The Urban Unit

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

TRANSPORT & CONNECTIVITY PLAN

Regional Development Plan of Sahiwal Division

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ADP	Annual Development Plan
ADT	Average Daily Traffic
BRT	Bus Rapid Transit
C&WD	Communication and Works Department, Government of the Punjab
DRTA	District Regional Transport Authority
GDP	Gross Domestic Product
GFAs	Goods Forwarding Agencies
LOS	Level of Service
NHA	National Highway Authority of Pakistan
P&D	Planning and Development Board, Government of the Punjab
PCU	Passenger Car Unit
PSS	Punjab Spatial Strategy
PTIAI	Public Transport Infrastructure Accessibility Index
SDGs	Sustainable Development Goals
VPD	Vehicles per day

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1 INTRODUCTION

1.1 Background

Regional transport planning involves the development of a transportation strategy tailored to a particular geographic area. The primary objective of regional transport planning is to guarantee that the transportation system within the region functions optimally, is productive, and sustainable. This process encompasses a multidisciplinary approach, engaging stakeholders from diverse sectors including government bodies, transportation service providers, local communities, businesses, and advocacy organizations.

Regional transport planning considers the region's and its residents' current and future transportation needs. This includes the demand for different modes of transport such as roads, public transit, biking and walking paths, and air transportation. The process considers the current and future land use patterns in the region and the impact that transportation has on the environment and quality of life in the region. The plan outlines specific projects and programs required to achieve these objectives.

Stakeholder engagement in regional planning includes consultation with representatives from the public, private, and non-profit sectors and community members. The input and perspectives of these stakeholders help shape the transportation plan to meet the needs of the region. This leads to developing a well-coordinated plan for managing and improving the transport system, which particularly focuses on more efficient use of existing resources. Additionally, regional transport planning helps promote economic development in the region by improving access to employment, educational, and recreational opportunities.

Throughout financial year, the Planning and Development (P&D) Board, Government of the Punjab, receives numerous funding requests for road and transport schemes put forwarded by the Communication and Works (C&W) and the Transport Departments. The individual schemes however at times lack a regional perspective and overlook benefits that may be associated with the alternative transport and connectivity schemes. This regional transport plan will address the gaps for Sahiwal Division for the next ten years (2024-2034) with a core focus on ensuring that the transportation system is efficient, effective, and sustainable.

Through this regional transport plan, the Urban Unit provided a platform for stakeholder engagement and collaboration for collecting any missing data. These stakeholders included but were not limited to the C&W, District Regional Transport Authorities (DRTAs), and other relevant government officials in the respective district administrations: Sahiwal, Okara, and Pakpattan.

1.2 Sahiwal Division - An Overview

Sahiwal Division is in the North of Punjab Province, near Lahore (170 km away) and Multan to the southwest (180 Km away). Other key destinations are Islamabad, 418 km; Quetta 815 km; and Karachi, 1052 km (Figure 1-1). The division is connected to these destinations via a network of national and provincial roads and the railway network.

The division is comprised of three districts: Sahiwal, Okara, and Pakpattan.

1.2.1 District Sahiwal

Sahiwal District spans over 3201 km^2 and has a population of around 2.517 million according to the 2017 Census. The district is situated between River Ravi and Sukh Beas Nullah, approximately 152 m above mean sea level. River Ravi forms its northwestern boundary for the entire length of the district, across which are the Faisalabad and Toba Tek Singh districts. On the southeast runs the Sukh Beas Nullah separating the district from the Pakpattan and Vehari districts. Likewise, on the northeast and southwest borders are the districts of Okara, Khanewal, and Pakpattan, respectively.

The district is comprised of two tehsils: Sahiwal, and Chichawatni. It is known for producing variety of crops including Wheat, Rice, cotton, Sugarcane, Barley, Maize, Mustard, and castor seed. Sahiwal is a major multi-crop area of Pakistan, and many pesticide companies conduct operations in the City. Sahiwal is well-known for cotton ginning and pressing, dairy products, drugs, and pharmaceuticals, textile spinning, textile weaving and tobacco. Tourism has been a growing contributor to the district's economy due to its rich cultural and historical heritage. Attractions such as Harappa Museum, Sahiwal coal power plant, Zafar Ali Stadium, and Masjid-e-Shuhada.

1.2.2 District Okara

Okara, established in 1982 as a separate district, comprises three tehsils: Okara, Depalpur and Renala Khurd. The district is bounded on the east by Kasur district, and on the west by Sahiwal and Pakpattan districts. These two districts are separated from Okara by the River Ravi, which forms a natural boundary for the whole length (about 40 km) of Okara district. On the south of Okara is Bahawalnagar district, and the Indian border lies on the southeastern side of the district.

The district covers a total area of 4,377 km^2 and has total population of 1.709 million according to the 2017 census. Okara is historically famous for its agricultural-based economy and cotton mills, which existed since the British colonial era. Now, industry of all types including Rice, Sugar, Oil/Ghee, Electronics, Textile, Cotton, Surgical Cotton, export quality Crockery products, services and professional associations have developed in the area. Due to its rich cultural and historical heritage, tourism has become an increasingly significant contributor to the district's economy. Notable attractions include Bhoman Shah, Goal Masjid Okara, and Mir Chakar e Azam Rind.

1.2.3 District Pakpattan

Pakpattan District, established in 1849, comprises two tehsils: Pakpattan, and Arifwala. The district is bounded on the northwest by Sahiwal district, on the north by Okara district, on the south by the Sutlej River as well as Bahawalnagar district, and on the southwest by Vehari district.

