	Surface Type	
9	Poor and Minority Group	

6.6 Five year budget expenditure

Budget expenditure plan is a major output of this study. The scope of the study requires allocation of budget for required interventions in the prioritized roads for each year.

The budget was estimated for each year based on following basic assumptions:

- All the roads will be upgraded and/or constructed by the end of 20 years.
- The budget of the municipality increases by 10% each year along with enhancement in management and other capacity of the municipality and locals (user and contractors).
- Of the total budget 30% is allocated for the maintenance of the roads annually.
- Of the remaining 70% budget, budget is allocated for Class A, B, C and D roads as 40%, 30%, 20% and 10% respectively (also shown in figure 2).
- The allocated budget should construct the defined length of road starting from market area towards sub-urban area.
- Budget for each road is calculated and construction of about 1 Km of each road is considered for each year and budget is divided among the prioritized roads accordingly.
- Yearly budget allocation is done for Class A, B and C roads only. This is because the data for prioritization of class D roads is not available and cannot be realistically obtained.
- Budget for two lane metaled road with shoulder supporting NMT (<5m) for Class A and Class B roads are allocated. For, Class C roads with single/intermediate lane metaled carriageway and graveled remaining width is considered for budgeting.
- In case of Class A and B roads, existing width guides the carriageway width of the interventions. The carriageway is considered as per the existing road width from single lane to two lane.

Summary of the estimated budget is presented in the *Table 11*. The road wise allocation of budget for each year has been calculated. Yearly detail budget allocated for prioritized roads is given in Volume II of the report.

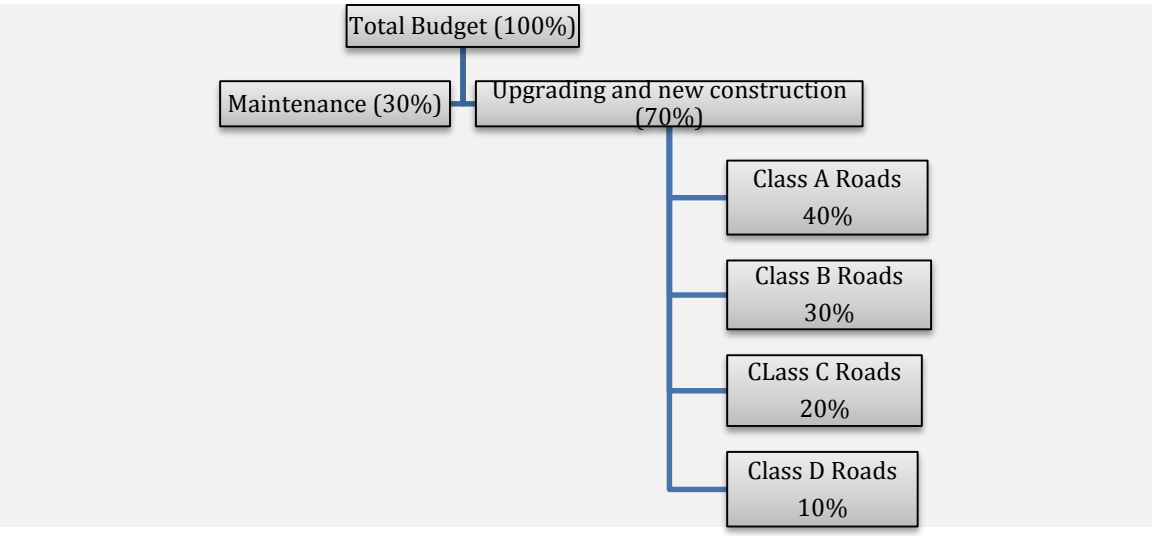


Figure 2 Budget share for different intervention and class of road

Table 12 Estimated budget summary for five years

	Budget allocated in thousands (NRs.)						
Year	Class A	Class B	Class C	Class D	Total	Maintenance	Grand total
1	49,593	37,195	24,797	12,398	123,983	53,136	177,119
2	54,553	40,914	27,276	13,638	136,381	58,449	194,830
3	60,008	45,006	30,004	15,002	150,020	64,294	214,314
4	66,009	49,507	33,004	16,502	165,022	70,724	235,746
5	72,610	54,457	36,305	18,152	181,524	77,796	259,320
Total	302,773	227,079	151,386	75,692	756,930	324,399	1,081,329

The allocated budget will upgrade and construct 19 Km of Class A roads, 11.39 Km of Class B roads and 10.90 Km of Class C roads to black topped condition of single to double lane standard depending on the existing width.

Table 13 Allocated budget for Class A roads (in thousands)

Road Code	Rank	Road Length (km)				Total Width	Types of Cross Drainage Structures			Year I		Year II		Year III		Year IV		Year V	
		Earthen	Gravel	Metalled	Total		Bridge	Causeway	Culvert	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)
04M04A002	1	0.00	3.28	0.00	3.28	5.36	0	0	0	1.00	11,242	1.00	11,242	1.00	11,242	0.28	3,200		
04M04A006	2	0.00	5.34	0.00	5.34	8.96	0	0	0	1.00	17,721	1.00	17,721	1.00	17,721	1.00	17,721	1.34	23,691
04M04A004	3	0.00	3.08	0.00	3.08	9.00	2	0	0	1.00	17,800	1.00	17,800	1.08	19,224				
04M04A005	4	0.00	1.47	0.00	1.47	8.50	0	0	0	0.17	2,830	0.47	7,790	0.71	11,821	0.13	2,114		
04M04A001	5	3.51	4.68	0.00	8.19	6.00	0	0	0							1.00	12,650	1.00	12,650
04M04A007	6	2.11	1.43	0.00	3.54	5.20	0	0	0							1.00	10,881	1.00	10,881
04M04A003	7	0.00	6.03	0.00	6.03	11.80	0	0	0							0.81	19,443	1.06	25,388
Total		5.61	25.31	0.00	30.93					3.17	49,593	3.47	54,553	3.79	60,008	4.22	66,009	4.40	72,610

Table 14 Allocated budget for Class B roads (in thousands)

Road Code	Rank	Road Length (km)				Total Width	Types of Cross Drainage Structures			Year I		Year II		Year III		Year IV		Year V	
		Earthen	Gravel	Metalled	Total		Bridge	Causeway	Culvert	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)
04M04B001	1	0.00	4.05	0.00	4.05	9.70	0	0	0	1.00	19,332	1.00	19,921	1.00	19,332	1.05	20,314		
04M04B003	2	0.00	4.57	0.00	4.57	10.77	2	0	0	0.82	17,863	0.97	20,993	1.00	21,685	1.00	21,685	0.78	16,812
04M04B009	3	1.12	0.00	0.00	1.12	10.59	0	0	0					0.19	3,989	0.35	7,508	0.58	12,381
04M04B004	4	1.86	2.89	0.00	4.75	7.12	0	0	0									1.00	14,512
04M04B011	5	1.05	0.00	0.00	1.05	8.39	0	0	0									0.65	10,752
Total		8.60	19.05	0.00	27.65					1.82	37,195	1.97	40,914	2.19	45,006	2.40	49,507	3.01	54,457

Table 15 Allocated budget for Class C roads (in thousands)

Road Code	Rank	Road Length (km)				Total Width	Types of Cross Drainage Structures			Year I		Year II		Year III		Year IV		Year V	
		Earthen	Gravel	Metalled	Total		Bridge	Causeway	Culvert	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)	Length of construction (Km)	Budget allocated (NRs.)
04M04C036	1	0.00	2.61	0.00	2.61	5.00	0	0	0	1.00	10,450	1.00	10,450	0.61	6,414				
04M04C054	2	0.00	0.49	0.00	0.49	6.00	0	0	0	0.49	6,178								
04M04C020	3	0.00	0.48	0.00	0.48	5.00	0	0	0	0.48	5,051								
04M04C058	4	0.00	0.15	0.00	0.15	6.00	0	0	0	0.15	1,913								
04M04C032	6	0.00	0.52	0.00	0.52	5.00	0	0	0	0.12	1,205	0.41	4,241	0.00					
04M04C046	7	0.00	0.76	0.00	0.76	6.00	0	0	0			0.76	9,618	0.00					
04M04C004	8	1.76	0.00	0.00	1.76	12.00	0	0	0			0.18	2,967	1.00	16,500	0.58	9,560		
04M04C002	9	0.00	1.32	0.00	1.32	10.00	0	0	0					0.43	7,090	0.89	14,721		
04M04C005	10	0.00	1.44	0.00	1.44	14.00	0	0	0							0.53	8,723	0.91	14,962
04M04C016	11	0.00	0.73	0.00	0.73	10.00	0	0	0									0.73	12,072
04M04C017	12	0.00	0.30	0.00	0.30	6.00	0	0	0									0.30	3,735
04M04C009	13	0.00	1.29	0.00	1.29	10.00	0	0	0									0.34	5,536
Total		4.55	54.07	4.27	62.89					2.24	24,797	2.35	27,276	2.04	30,004	2.00	33,004	2.27	36,305

The current trend in investment in the municipality is as follows:

Table 16 Investment trend in road sector

	Budget Expenditure in road sector		
	FY 2069-70*	FY 2070-71*	FY 2071-72
Surunga	3,570,000	5,051,000	
Ghailadubba	1,785,000	2,525,500	
Total	5,355,000	7,576,500	10,000,000

**VDC budget*

The trend in investment in road sector shows that every year the budget is increased by around NRs. 2,300,000. After being designated as a municipality, for the development of the road network and overall development of the municipality, the existing municipal budget in road sector is projected to increase by 20% every year. Similarly, the roads of Class D should be constructed with active user participation with about 40% in direct investment or labour. The roads A002 and A006 are DRCN roads classified as Class A roads and have highest score in prioritization so, these roads should be developed with the help of DDC. These sources of funds are summarized below:

Table 17 Allocated budget and possible sources of funding

Year	2072-73	2073-74	2074-75	2075-76	2076-77	Total
Allocated budget	177,119	194,830	214,314	235,746	259,320	1,081,329
Sources:						
Municipal budget	12,000	14,400	17,280	20,736	24,883	89,299
User contribution	4,959	5,455	6,001	6,601	7,261	30,277
DDC	40,627	41,690	42,859	39,145	40,559	204,880
Other sources	119,533	133,285	148,174	169,264	186,617	756,873

This growth shows a budget gap of about 757 million in five year period. This resource gap should be fulfilled through other sources of funds such as donor agencies.

SECTION 7. SUMMARY AND FINDINGS

Preparation of municipality transport master plan has been completed after proper primary and secondary data collection, interaction with various stakeholders at various levels and planning of the necessary interventions and prioritization of the roads. The study has identified active transport users as the major trip making group, and therefore the proposed road hierarchy addresses those users with interconnected pedestrian facilities and cycle tracks. The projected trip share also demands such infrastructure. Majority of the roads demanded by wards are for maintenance, the inventory also shows that most of the roads needs maintenance and upgrading. Accessibility is still under consideration in some areas. Mobility has to be considered as majority of people are dependent on privately owned vehicle or walking for daily trips. City area is called the engine of development, and if the sub urban area are to follow the development they should be properly linked to the city area with proper roads.

Way forward

Preparation of municipality transport master plan is the first step in the planned development of the municipal area. Comprehensive city development plan, land use plan, drainage master plan, etc. are some other plans that needs to be prepared and integrated with municipality transport master plan. It can be done in the third year as mid period review. Before this, all the plans should be prepared. Other necessary policies, strategies and stages should also be worked out by the municipality. The finalized plans should be strictly implemented for plans do not bring change in the society but their implementation does.

Glossary

Active transport user	Active transport (also called non-motorized transport, NMT and human powered transport) refers to walking, cycling, and variants such as wheelchair, scooter and handcart use. It includes both utilitarian and recreational travel activity, plus stationary uses of pedestrian environments such as standing on sidewalks and sitting at bus stops
Base map	A map depicting background reference information such as landforms, roads, landmarks, and political boundaries, onto which other thematic information is placed. A base map is used for locational reference and often includes a geodetic control network as part of its structure. (source: support.esri.com) Google earth has been used to digitize the base map used for the study.
Capacity	The maximum number of vehicles that can pass over a given section of a lane or roadway in one direction (or in both directions for a two-lane or three-lane highway) during conditions.
Collector road	Collector roads provide both access and movement within residential, commercial and industrial areas. They are typically discontinuous between residential areas, so as to avoid traffic infiltration through neighbourhoods. Lower density developments and community land uses such as schools and convenience retail are often located on collector streets.
Emergency maintenance	Maintenance works that are to be carried out due to unexpected and sudden blockage of roads that stop vehicular movement due to natural disaster
Forecasting	The process of determining the future values of land use, socioeconomic, and trip making variables within the study area.
Local road	Local roads provide direct property access in residential, industrial, commercial and downtown areas. With local streets connecting primarily to collector roads, travel distances are short, speeds are relatively low and volumes are modest, as their primary function of accommodating traffic from adjacent lands.
Maintenance	The process of preserving the original condition or function of an asset

MTMP	The MTMP is a strategic planning document designed to identify and address the municipality's needs to the year 2020 and beyond. The MTMP is the document that identify, classify and prioritize the municipal roads; identify possible sources of funds and materials for the construction of the prioritized roads according to their respective standards and scientific mobilization of the available resource.
Network	Set of nodes and connecting links that represent transportation facilities in an area.
New construction	The work of building
Origin	The location of the beginning of a trip or the zone in which a trip begins.
Periodic maintenance	Maintenance works to be carried out in intervals of years and of large-scale
Recurrent maintenance	Small maintenance works not falling under routine maintenance that are carried out a few times a year in all roads to repair minor damage resulting from traffic and rainfall
Routine maintenance	Small maintenance works that are to be carried out in all the seasons on all roads on a regular basis
Specific maintenance	Spot treatments and repairs that do not occur every year or in every road, and which are very specific in nature and location.
Trip	A one-direction movement which begins at the origin at the start time, ends at the destination at the arrival time, and is conducted for a specific purpose.
Upgrading	The process of addition or change that makes something better than it was before
Usable area	The area that can be used for human construction. It includes cultivated and built up area. Environment sensitive area and barren lands are not usable area.

References

basemap-GIS Dictionary. (04 July, 2015). Retrieved from Esri: http://support.esri.com/en/knowledgebase/GISDictionary/term/basemap

Central Bureau of Statistics. (2013). *National Census 2011.* Kathmandu: Government of Nepal, National Planning Commission Secretariat.

City of Boulder. (2014). *Transportation Master Plan.* Boulder: City of Boulder.

Cole, S. (2005). *Applied Transport Economics Policy, Management and Decision Making.* London: Kogan Page Limited.

Elgar, E. (2002). *Transport Economics.* Cheltenham: Edward ELgar Publishing Limited.

Eppell, V. A., Bunker, J., & McClurg, B. (2001). A four level road hierarchy for network planning and management. *Proceedings 20th ARRB Conference.* Melbourne: Jaeger, Vicki, Eds.

Litman, T. (2015). *Evaluating Active Transport Benefits and Costs (Guide to valuing walking and cycling improvements and encouragement programs).* Victooria Transport Policy Institute.

National Planning Commission. (2012). *National population and housing census (A national report).* Kathmandu: Central Bureau of Statistics.

TRB. (2013). *Transit capacity and quality of service manual.* Washington D.C.: Transit cooperative research program.

Verma, A., & Ramanayya, T. (2015). *Public Transport Planning and Management in Developing Countries.* Boca Raton: CRC Press Taylor and Francis Group.

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Upgrading	The process of addition or change that makes something better than it was before
Usable area	The area that can be used for human construction. It includes cultivated and built up area. Environment sensitive area and barren lands are not usable area.

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basemap-GIS Dictionary. (04 July, 2015). Retrieved from Esri: http://support.esri.com/en/knowledgebase/GISDictionary/term/basemap

Central Bureau of Statistics. (2013). *National Census 2011.* Kathmandu: Government of Nepal, National Planning Commission Secretariat.

City of Boulder. (2014). *Transportation Master Plan.* Boulder: City of Boulder.

Cole, S. (2005). *Applied Transport Economics Policy, Management and Decision Making.* London: Kogan Page Limited.

Elgar, E. (2002). *Transport Economics.* Cheltenham: Edward ELgar Publishing Limited.

Eppell, V. A., Bunker, J., & McClurg, B. (2001). A four level road hierarchy for network planning and management. *Proceedings 20th ARRB Conference.* Melbourne: Jaeger, Vicki, Eds.

Litman, T. (2015). *Evaluating Active Transport Benefits and Costs (Guide to valuing walking and cycling improvements and encouragement programs).* Victooria Transport Policy Institute.

National Planning Commission. (2012). *National population and housing census (A national report).* Kathmandu: Central Bureau of Statistics.

TRB. (2013). *Transit capacity and quality of service manual.* Washington D.C.: Transit cooperative research program.