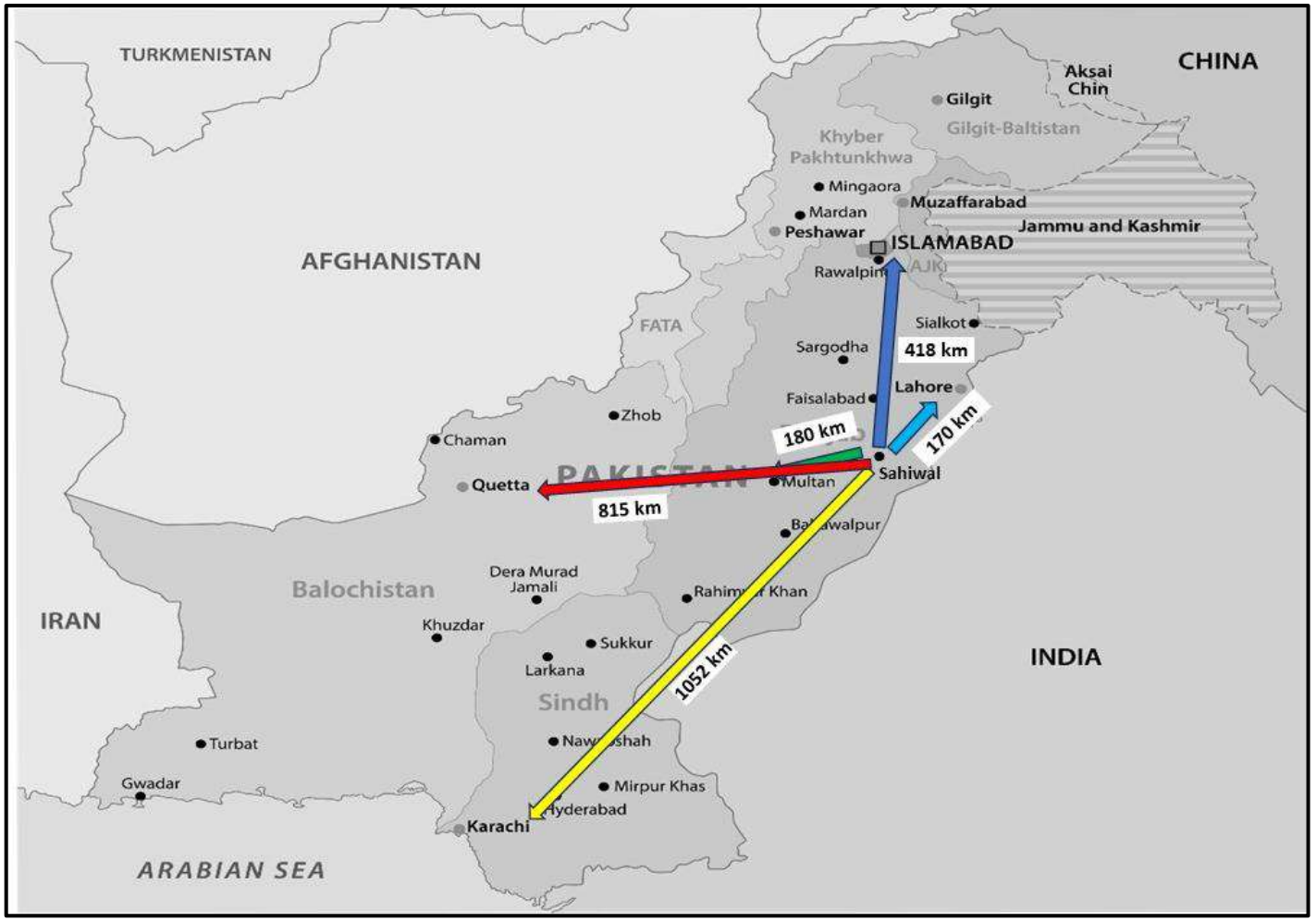


Figure 1-1: Sahiwal Division Location and Regional Positioning

According to the 2017 census, the total population of District Pakpattan is 1.824 million. The district covers a total area of 2,728 km^2. This agricultural landscape plays a crucial role in the local economy, supporting the production of crops like rice, wheat, barley, sugarcane, and various other fruits and vegetables.

Additionally, Pakpattan District is not solely dependent on agriculture; it has various manufacturing facilities that contribute significantly to its economy. Other industrial sectors in the district include 32 rice mills, 7 flour mills, and 250 brick kilns, all of which play a pivotal role in bolstering the local economy and providing employment opportunities for the residents of Pakpattan District. The Shrine of Hazrat Baba Farid R.A and Masjid Waris Shah are renowned tourist attractions in the district.

1.3 Transport Connectivity in Sahiwal Division

Figure 1-2 summarizes the key transport nodes and links that play a major role in transport connectivity within and beyond the region. The division is served by 22734 km of roads including only one National Highways N-5 (Lahore-Multan). Additionally, there are 33 railways stations. To support freight transport, there are 30 goods forwarding agencies (GFAs) in the division but no formal truck terminal in Sahiwal. For passenger transport, there are 11 inter-city public transport terminals in the division.

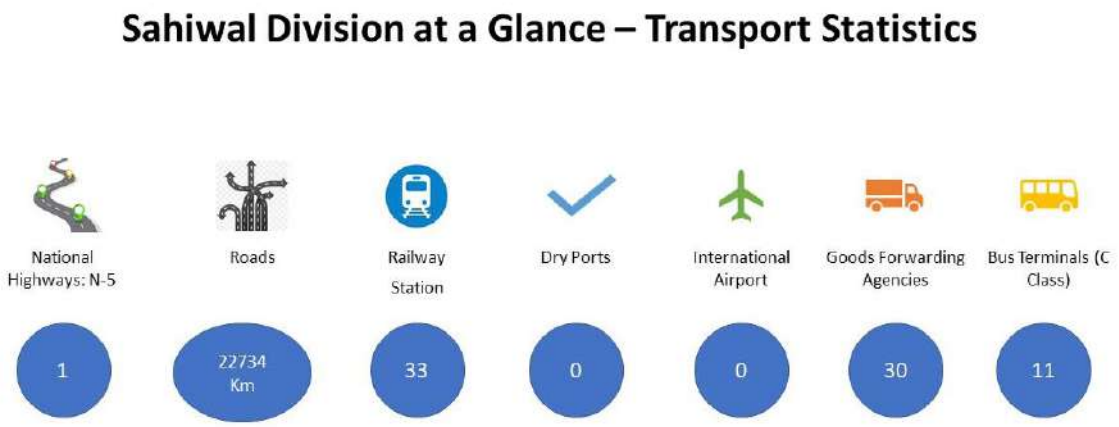


Figure 1-2: Key Transport Connectivity Nodes and Links Sahiwal

2 ROAD, RAIL AND AIR TRANSPORT

The total length of the road network in Pakistan at present is 500,749.27 km (NTRC, 2019). Punjab, being the most populous province of the country has the longest road network. The Total length of roads in Punjab is around 280,103 km. Further sub-classification of these roads includes approximately 1291 km of motorways, 185 km of Expressways, 14556 km of Highways, and 2342 km of primary roads.

The district-wise profile of the road network statistics of Sahiwal Division are summarized in Figure 2-1 to Figure 2-4. On the other hand, the road network details in the entire Sahiwal Division are illustrated in the below graphs.

2.1 Road Network in Sahiwal District

Sahiwal District has a total road network length of 8,317 km. The district is well connected with adjacent districts through an extensive network of national highways, and provincial highways. N5 serves as a primary corridor that connects Sahiwal with Lahore on the north east side and Multan on the south west side. In addition to national highways, major provincial highways connect Sahiwal with Okara, Arifwala and Pakpattan. Lengths of different road classes that fall in Sahiwal are shown in Figure 2-1.

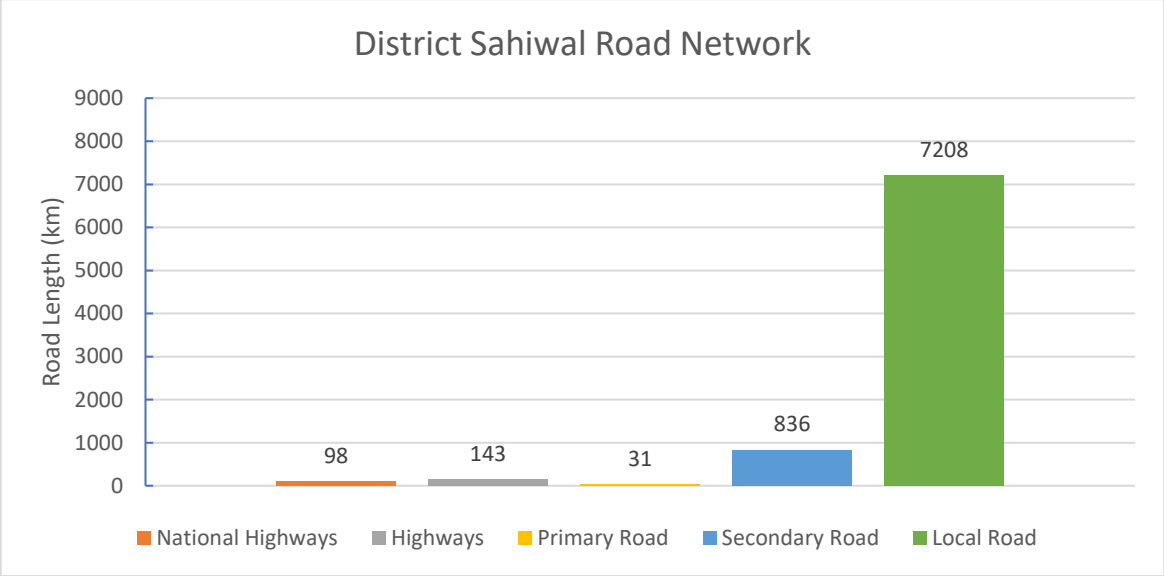


Figure 2-1: Road Network Statistics, District Sahiwal

Source: Digitization of Road Directory in the Country, NTRC, 2019

2.2 Road Network in Okara District

Okara district has a total road network length of 7973 km whereas the length of National Highways passing through Okara is 47 km. The length of road network in Okara with different road classes is illustrated in Figure 2-2. The Okara district is well connected with adjoining districts through an extensive network of national highways, and provincial highways. N5 connects Okara to Lahore on the northeast and Multan on the southwest.