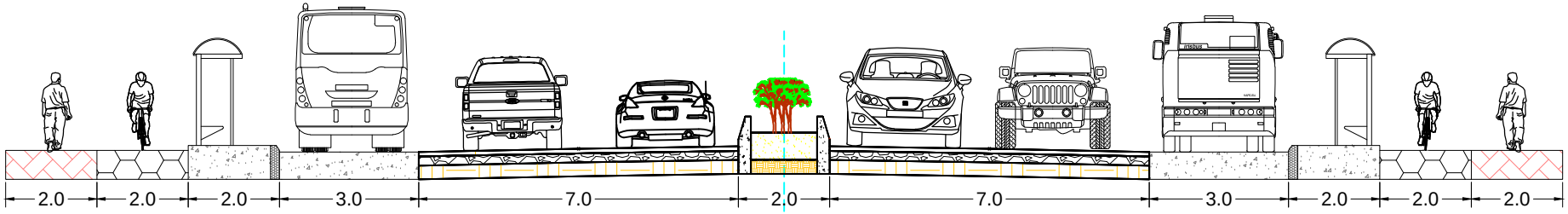
Verma, A., & Ramanayya, T. (2015). *Public Transport Planning and Management in Developing Countries.* Boca Raton: CRC Press Taylor and Francis Group.

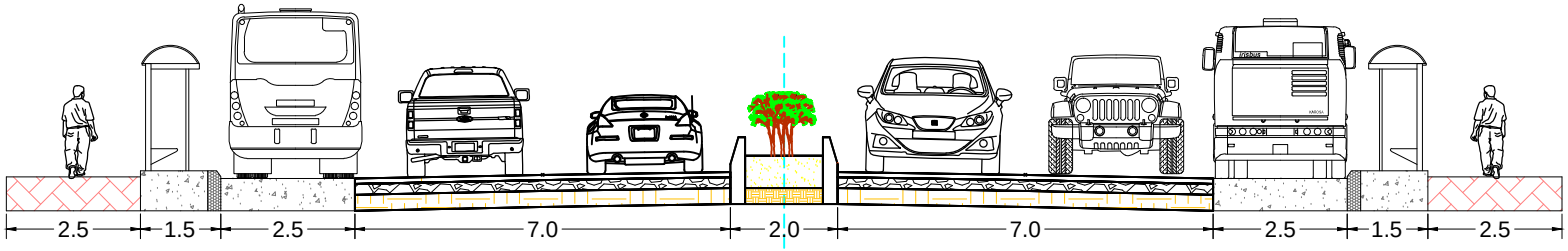
ANNEX I - A

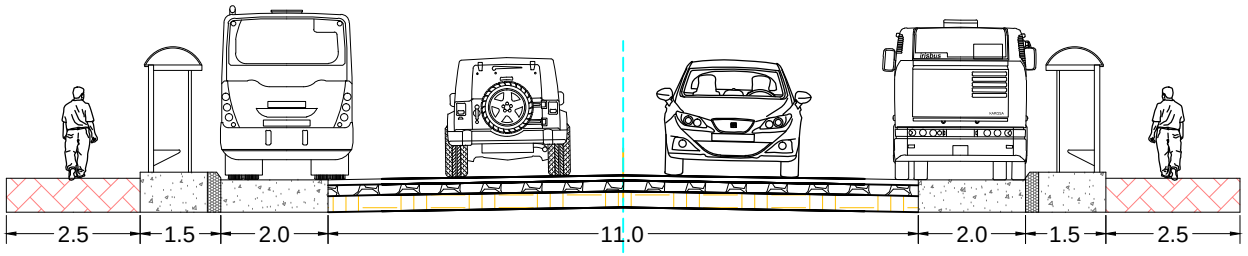
TYPICAL ROAD CROSS-SECTIONS

ANNEX I-A TYPICAL ROAD SECTIONS

TYPICAL SECTIONS FOR CLASS A ROADS WITH BUS BAY

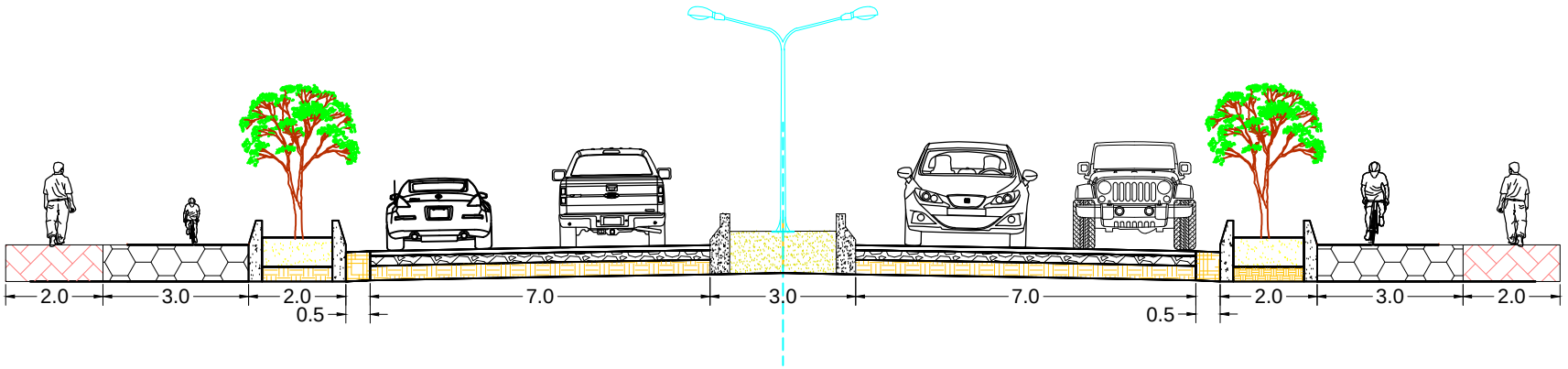


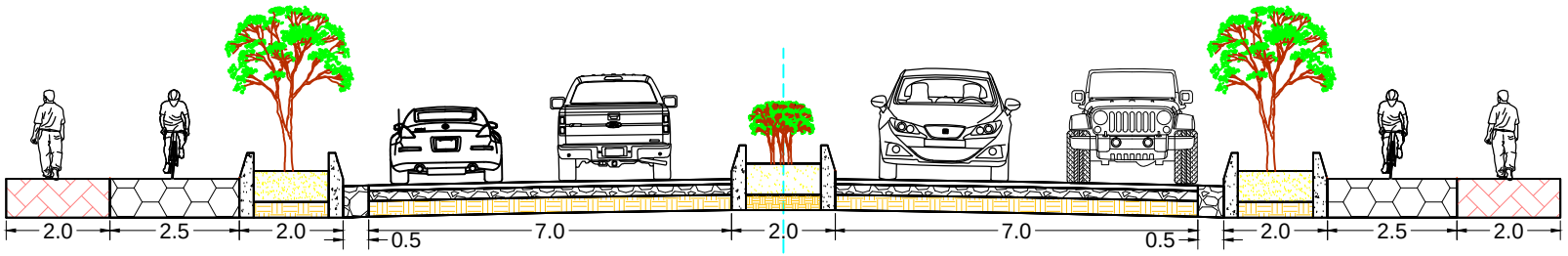


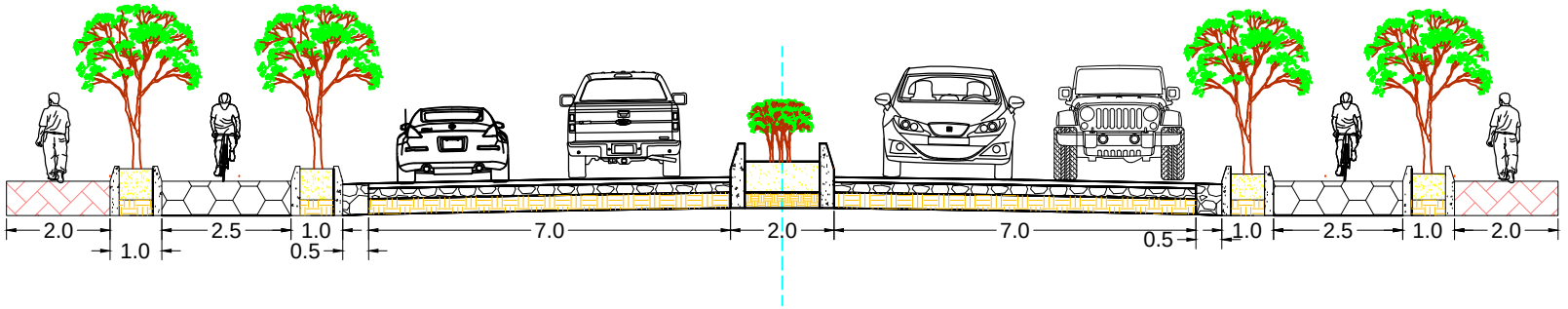


ANNEX I-A TYPICAL ROAD SECTIONS

TYPICAL SECTIONS FOR CLASS A ROADS

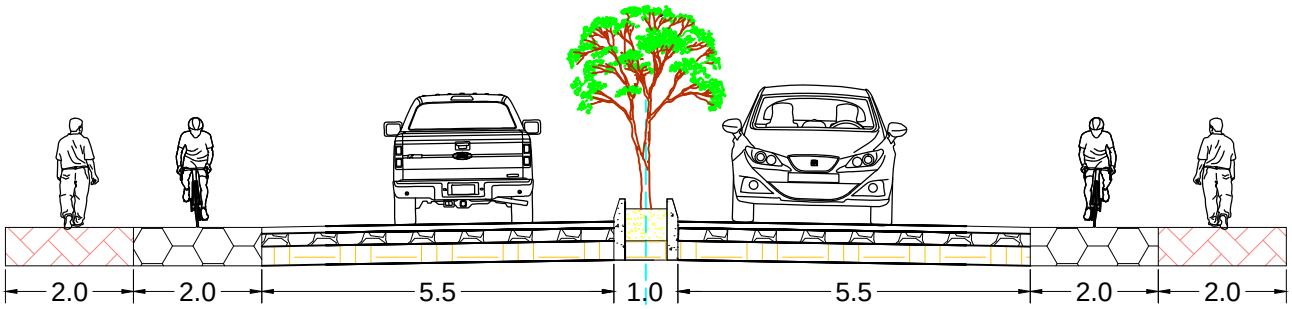


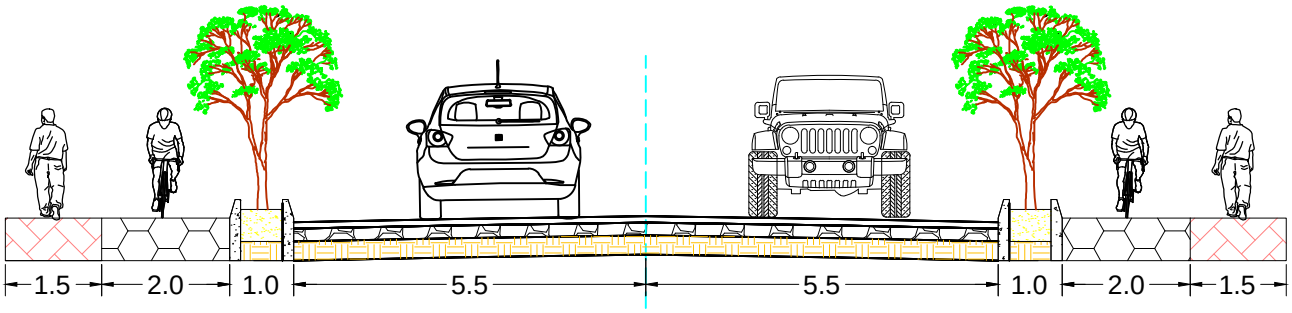


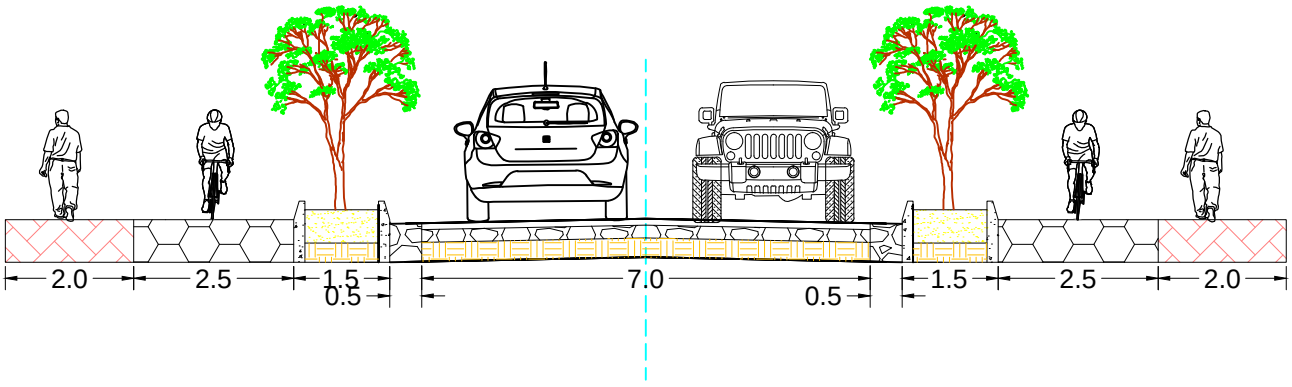


ANNEX I-A TYPICAL ROAD SECTIONS

TYPICAL SECTIONS FOR CLASS B ROADS

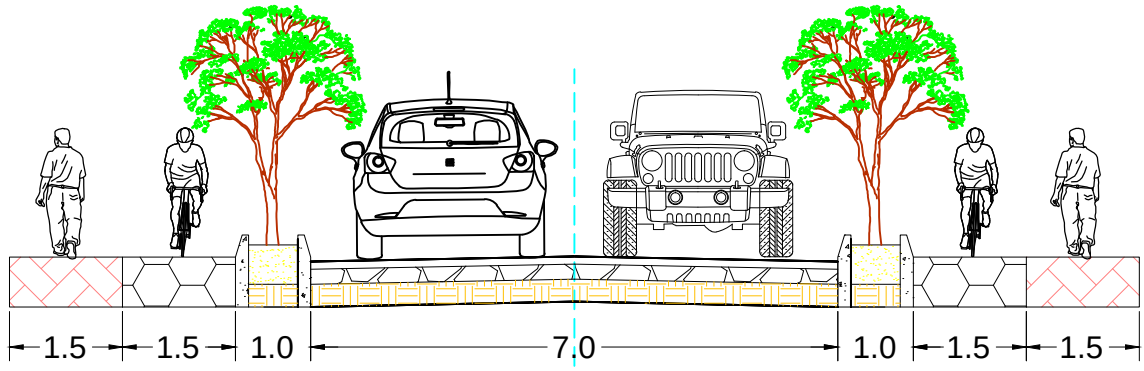


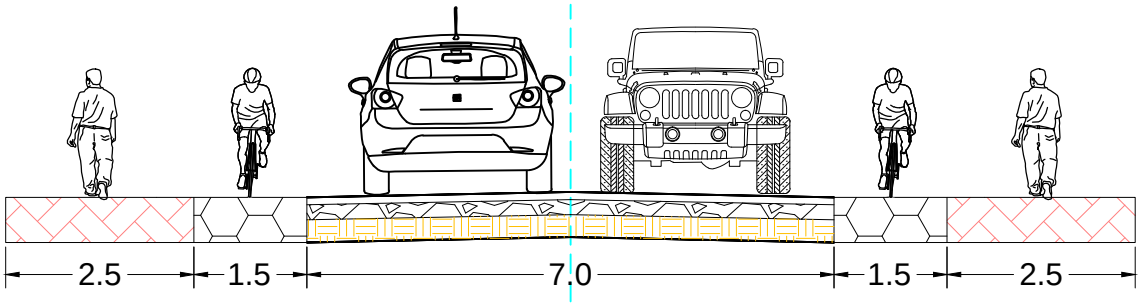


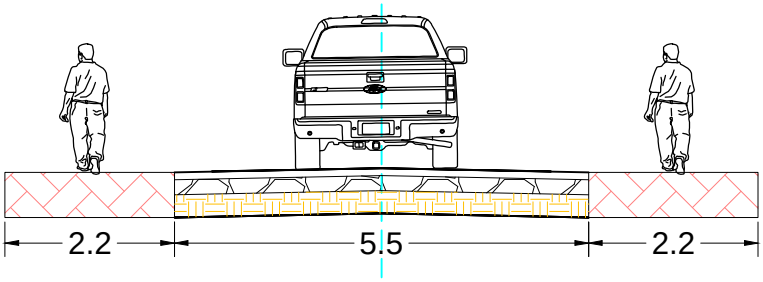


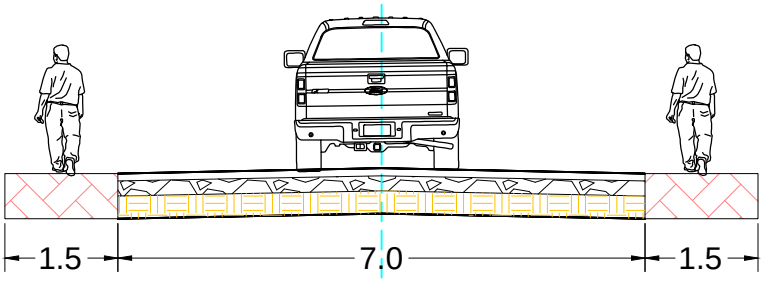
ANNEX I-A TYPICAL ROAD SECTIONS

TYPICAL SECTIONS FOR CLASS C ROADS





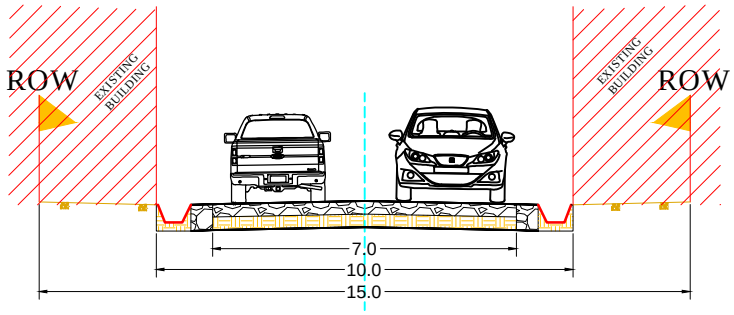




ANNEX I - B

ROAD DEVELOPMENT PHASES

CLASS C ROADS



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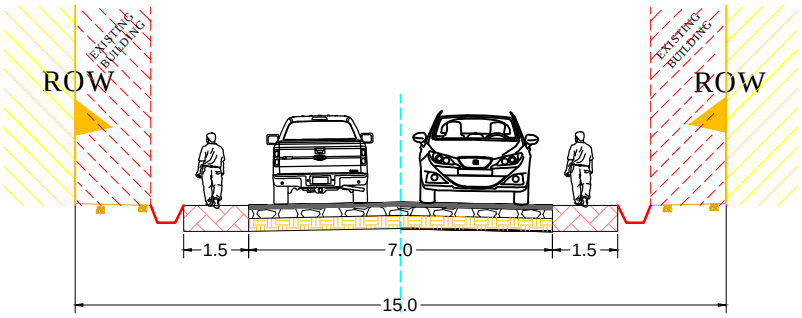

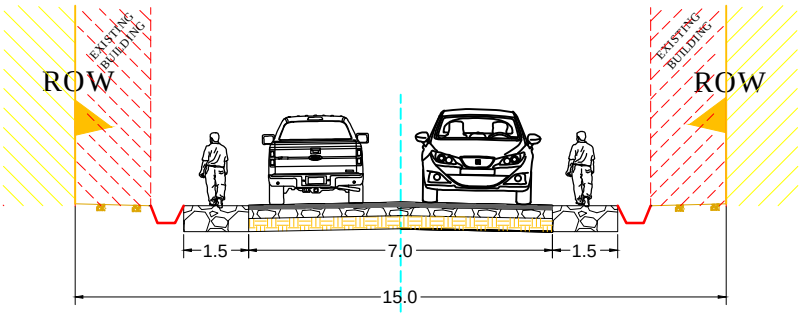

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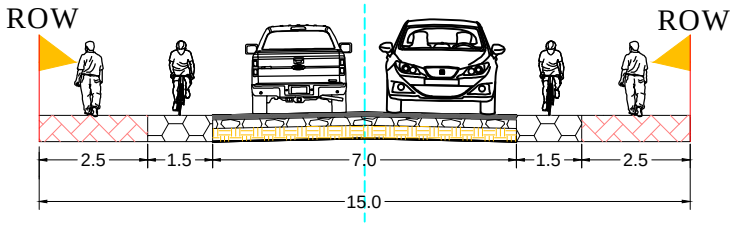
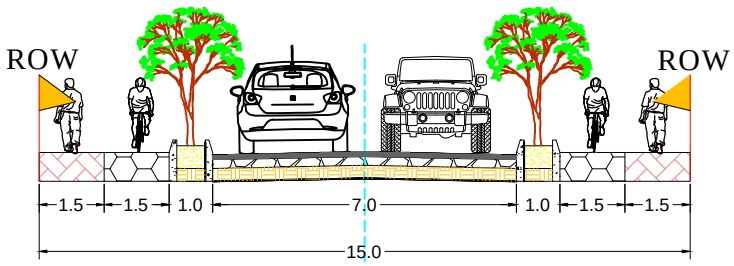
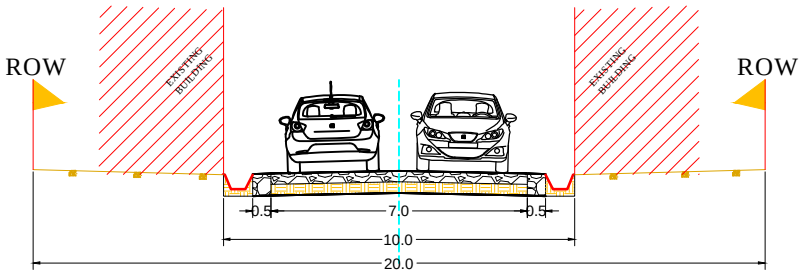




Phase III

CLASS B ROADS



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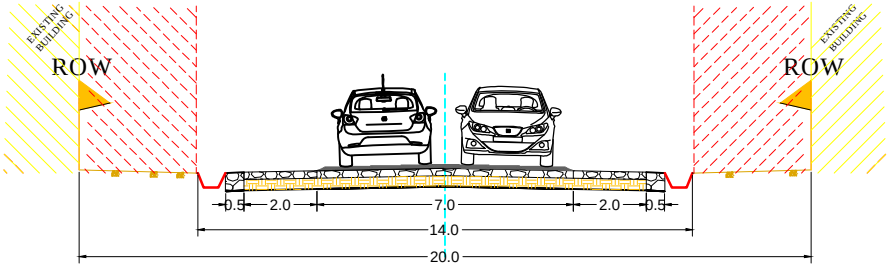

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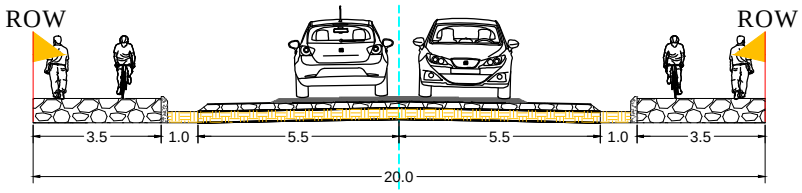
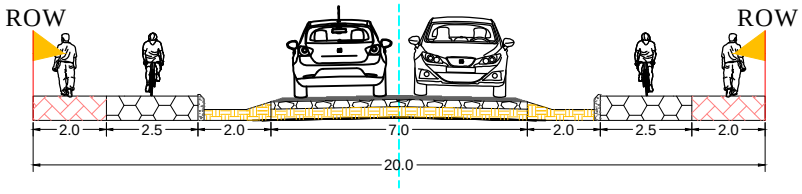
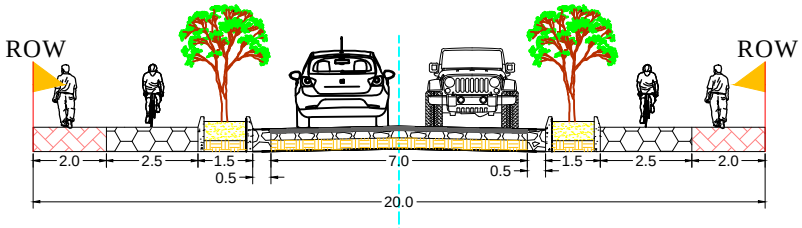
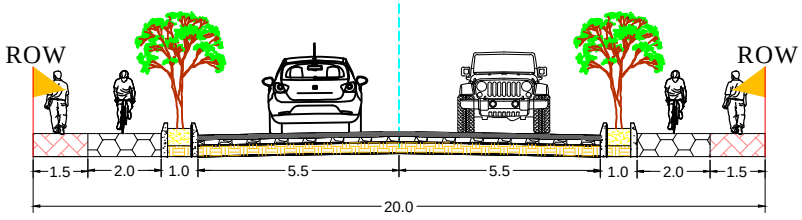




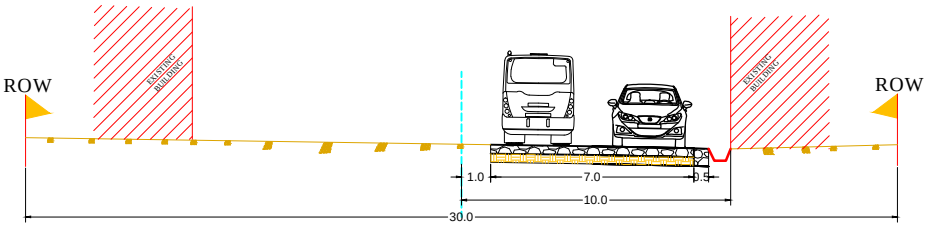
Phase III



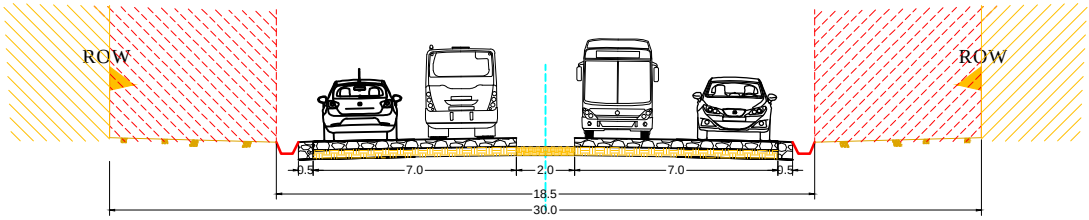


Phase IV

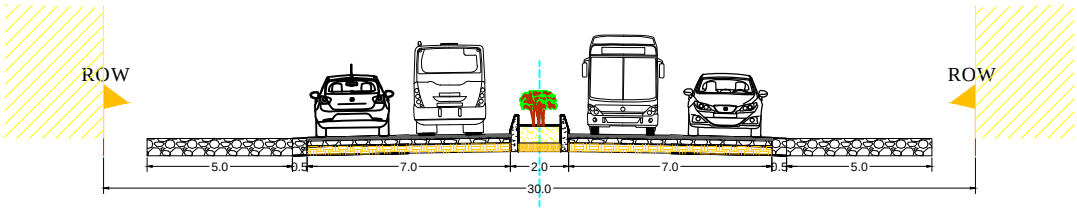
CLASS A ROADS



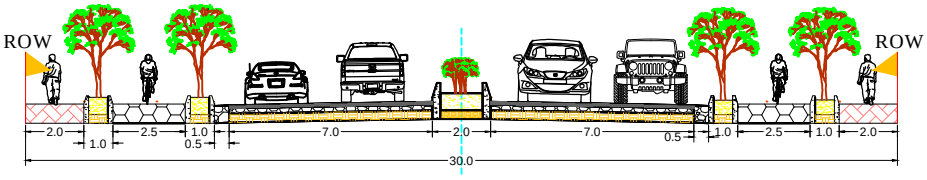
Phase I

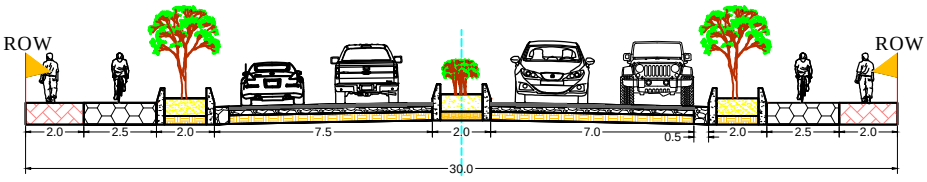


Phase II



Phase III





Phase IV

ANNEX I - C

MAPS

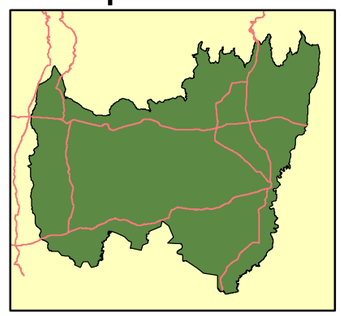
Kankai Municipality
Municipal Transport Master Plan

Strategic Road Network Map

Legend

- SRN
- Other Districts
- JHAPA

Jhapa District



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Kankai, Jhapa

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Shankhamul-34, Kathmandu, Nepal
Email: nestconsultancy@gmail.com

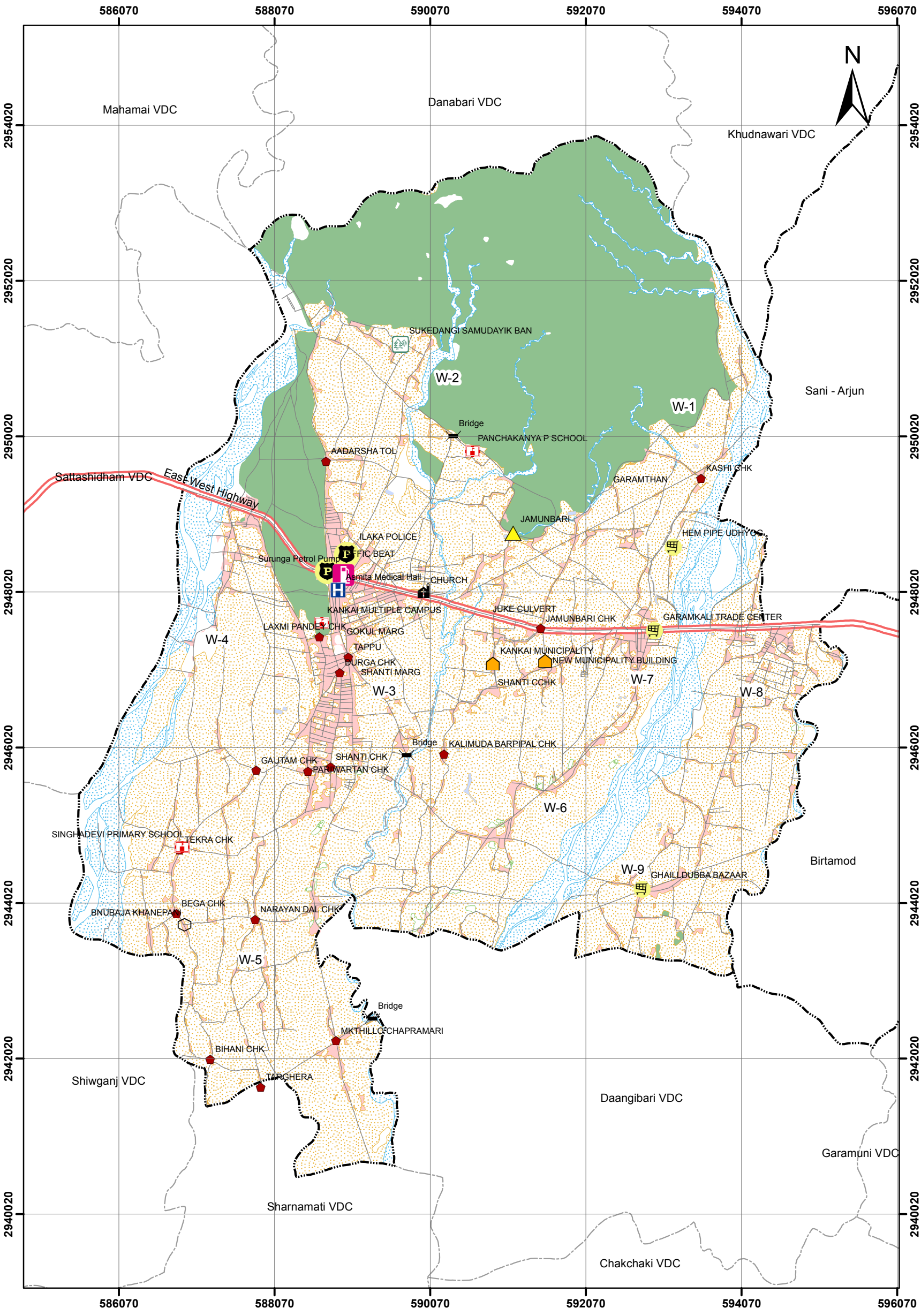
(Scale: 1:2500000)

0 37.5 75 150 225 300 Kilometers

Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
Scale Factor: 0.9999
Latitude Of Origin: 0.0000
Units: Meter

Kankai Municipality
Municipal Transport Master Plan

Indicative Development Potential Map



Legend

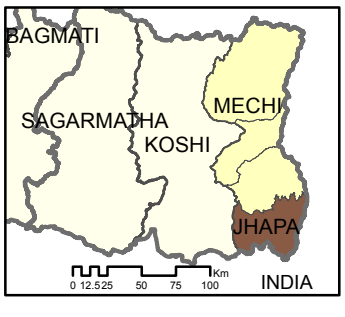
IDPM points

Name

- Water Tank
- Chowk
- Medical centre
- Bridge
- Church
- Markets
- Ilaka Police
- Jamunbari
- Schools
- Kankai Municipality Building
- New Municipality Building
- Sukedangi Samudayik Ban
- Surunga Petrol Pump
- Traffic Beat
- Road
- SRN
- Municipal Boundary
- VDC Boundary
- Bush
- Barren Land
- Built Up
- Canal
- Cultivation
- Forest
- Orchard
- Waterbodies
- Sand

Data Source: Google Earth Satellite Imagery 2015. VDC, ward and Municipal boundaries are obtained from Department of Survey and field verified.