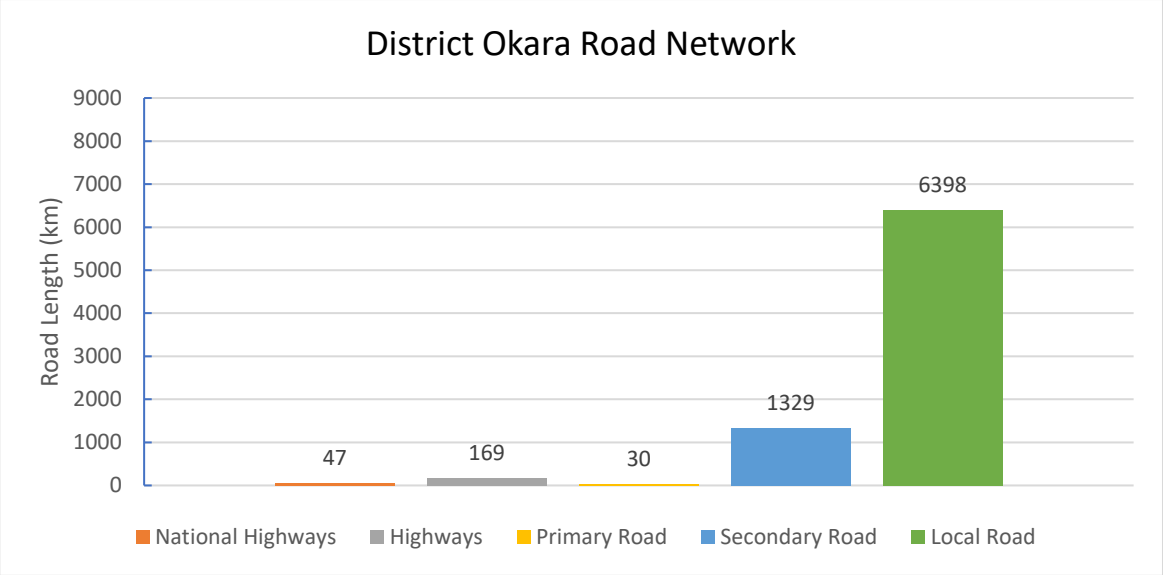


Figure 2-2: Road Network Statistics, District Okara

Source: Digitization of Road Directory in the Country, NTRC, 2019

2.3 Road Network in Pakpattan District

Pakpattan district has a total road network length of 6,444 km. The length of provincial highways passing through Pakpattan is 230 km. Provincial highways connect the district with Burewala in the West, Bahawalnagar in the South, and Sahiwal in the North. The length of different road classifications is shown in Figure 2-3.

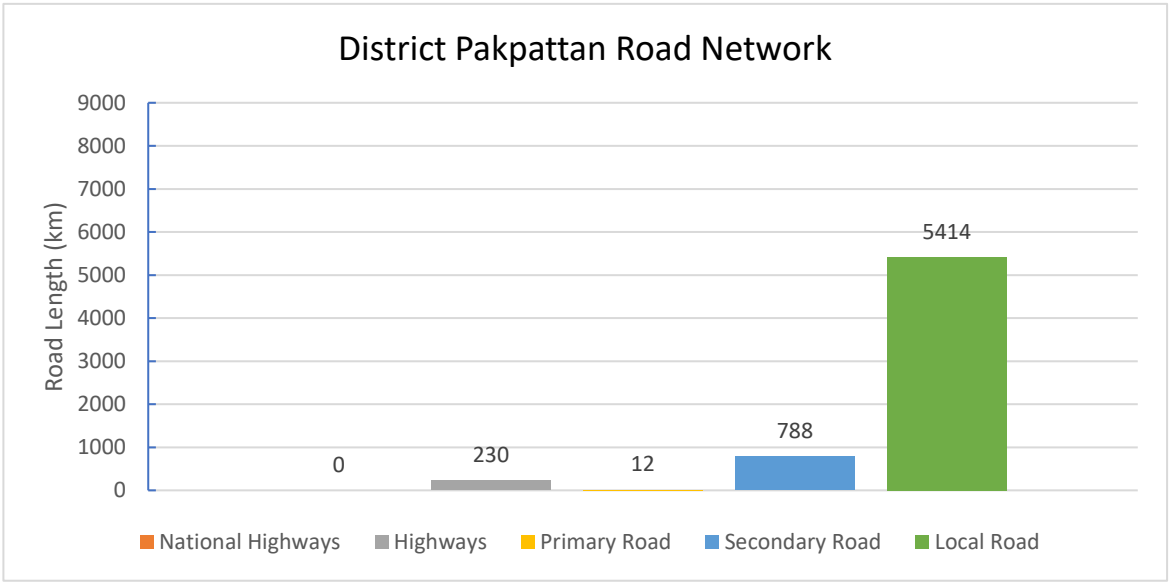


Figure 2-3: Road Network Statistics, District Pakpattan

Source: Digitization of Road Directory in the Country, NTRC, 2019

2.4 Road Network Mobility

Motorways, national highways, and provincial highways, especially those with dual carriageways accommodate high-speed traffic. The average design speed of motorways in Pakistan is 120 km/hr, national highways 100 km/hr, and provincial roads, 80 km/hr for dual carriageways and 50 km/hr for single carriageways. However, factors such as high traffic volume and deteriorated roads often result in less than desired speeds on these roads, particularly on provincial highways that find it hard to compromise between access and mobility.

The only high-speed national roads include N-5 (Lahore-Multan Road) which connects Sahiwal with Lahore in the Northeast and Multan in the southwest.