Eastern Development Region



(Scale 1:50000)

0 0.4 0.8 1.6 2.4 3.2 Km

Kankai Municipality Office
Kankai, Jhapa

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Suruchi Marga,Shankhamul-34, Kathmandu, Nepal
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Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
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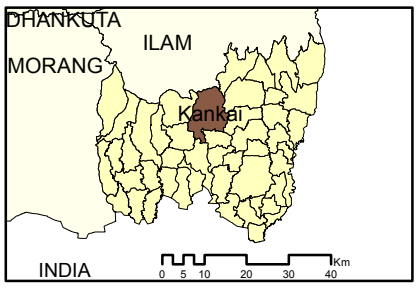
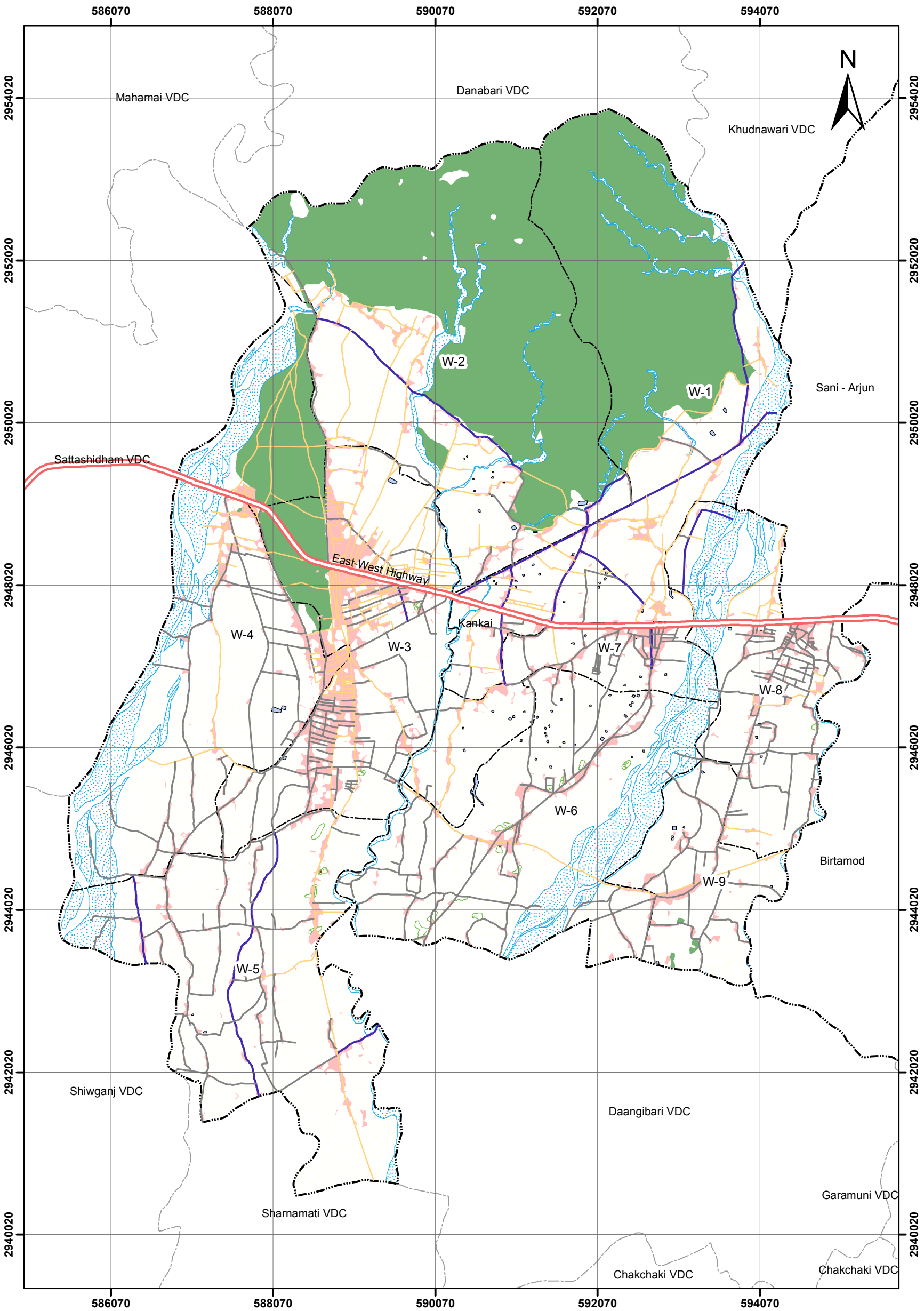
Units: Meter

Jhapa District

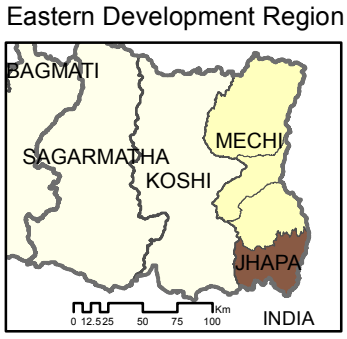


Kankai Municipality
Municipal Transport Master Plan

Road Inventory Map (Hierarchy by Width)



Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

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Kankai, Jhapa

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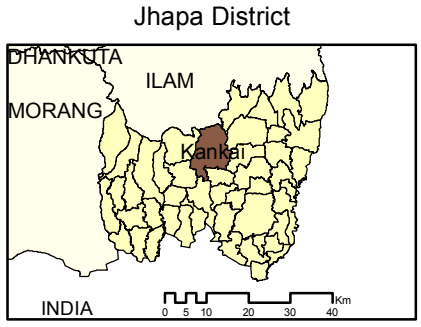
Units: Meter

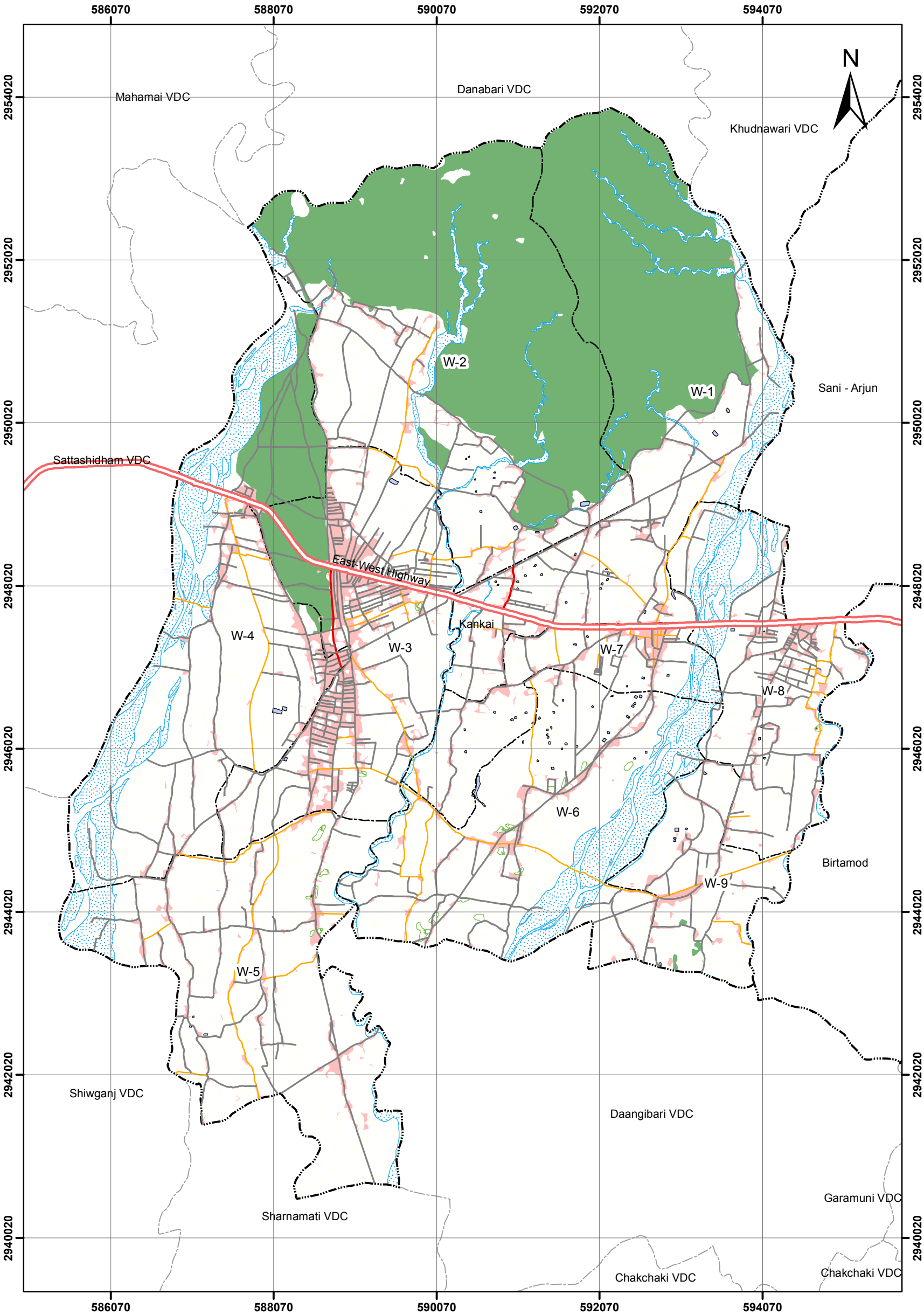
Jhapa District



3.a

Kankai Municipality
Municipal Transport Master Plan

Road Inventory Map
(Surface Type)



Legend

- Municipal Boundary
- Ward Boundary
- VDC Boundary
- SRN
- Metalled

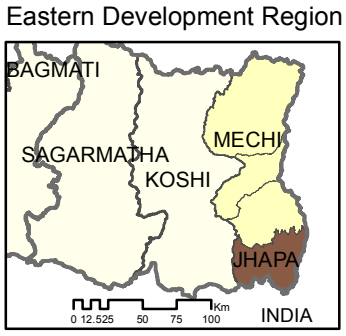
Surface type

- Earthen
- Gravelled

Landcover

- Bush
- Built Up
- Cultivation
- Forest
- Orchard
- Waterbodies
- Sand

Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

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Kankai, Jhapa

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Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
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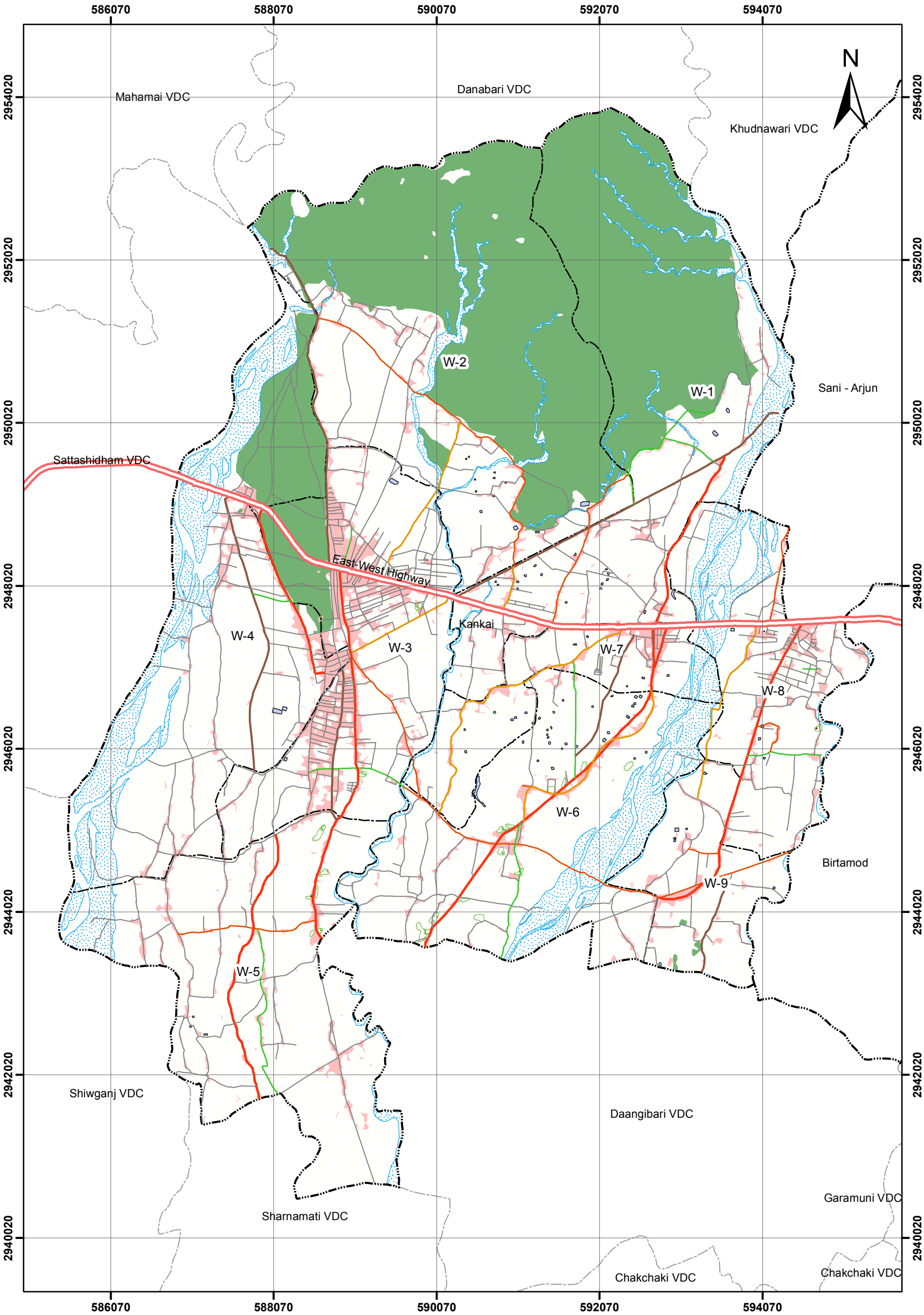
Units: Meter

Jhapa District

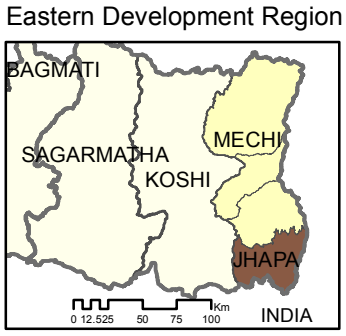
3.b

Kankai Municipality
Municipal Transport Master Plan

Road Inventory Map
(Order of Priority)



Eastern Development Region



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0 0.375 0.75 1.5 2.25 3 Km

Kankai Municipality Office
Kankai, Jhapa

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Projection: Transverse Mercator
Datum: Everest Adj 1937
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
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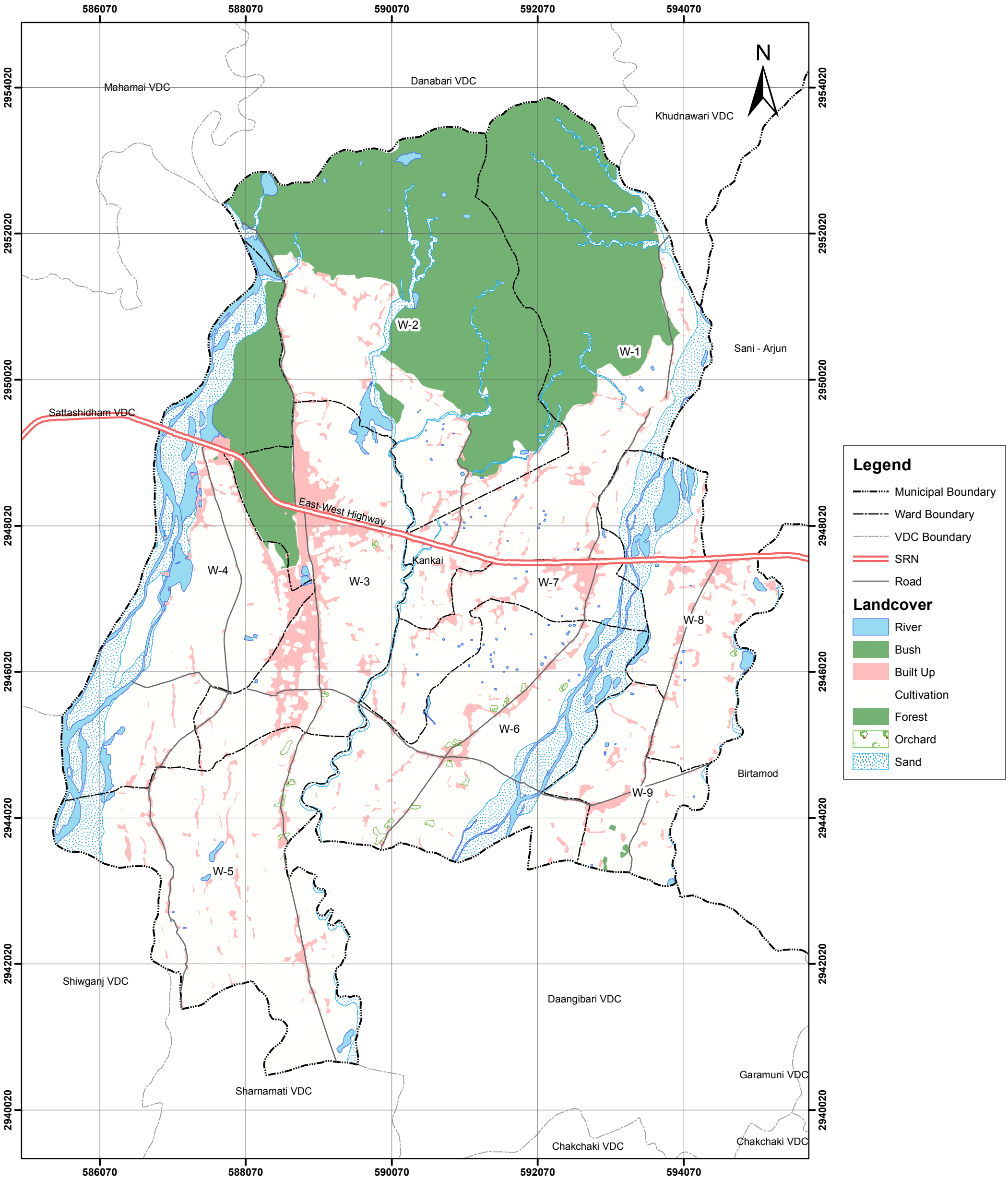
Latitude Of Origin: 0.0000
Units: Meter

Jhapa District

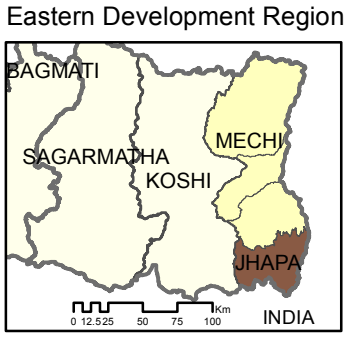
3.c

Kankai Municipality
Municipal Transport Master Plan

Land Use Map



Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

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False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
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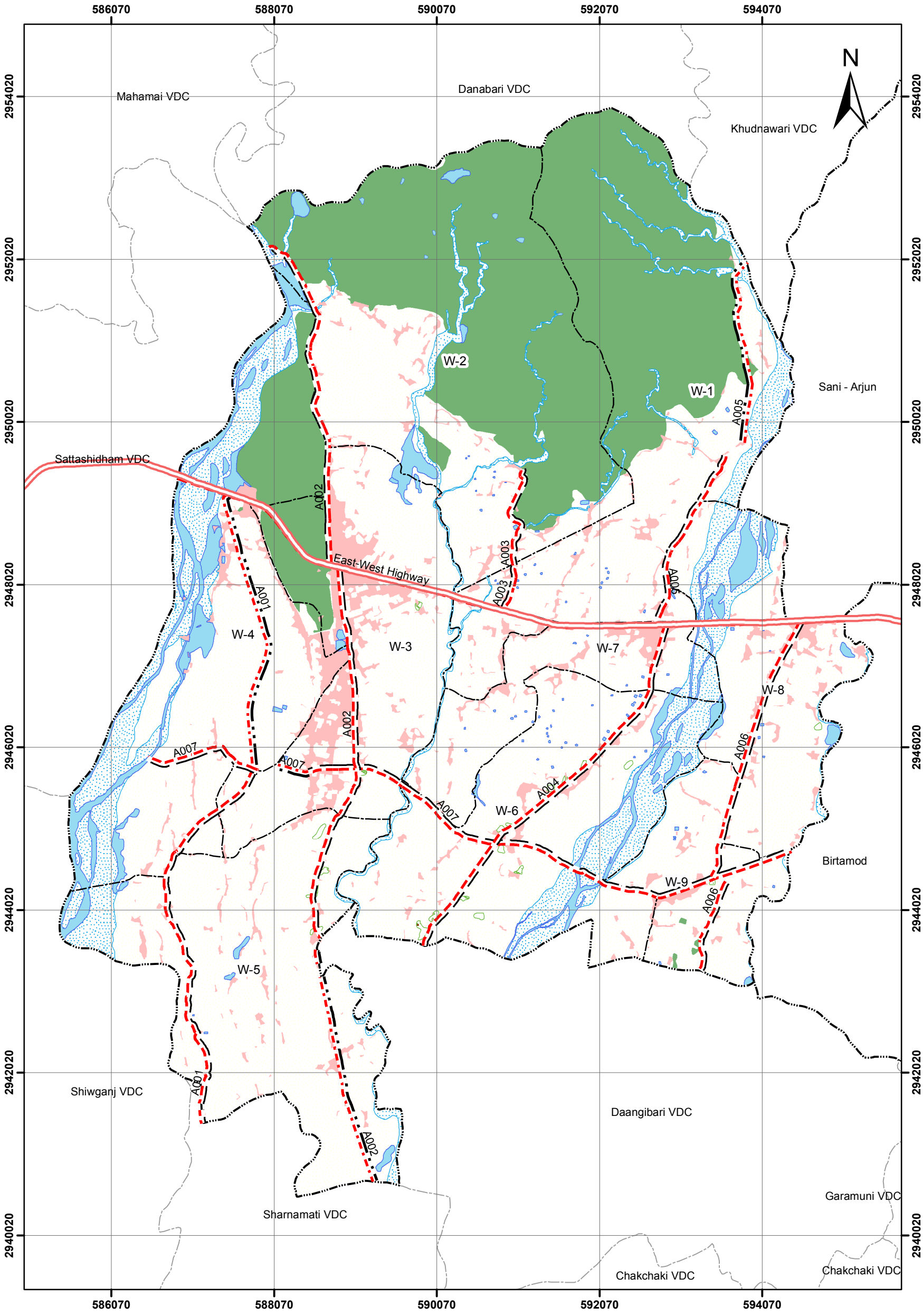
Latitude Of Origin: 0.0000
Units: Meter

Jhapa District

Kankai Municipality
Municipal Transport Master Plan

MTPP Map: CLASS A



Legend

- Municipal Boundary
- Ward Boundary
- VDC Boundary
- SRN

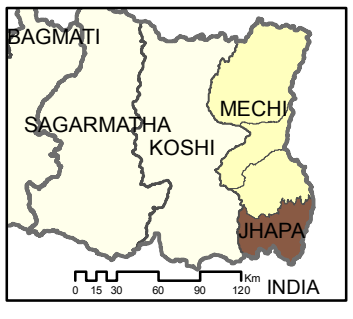
Class, Intervention

- A, Periodic Maintenence
- A, New Construction
- A, No Intervention
- A, Upgradation

Landcover

- River
- Bush
- Built Up
- Cultivation
- Forest
- Orchard
- Sand

Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

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Kankai, Jhapa

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Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
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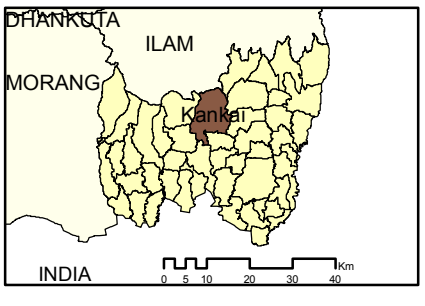
Units: Meter

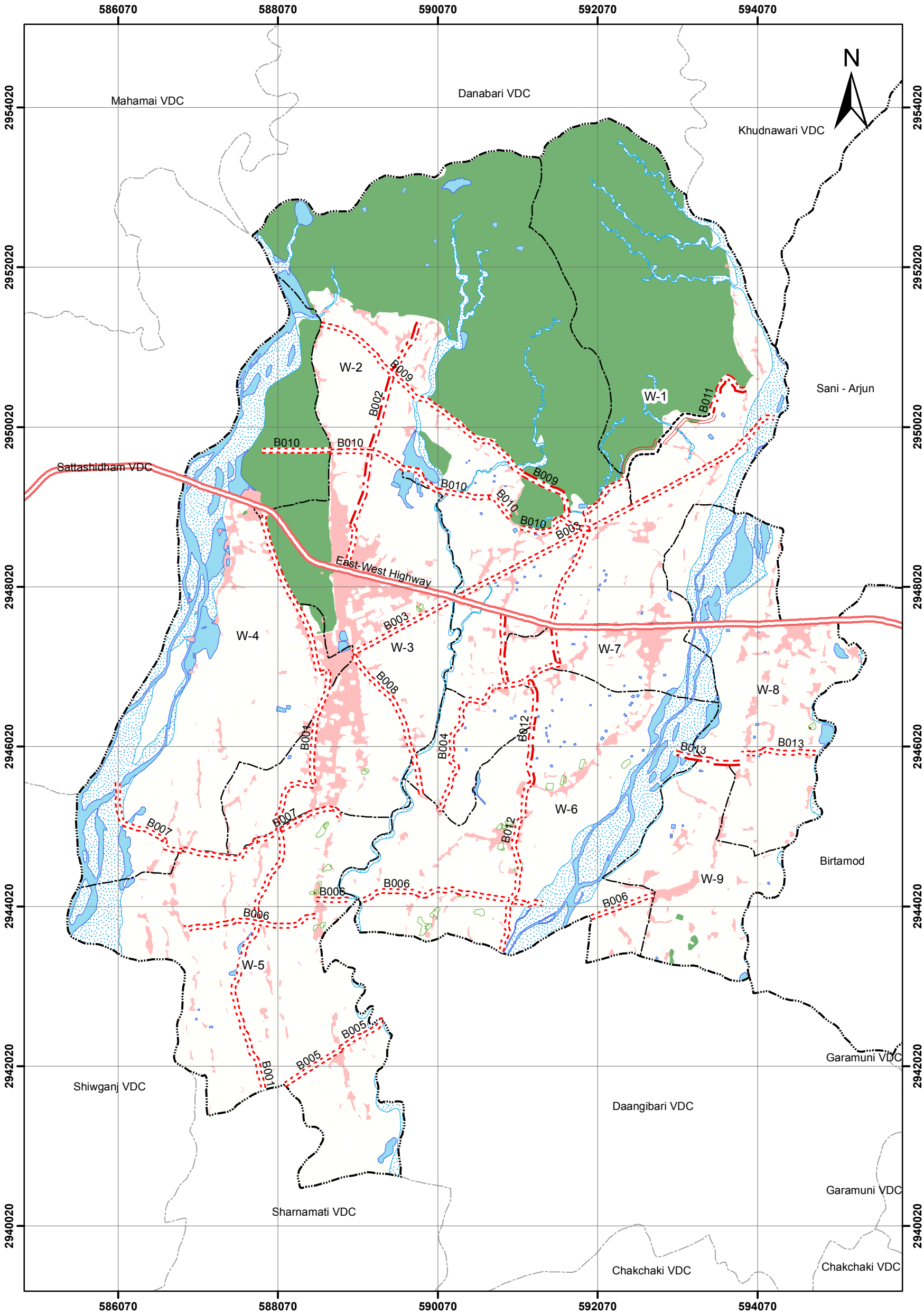
Jhapa District



5.a

Kankai Municipality
Municipal Transport Master Plan

MTPP Map: CLASS B



Legend

- Municipal Boundary
- Ward Boundary
- VDC Boundary
- SRN

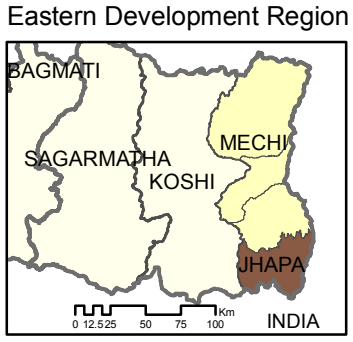
Class, Intervention

- B, Periodic Maintenence
- B, New Construction
- B, No Intervention
- B, Rehabilitation
- B, Upgradation

Landcover

- River
- Bush
- Built Up
- Cultivation
- Forest
- Orchard
- Sand

Eastern Development Region



(Scale 1:50000)

0 0.4 0.8 1.6 2.4 3.2 Km

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Kankai, Jhapa

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Suruchi Marga,Shankhamul-34, Kathmandu, Nepal
Email: nestconsultancy@gmail.com

Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
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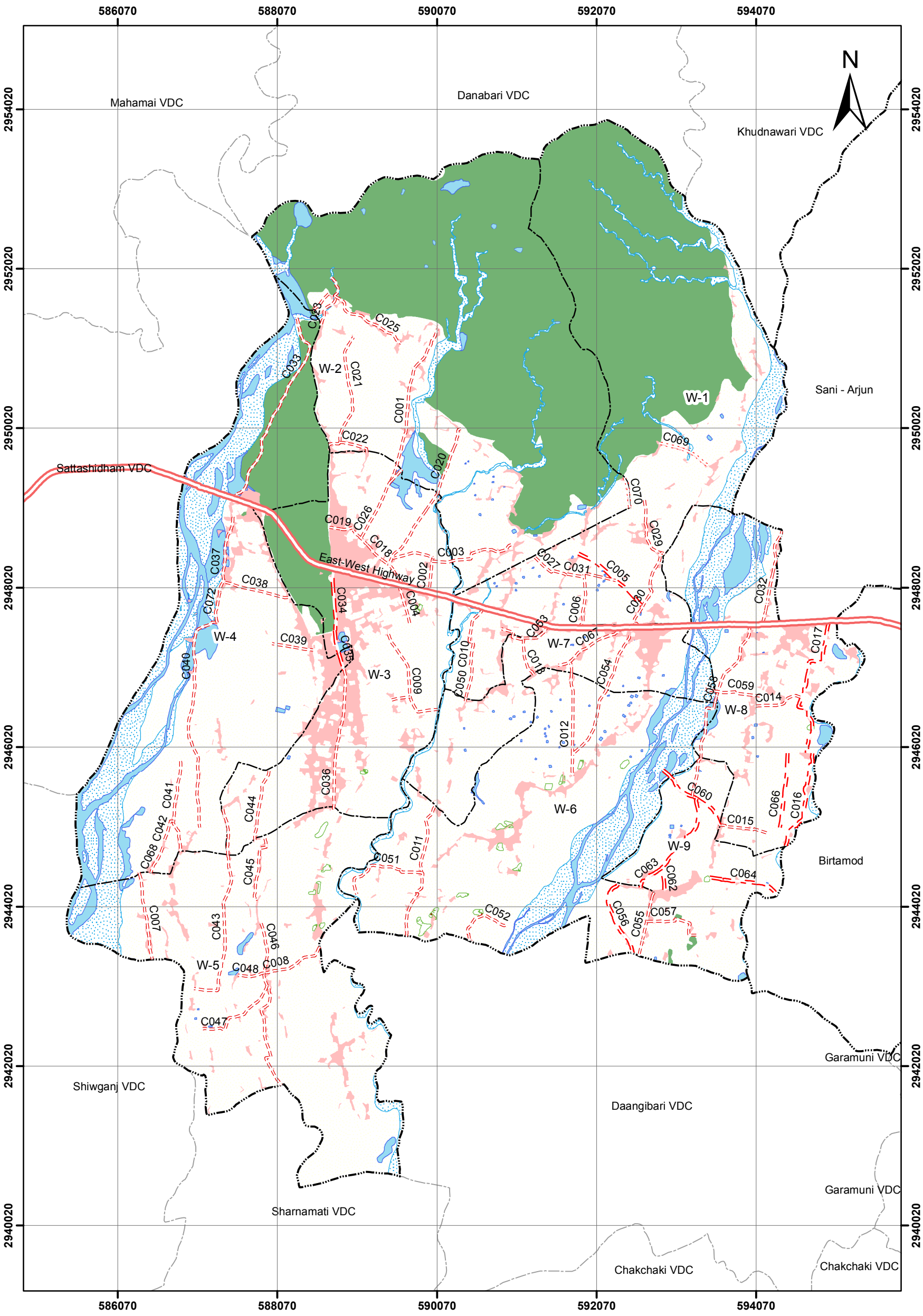
Units: Meter