Key provincial roads that provide connectivity primarily through single-carriageways among key cities in the division include Sahiwal, Depalpur, Bangla Gogera, Okara, Pakpattan, Arifwala, and Burewala. The provincial highways linking key cities within the division, including those connecting Sahiwal to Pakpattan, Sahiwal to Arifwala, and Depalpur to Kasur, consist of dual carriageways. Figure 2-4 depicts an overall situation of roadway mobility in terms of the road types in the division.

Figure 2-5 shows existing primary (national) and secondary (provincial) freight corridors based on extant HTV volume and the spatial distribution of small, medium, and large-scale industrial units in the Sahiwal Division. The national freight corridors include only N-5.

The provincial freight corridors include Pakpattan-Sahiwal Road, Lahore-Multan Road, Depalpur-Okara Road, Depalpur-Kasur Road, Chichawatni-Burewala Road, Arifwala-Bahawalnagar Road, Noor shah Road, Gaimber-Pakpattan Road, and Haveli Lakha-Head Sulemanki Road.

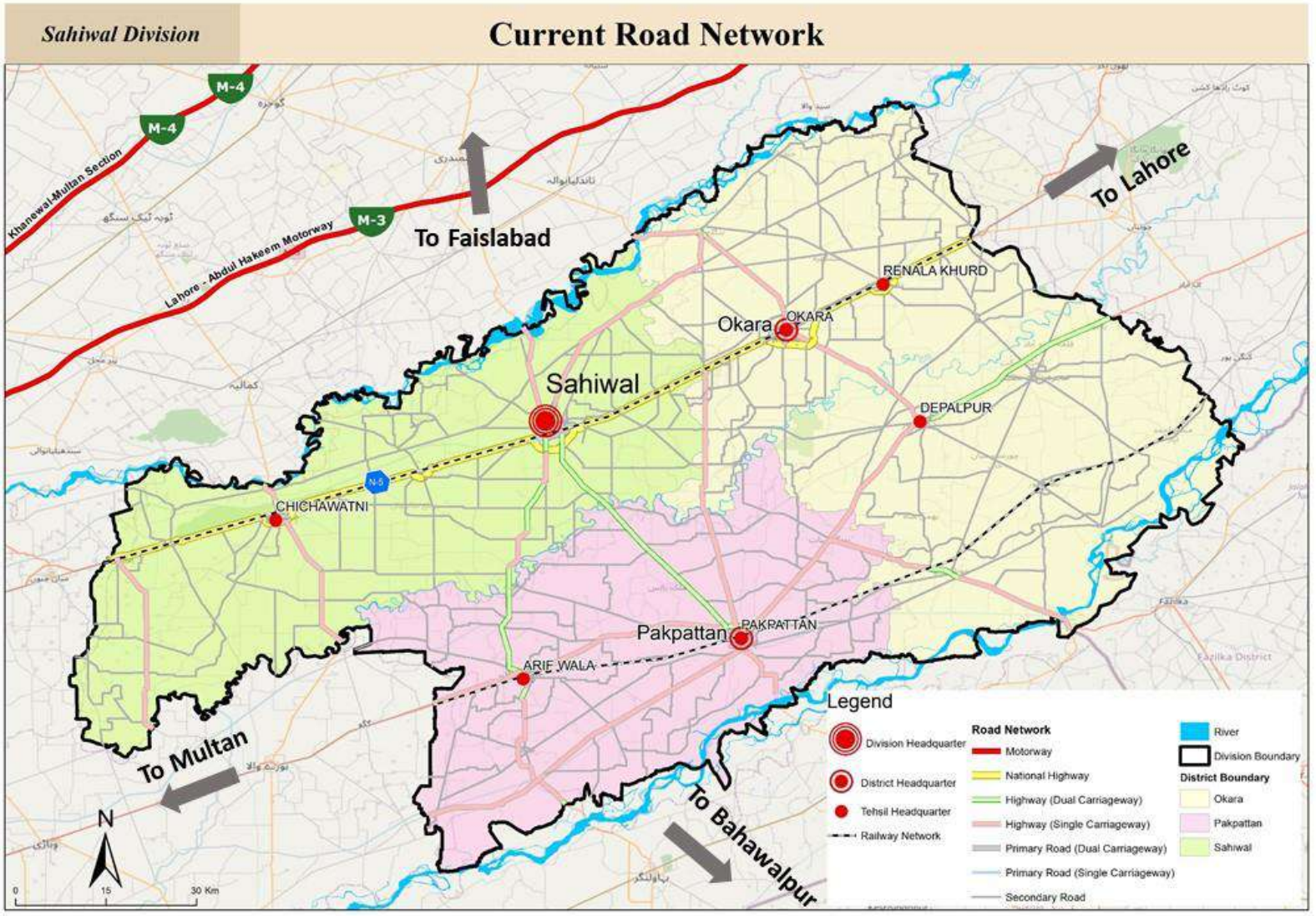


Figure 2-4: Current Road Network in Sahiwal Division

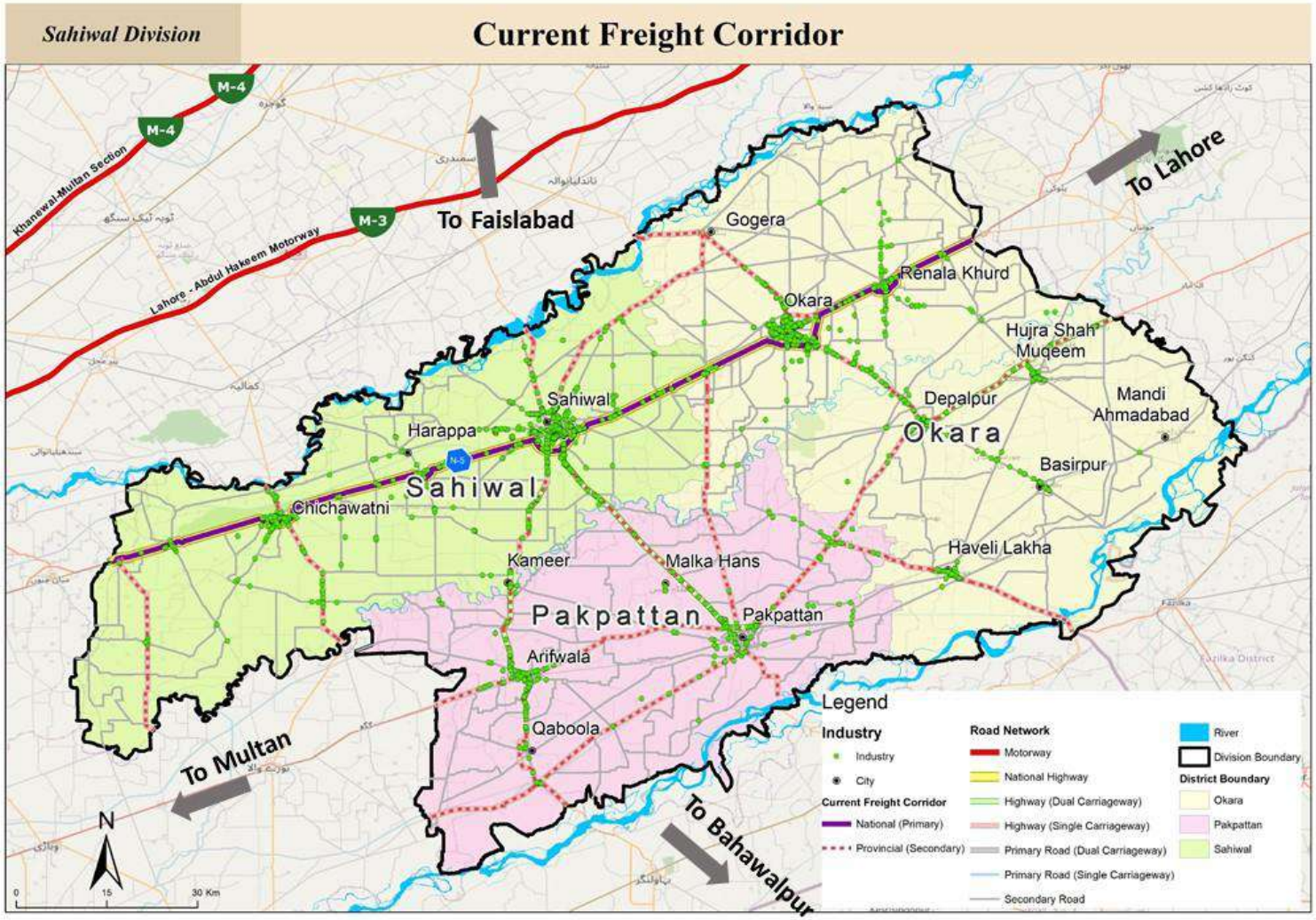


Figure 2-5: Freight Corridors in Sahiwal Division

2.4.1 Road Sector Funding by Year

The total funding of the annual development program in the Sahiwal Division for all the sectors is year-wise in shown Figure 2-8. From 2018 to 2023, the all-sector funds ranged from PKR 1.50 billion in 2018 to PKR 2.26 billion in 2023. The road sector funds varied from PKR 0.82 billion in 2018 to almost null in 2023. The percentage allocations for road sector funds ranged accordingly from 55 to almost null. The highest percentage allocation of road sector funds was observed in 2022, with PKR 14.38 billion being allocated, which is equivalent to 90% of the all-sector funds. In contrast, the lowest percentage allocation of Road Sector Funds was observed in 2018. The timely repair and maintenance of roads requires an accumulation of funds, which at times require more funding than routinely needed.