Jhapa District

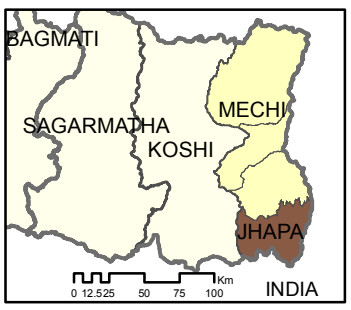
5.b

Kankai Municipality
Municipal Transport Master Plan

MTPP Map: CLASS B



Eastern Development Region



(Scale 1:50000)

0 0.4 0.8 1.6 2.4 3.2 Km

Kankai Municipality Office
Kankai, Jhapa

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Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
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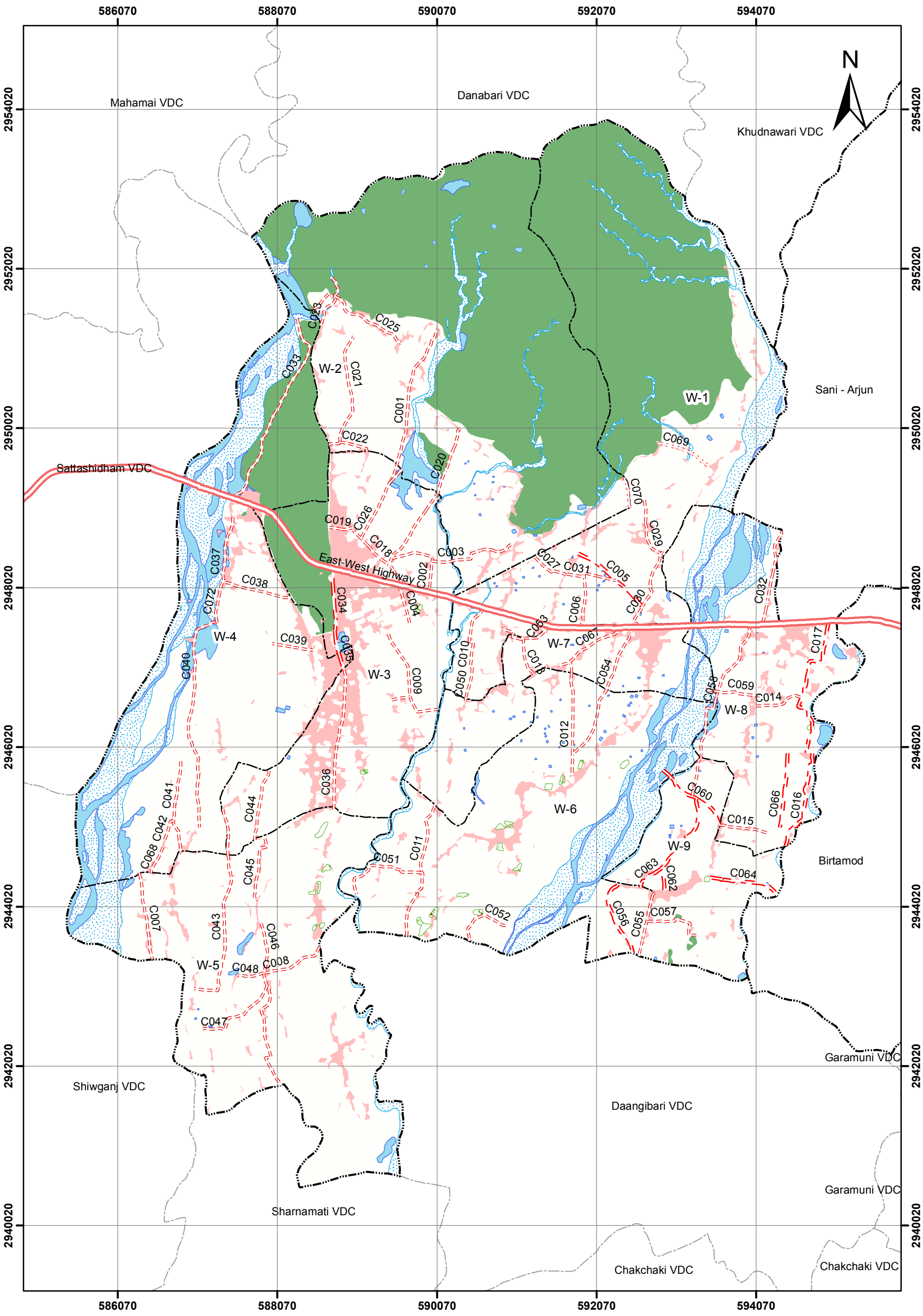
Latitude Of Origin: 0.0000
Units: Meter

Jhapa District

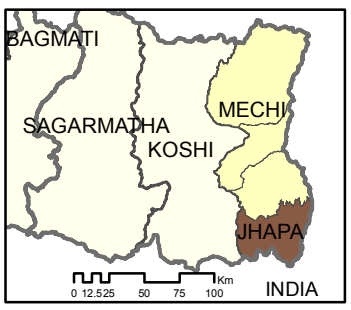
5.c

Kankai Municipality
Municipal Transport Master Plan

MTPP Map: CLASS B



Eastern Development Region



(Scale 1:50000)

0 0.4 0.8 1.6 2.4 3.2 Km

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Projection: Transverse Mercator
Datum: Everest Adj 1937
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
Scale Factor: 0.9999
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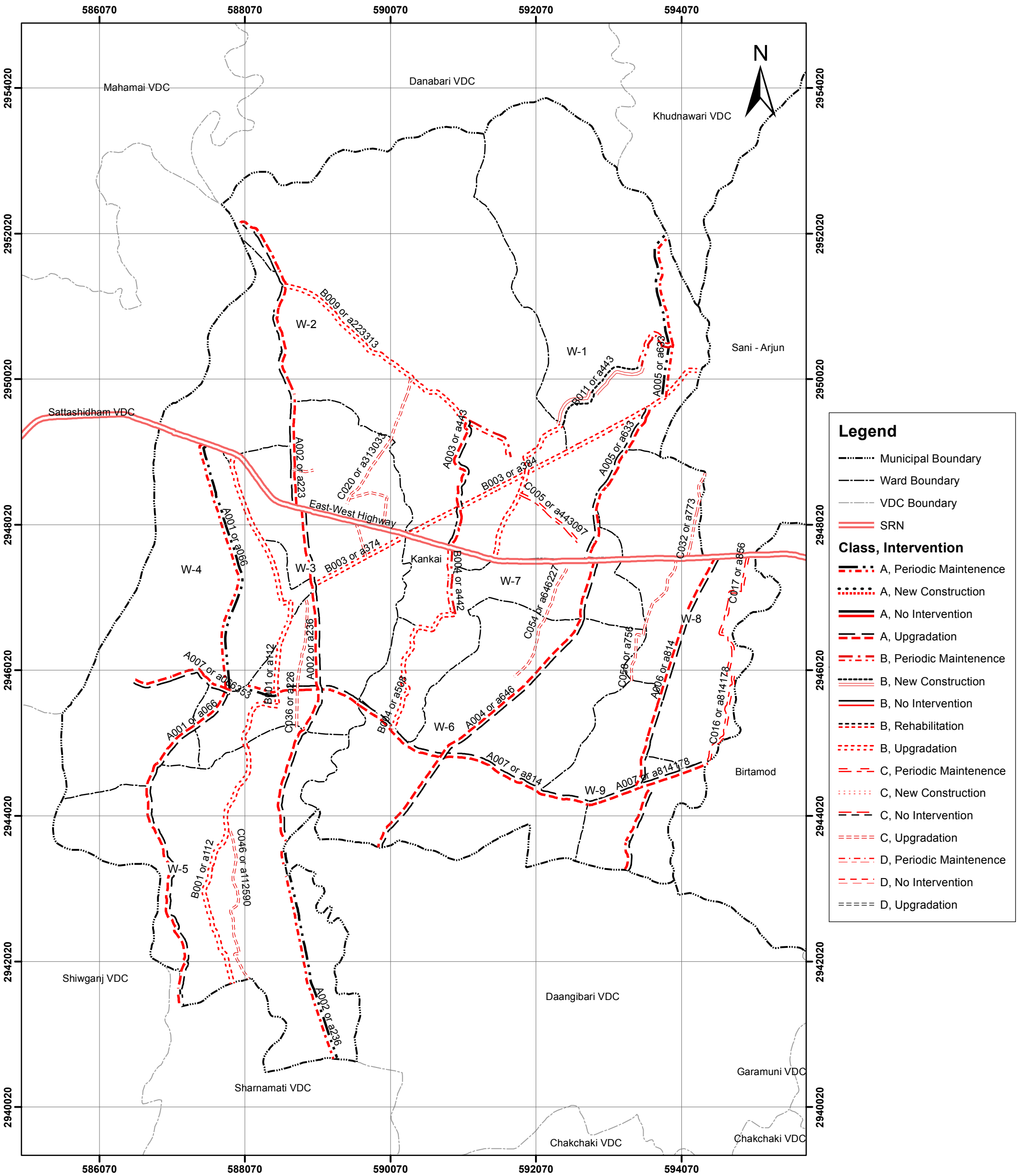
Units: Meter

Jhapa District

5.c

Kankai Municipality
Municipal Transport Master Plan

Consolidated MTMP Map



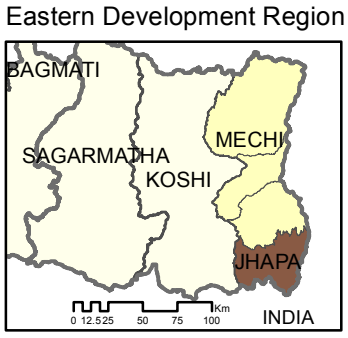
Legend

- Municipal Boundary
- Ward Boundary
- VDC Boundary
- SRN

Class, Intervention

- A, Periodic Maintenence
- A, New Construction
- A, No Intervention
- A, Upgradation
- B, Periodic Maintenence
- B, New Construction
- B, No Intervention
- B, Rehabilitation
- B, Upgradation
- C, Periodic Maintenence
- C, New Construction
- C, No Intervention
- C, Upgradation
- D, Periodic Maintenence
- D, No Intervention
- D, Upgradation

Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

Kankai Municipality Office
Kankai, Jhapa

NEST Pvt. Ltd.
Suruchi Marga,Shankhamul-34, Kathmandu, Nepal
Email: nestconsultancy@gmail.com

Projected Coordinate System:□ModifiedUTM_87
Projection:□Transverse_Mercator
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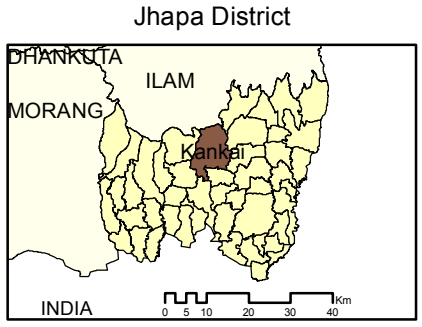
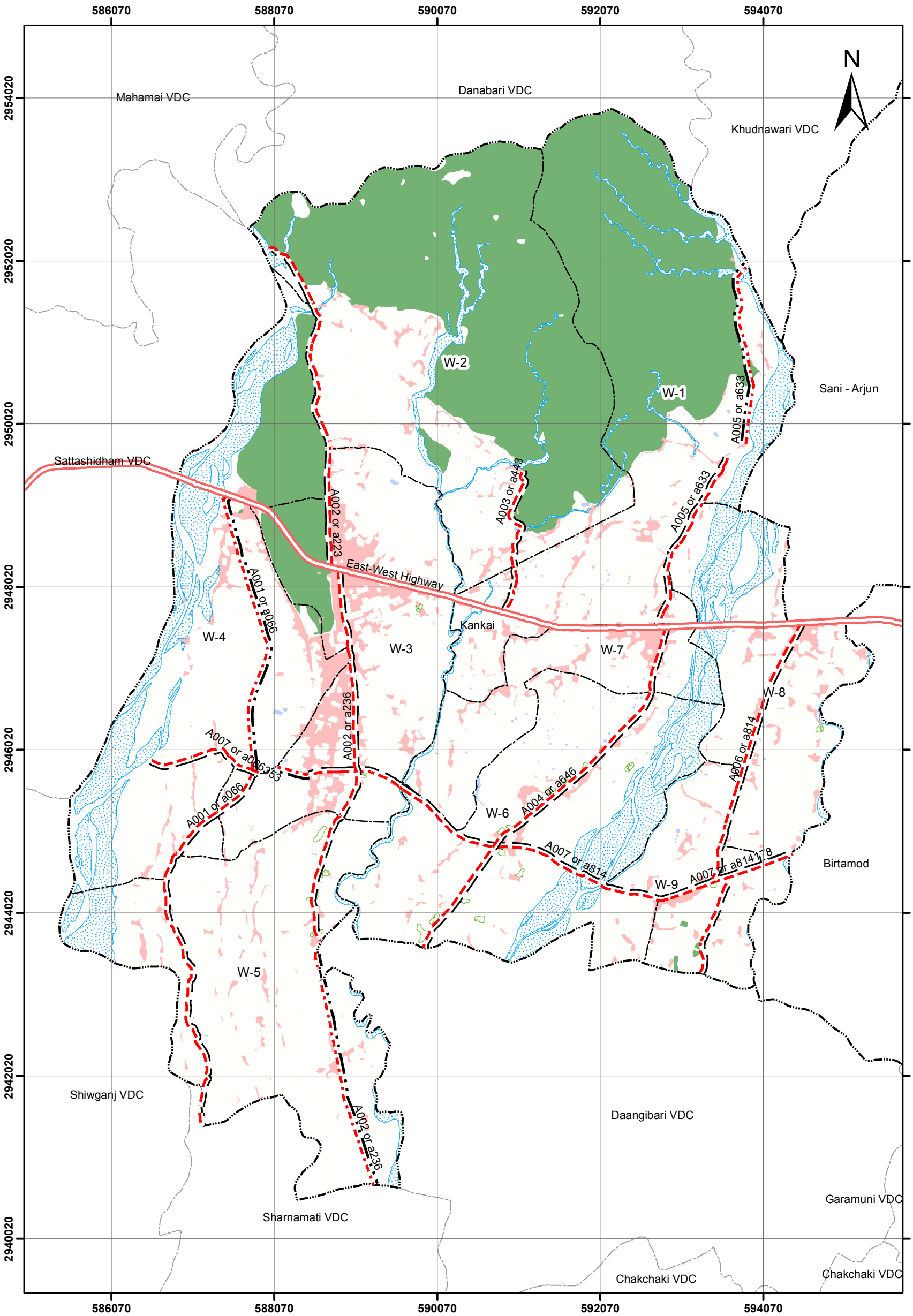
False_Northing:□0.00000000
Central_Meridian:□87.00000000
Scale_Factor:□0.99990000
Latitude_Of_Origin:□0.00000000
Linear Unit: □Meter

Jhapa District

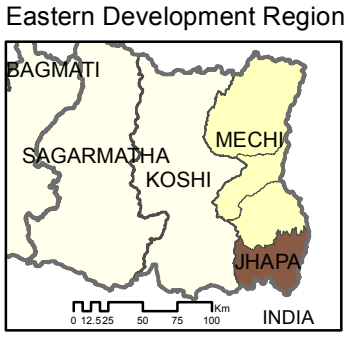


Kankai Municipality
Municipal Transport Master Plan

MTMP Map: CLASS A



Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

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Projected Coordinate System:□ModifiedUTM_87
Projection:□Transverse_Mercator
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False_Northing:□0.00000000
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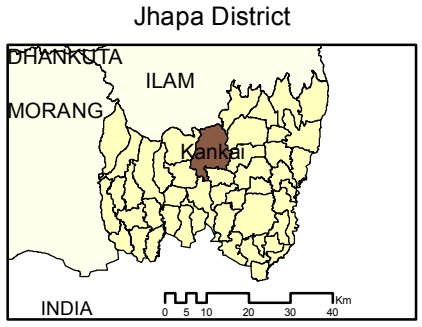
Linear Unit: □Meter

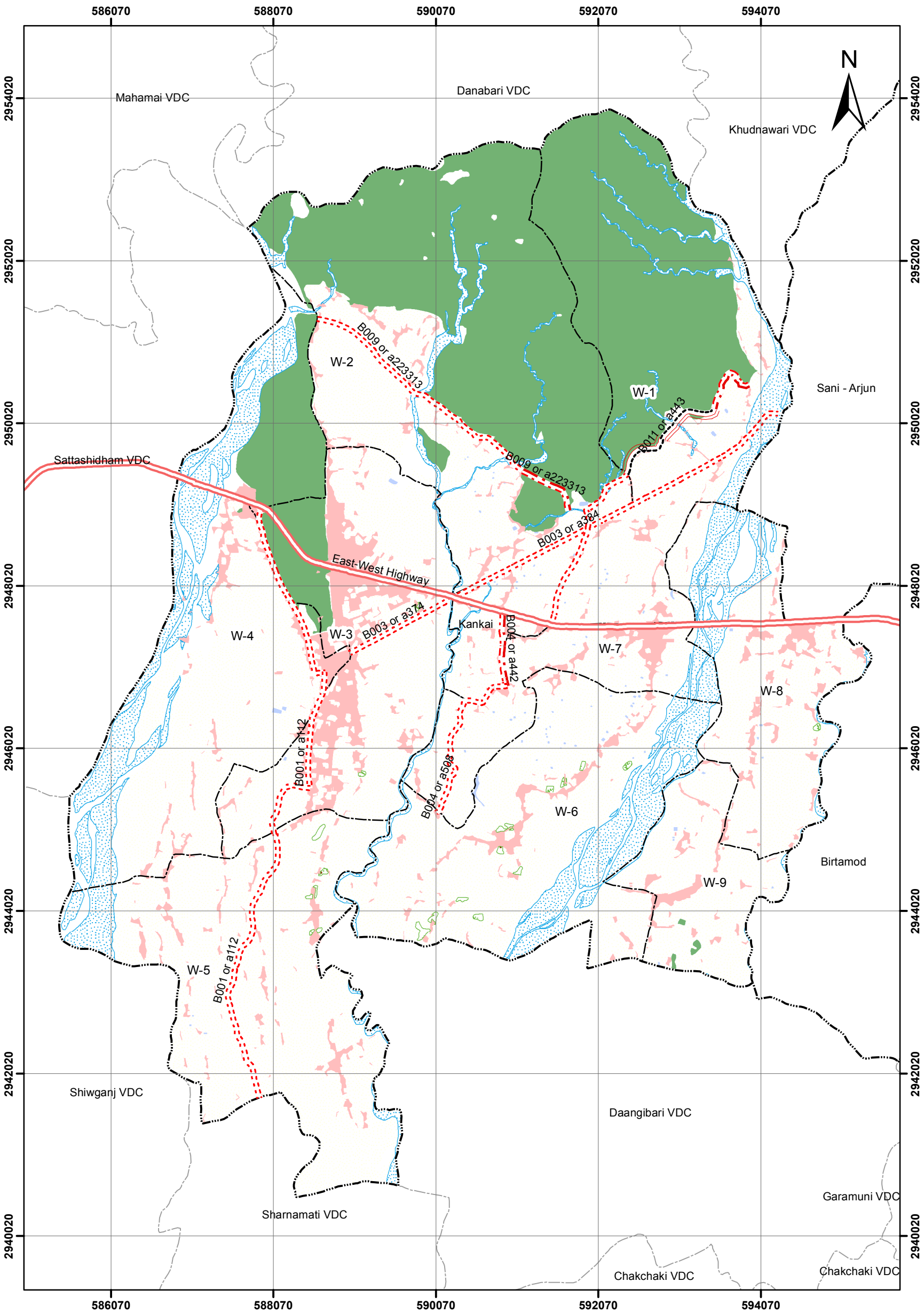
Jhapa District



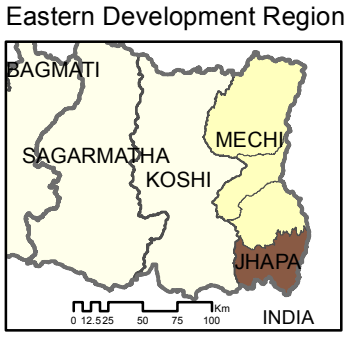
6.a

Kankai Municipality
Municipal Transport Master Plan

MTMP Map: CLASS B



Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

Kankai Municipality Office
Kankai, Jhapa

NEST Pvt. Ltd.
Suruchi Marga,Shankhamul-34, Kathmandu, Nepal
Email: nestconsultancy@gmail.com

Projected Coordinate System:□ModifiedUTM_87
Projection:□Transverse_Mercator
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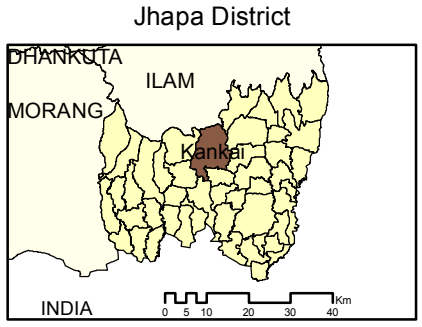
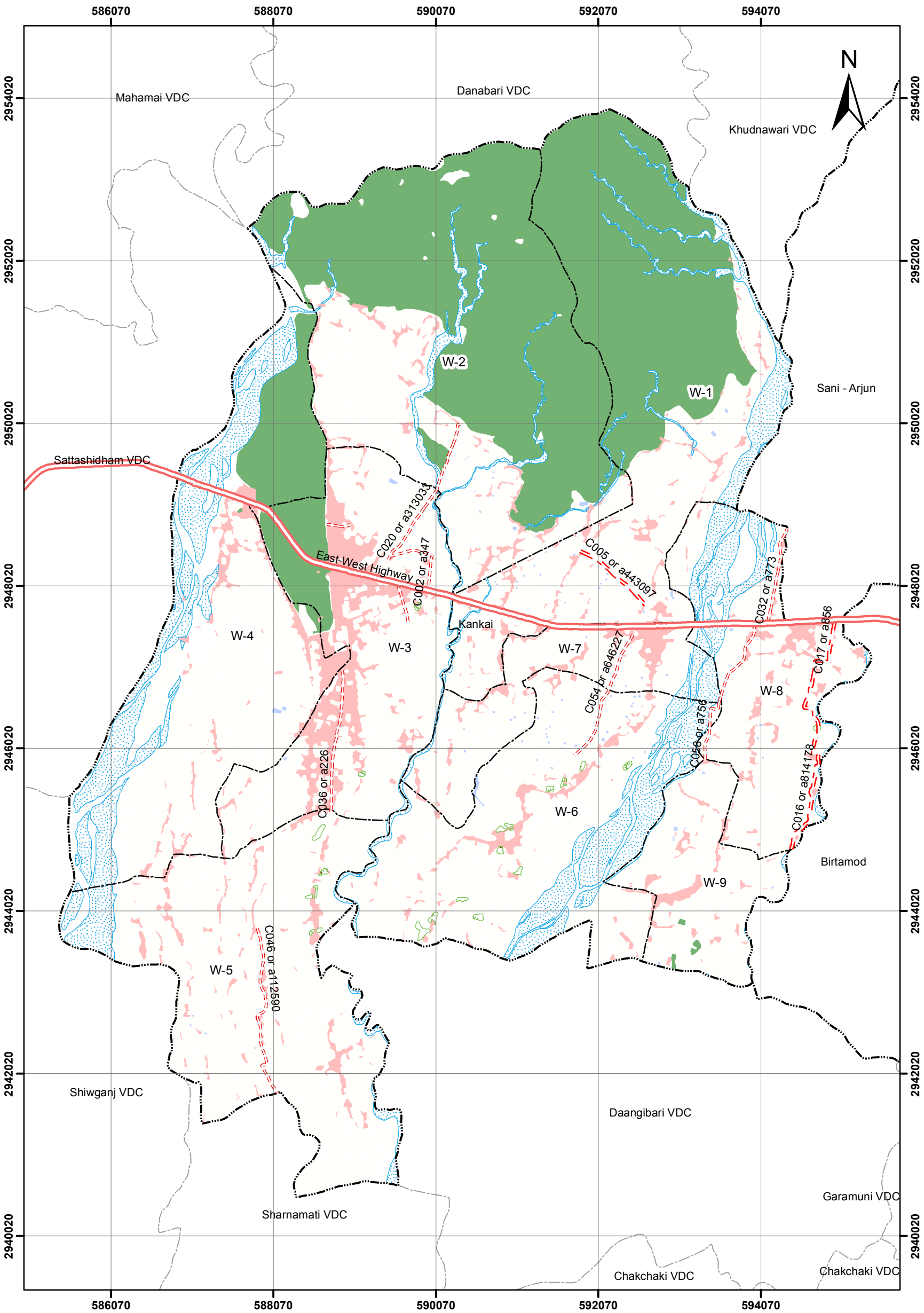
Jhapa District



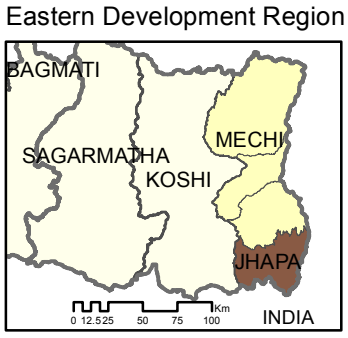
6.b

Kankai Municipality
Municipal Transport Master Plan

MTMP Map: CLASS C



Eastern Development Region



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0 0.375 0.75 1.5 2.25 3 Km

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Kankai, Jhapa

NEST Pvt. Ltd.
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Projected Coordinate System:□ModifiedUTM_87
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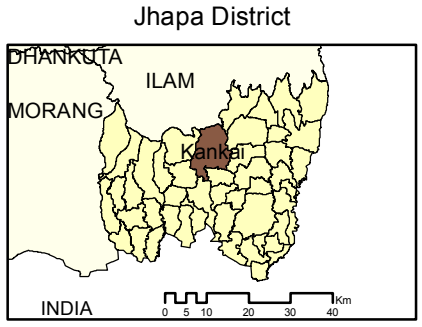
Jhapa District



Kankai Municipality
Municipal Transport Master Plan

Bridges and Culverts

Legend

- Municipal Boundary
- Ward Boundary
- VDC Boundary
- SRN
- Road

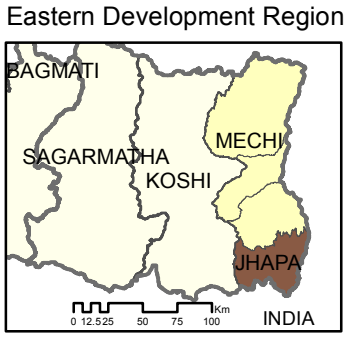
Category

- CDS,needs intervention
- Proposed CDS

Landcover

- Bush
- Cultivation
- Forest
- Orchard
- Waterbodies
- Sand

Eastern Development Region



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Kankai, Jhapa

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Projected Coordinate System:□ModifiedUTM_87
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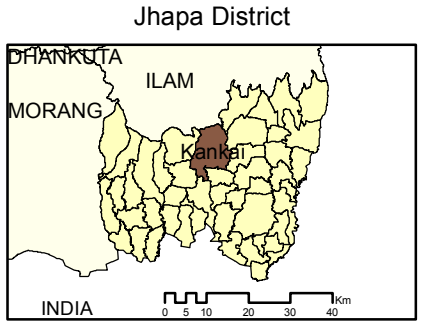
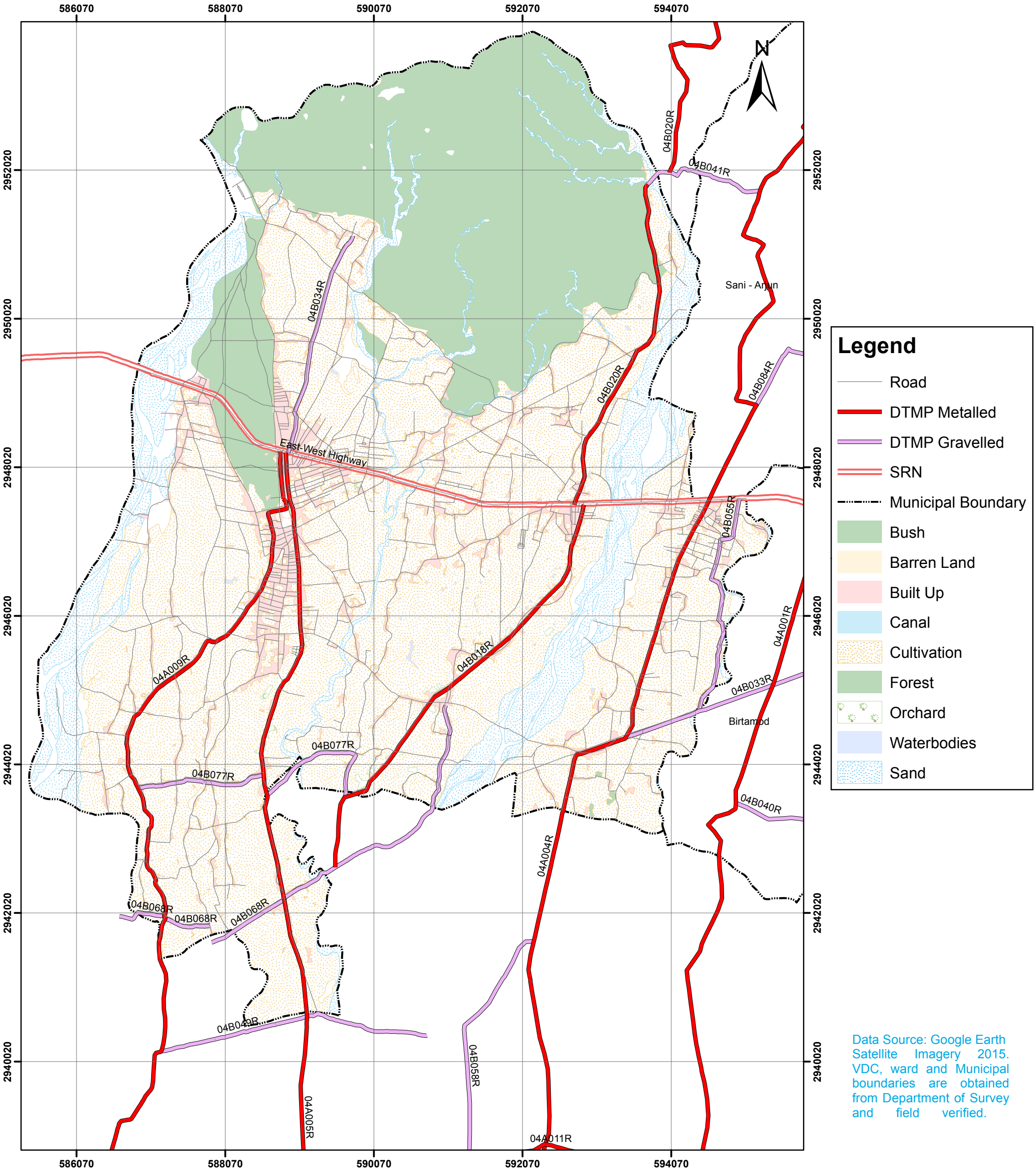
Jhapa District



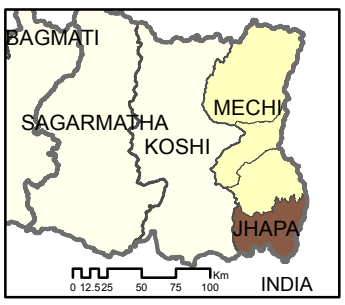
Kankai Municipality
Municipal Transport Master Plan

DRCN in Kankai Municipality



Data Source: Google Earth Satellite Imagery 2015. VDC, ward and Municipal boundaries are obtained from Department of Survey and field verified.