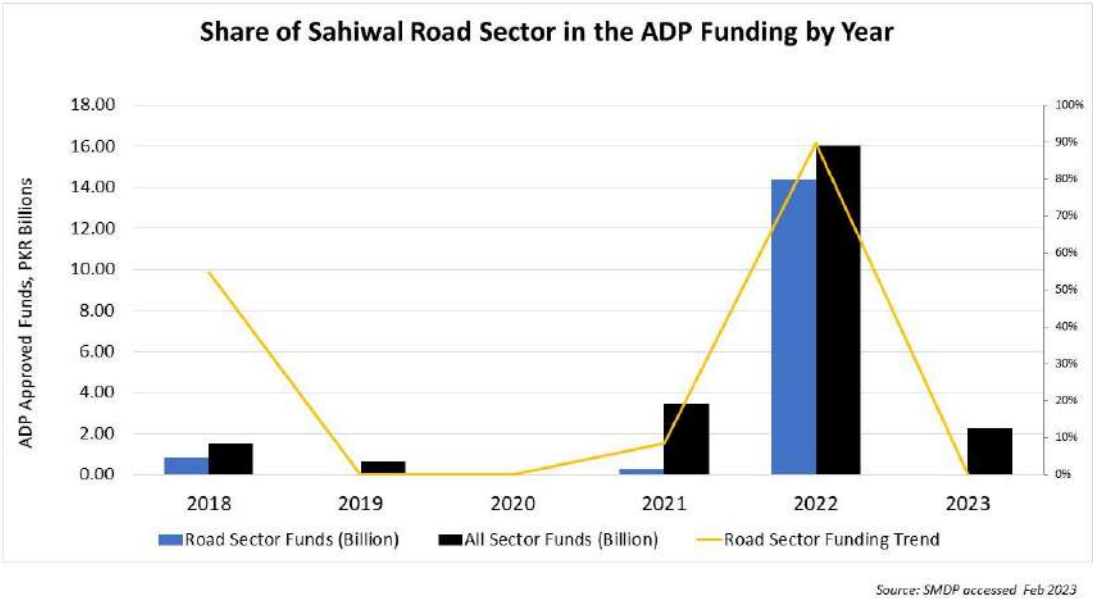


Figure 2-6: Share of Road Sector in ADP Funding

2.5 Freight Transport

Freight delivery in Pakistan greatly relies on the road network. The same is true for Punjab. At present, more than 96% of the freight traffic is carried through roads. The main reason for this is the inefficient freight operations by other modes, particularly railways.

Punjab has the largest economy in the country and is the most industrialized province having around 68,000 industrial units. Punjab also serves as a spatial link between Khyber Pakhtunkhwa and Sindh i.e., provides North to South connectivity. Much of the local and international freight transport emerging from the seaports of Port-Qassim and Gwadar transverse Punjab to its desired destination. Currently, there are 7 major dry ports in Punjab listed below in Table 2-1. These ports serve as a hub for shipment of international and domestic cargo to inland destinations.

Table 2-1: Dry Ports in Punjab

Sr No.	Dry Port	Type
1	Lahore Dry Port	Public sector
2	Multan Dry Port	Public sector
3	Rawalpindi Dry Port	Public sector
4	NLC dry port (Jia Bagga Lahore)	Private sector
5	Sialkot Dry Port	Private sector
6	Premnagar dry port	Private sector
7	Faisalabad Dry Port	Private sector

Besides freight and logistics transport agencies that mainly deal with container shipments concerning large industries, goods forwarding agencies (GFAs) play a key role in transporting goods for small-scale industries and vendors. There are more than 640 GFAs in Punjab (Table 2-2). Of these, 6 lie in Sahiwal, 17 in Okara, and 7 in Pakpattan. Private goods forwarding agencies operate independently, and there appears to be a deficiency in public sector monitoring and regulation enforcement within the trucking industry.

Table 2-2: Goods Forwarding Agencies (GFAs) in Punjab

District	GFA's	District	GFA's	District	GFA's
T.T Singh	56	Okara	17	Layyah	6
Sialkot	16	Khushab	30	Nankana sahib	10
Jhang	10	Lodhran	6	M.B din	14
Gujrat	10	Sahiwal	6	Kasur	38
Chiniot	14	Bhakar	19	Muzaffargarh	36
Bahawalnagar	27	Hafizabad	4	Bahawalpur	8
Chakwal	11	Gujranwala	2	Narowal	17
Multan	21	Rawalpindi	102	Pakpattan	7
Vehari	23	Faisalabad	106	R.Y khan	2
Mianwali	9	Sheikhupura	0	Attock	0

Private Goods Forwarding Agencies (GFAs) typically lease open spaces and transform them into makeshift truck parking areas (as depicted in Figure 2-7). Unfortunately, these facilities often lack essential amenities for drivers, such as dining areas, rest zones, and sleeping accommodations. Security measures are also insufficient, and drivers who were interviewed raised apprehensions regarding the safety of their cargo. Furthermore, the absence of formal truck terminals has led to challenges in terms of accessibility for goods transport.

Figure 2-7: A Goods-Forwarding-Agency Stand in Sahiwal Public Transport

2.6 Public Transport

Public transport affects socio-economic development of cities in two ways. Firstly, inadequacies in public transport provision create barriers by limiting individual and

community participation in activities such as employment, health, education, etc. These inadequacies can be due to insufficient network links between the transport system and activities. Secondly, the operation of the public transport system results in environmental, aesthetic, and social externalities on individuals and communities, as opposed to others. In both scenarios, people are forced to opt for alternate modes of travel, usually private means to access their desired activities.

The rapid increase in population has resulted in more vehicular trips across the province and within the cities. Consequentially, the transport system has observed major changes. Apart from urbanization, other factors have also contributed to these variations. Nonetheless, multiple efforts have been made to revitalize the public transport system in the province; however, the share of private vehicular trips both within intercity and intra-city travel has remained higher. The public transport system can be classified as:

- Intercity Public Transport
- Intra-city (or Urban) Public Transport

2.6.1 Inter-City Public Transport

Intercity Transport in Punjab is partially deregulated. The Government of Punjab only regulates the fare of non-air-conditioned intercity transport to ensure equity, and convenience to the public. Presently there are more than 116,000 intercity and 26,000 intra-city vehicles playing in Punjab who have obtained route permits from regulatory authority during 2014-17. Likewise, there are three hundred and seventy-four (374) intercity bus terminals in Punjab classified as A, B, C and D Class terminals. Presently, there is no A-class terminal in the province, there are only three (3) B-class terminals. There are one hundred and fourteen (114) C-class terminals. Likewise, there are two hundred and fifty-five (255) D-class terminals in the province.