Eastern Development Region



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Kankai Municipality Office
Kankai, Jhapa

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Suruchi Marga,Shankhamul-34, Kathmandu, Nepal
Email: nestconsultancy@gmail.com

Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
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False Northing: 0.0000
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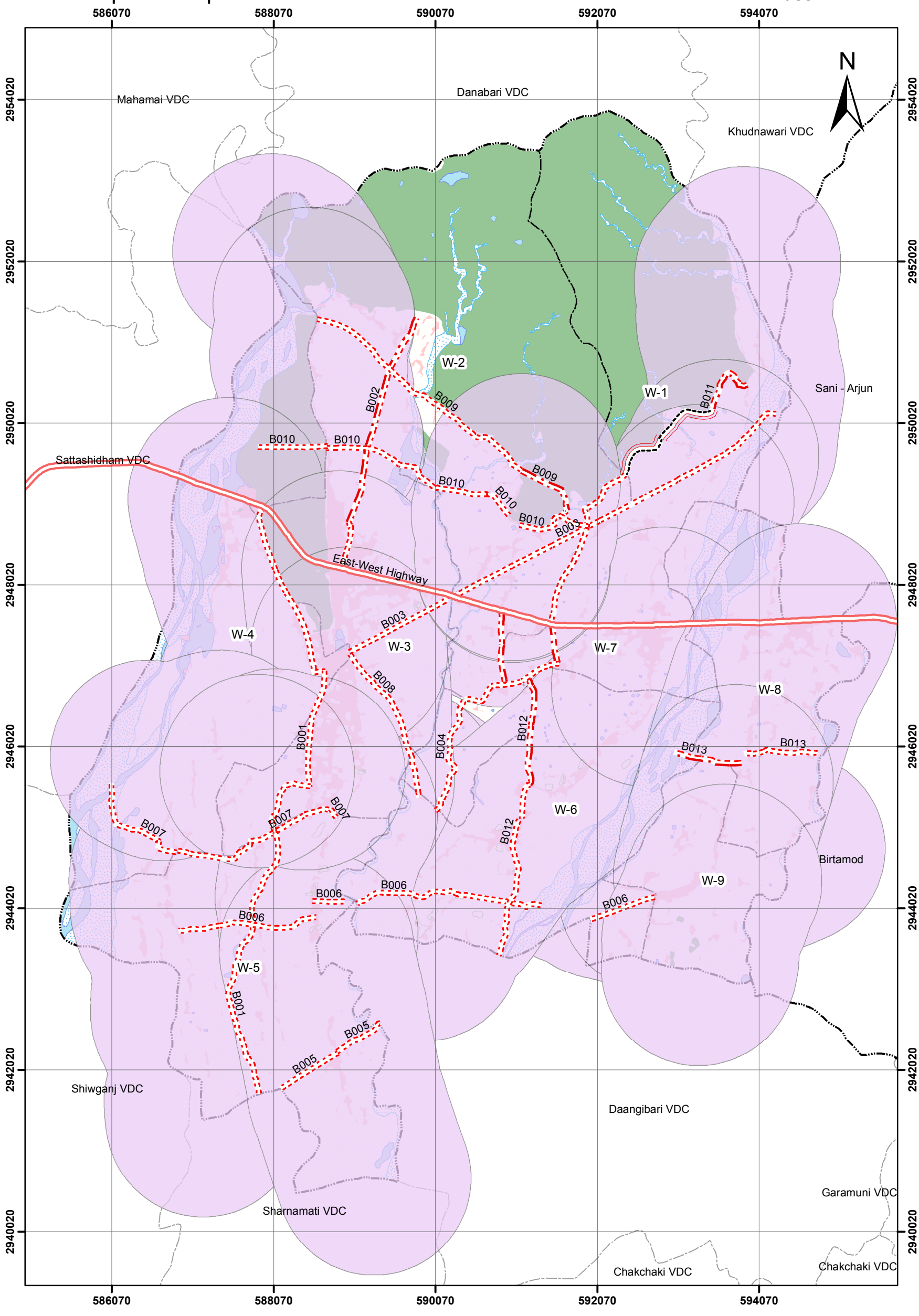
Units: Meter

Jhapa District

Kankai Municipality
Municipal Transport Master Plan

Accessibility Buffer Map
Class A



Legend

- SRN

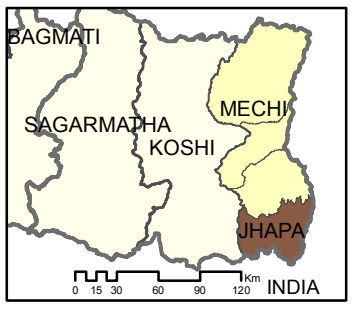
Class, Intervention

- B, Periodic Maintenence
- B, New Construction
- B, No Intervention
- B, Rehabilitation
- B, Upgradation
- buffer A
- Municipal Boundary
- Ward Boundary
- VDC Boundary

Landcover

- River
- Bush
- Built Up
- Cultivation
- Forest
- Orchard
- Sand

Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

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Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
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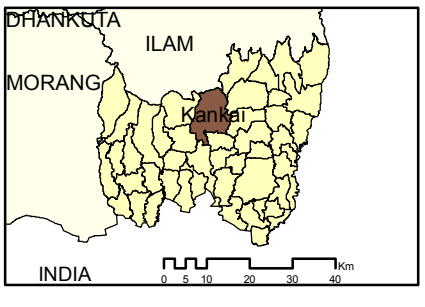
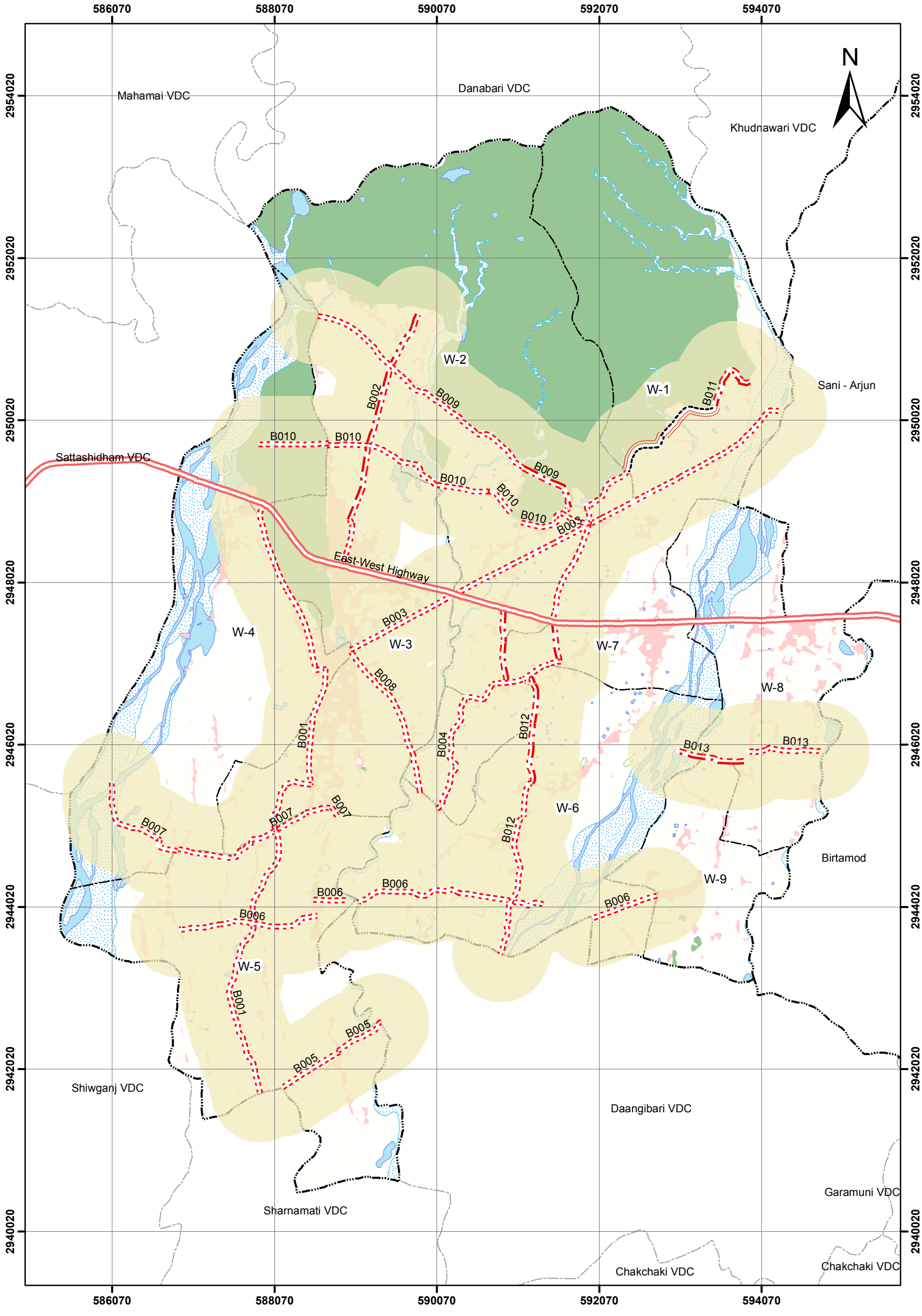
Units: Meter

Jhapa District



Kankai Municipality
Municipal Transport Master Plan

Accessibility Buffer Map
Class B



Legend

- SRN

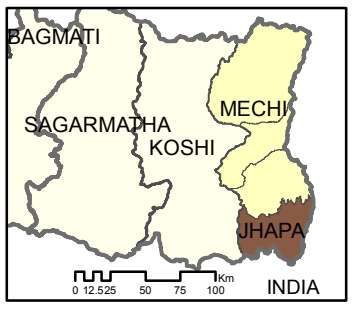
Class, Intervention

- B, Periodic Maintenence
- B, New Construction
- B, No Intervention
- B, Rehabilitation
- B, Upgradation
- buffer B
- Municipal Boundary
- Ward Boundary
- VDC Boundary

Landcover

- River
- Bush
- Built Up
- Cultivation
- Forest
- Orchard
- Sand

Eastern Development Region



(Scale 1:50000)

0 0.375 0.75 1.5 2.25 3 Km

Kankai Municipality Office
Kankai, Jhapa

NEST Pvt. Ltd.
Suruchi Marga,Shankhamul-34, Kathmandu, Nepal
Email: nestconsultancy@gmail.com

Coordinate System: ModifiedUTM 87
Projection: Transverse Mercator
Datum: Everest Adj 1937
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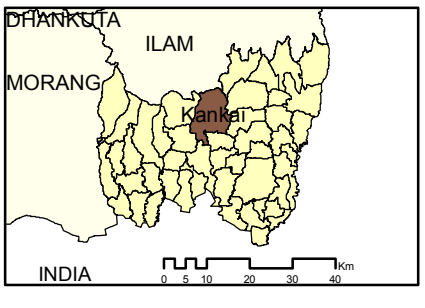
Units: Meter

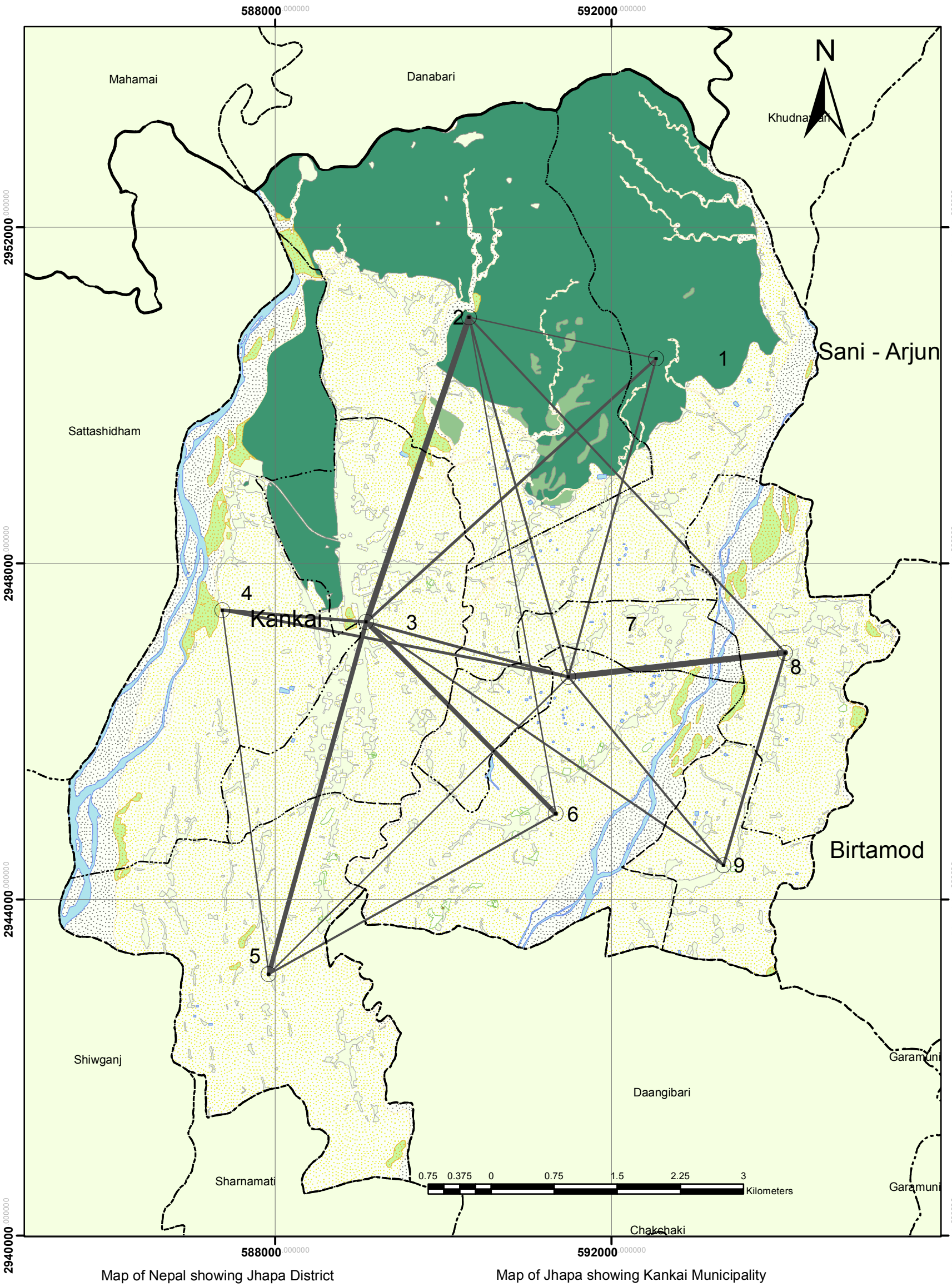
Jhapa District



Kankai Municipality

Desire Line Map

Scale: 1:50000



Legend

- District Boundary
- Municipal Boundary
- VDC Boundary
- Ward Boundary
- DLpoints

Trips

- 1-5
- 6-10
- 11-20
- 21-40
- 41-120

Landcover

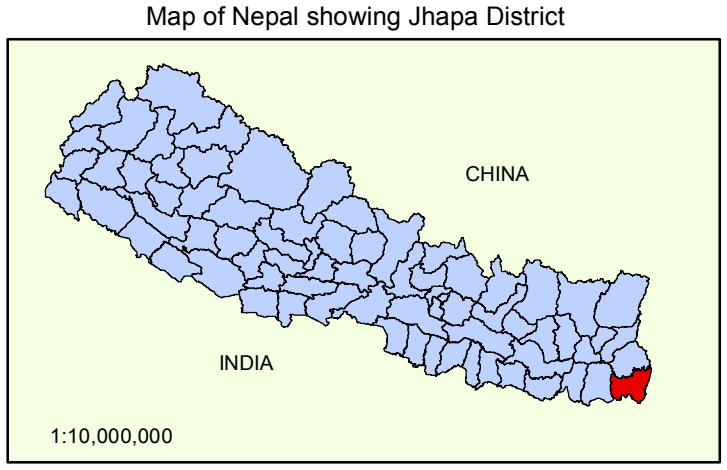
Category

- Barren Land
- Builtup
- Bush
- Cultivation
- Forest
- Grass
- Orchard
- Pond or Lake
- River
- Sand
- Waterbody

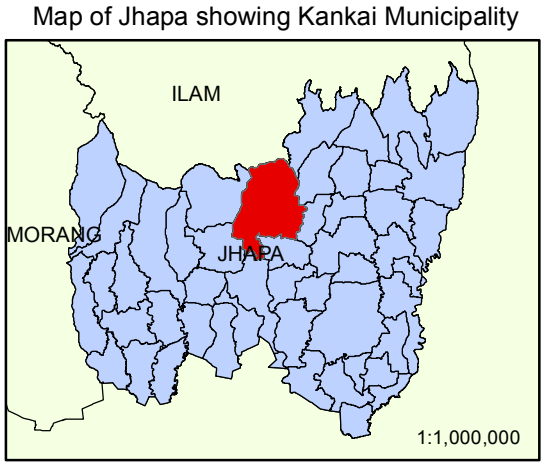
Map No:	10
Map:	Desire Line Map
Project Name:	Municipal Transport Master Plan(MTMP)
	Kankai Municipality, Jhapa
Date:	June 2015

Projected Coordinate System	
Projection	Transverse Mercator
False Easting	500000
False Northing	0
Central Meridian	87
Spheroid	Everest Adj 1937

Map of Nepal showing Jhapa District



Map of Jhapa showing Kankai Municipality



Government of Nepal
Ministry of Federal Affairs and Local Development
Kankai Municipality
Kankai, Jhapa

NEST PVT LTD
Suruchi Marga, Sankhamul-34
Kathmandu, Nepal
Email: nestconsultancy@gmail.com

ANNEX I - D

PHOTOGRAPHS

Photo 1 Orientation meeting for the preparation of MTMP with different stakeholders

Photo 2 Ward level meeting at different wards to collect demand form

Photo 3 Volunteers from Bright Future Higher Secondary School conducting traffic vehicle count

Photo 4 Field report presentation

Photo 5 Draft report presentation

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Sankhamul, Kathmandu