There are 60 intercity bus terminals in Sahiwal Division of which 11 are owned by the government while the rest (49) are privately owned. District-wise list of bus terminals with type is given in Table 2-3. The overall state of the bus terminal in Sahiwal is fair, with limited access to essential facilities for both the public and drivers. Poor cleanliness, pavement, and drainage conditions persist in general bus stand of many THQs in the division. Note, more on the accessibility of these bus terminals follows in the next chapter. The general bus stands in the Sahiwal division are illustrated in Figure 2-8.

Table 2-3: District Wise Bus Terminals in Sahiwal

District	Terminal Type	Number of Terminal
Sahiwal	C Class Stand	03
	D Class Stand	21
Okara	C Class Stand	06
	D Class Stand	16
Pakpattan	C Class Stand	02
	D Class Stand	12

A (Sahiwal) B (Sahiwal)

C (Okara) D (Pakpattan)

Figure 2-8: Bus Terminals in Sahiwal division

Figure 2-9 provide more insights in to access of public to bus terminal. Accessibility analysis of the bus terminals shows that they can serve 35.25% of the population between 0 and 10 minutes, 34.90% of the population within 10 to 20 minutes, and 23.30% between 20 to 30 minutes. It takes more than 30 minutes for the remaining 6.55% of the population to access bus terminal.

Intercity Bus Coverage		
Time (Min)	Population	%age
0-10	2448443	35.25%
10-20	2423489	34.90%
20-30	1617865	23.30%
30-40	455200	6.55%

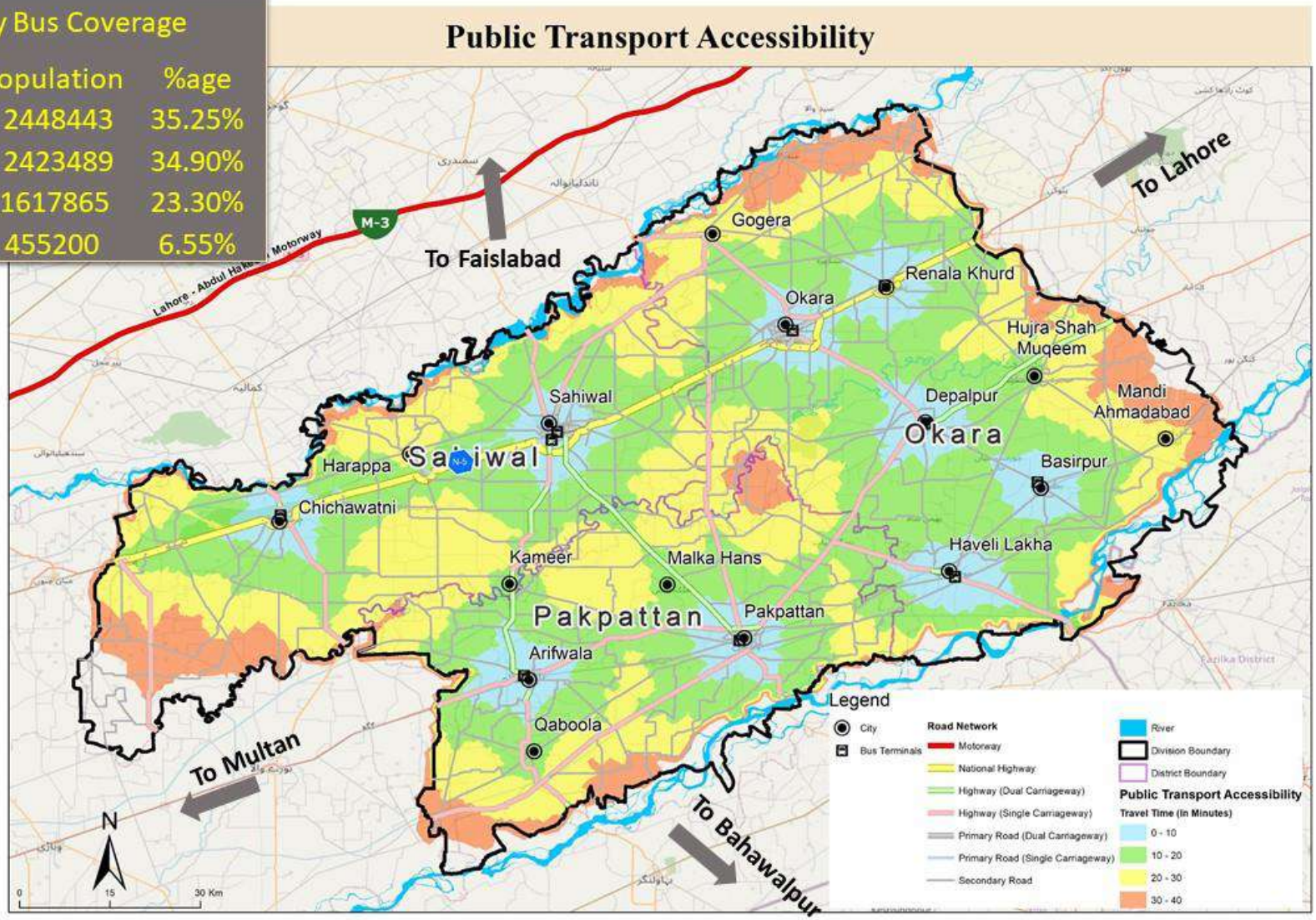


Figure 2-9: Public Transport Accessibility in Sahiwal Division

2.7 Rail Network

Rail transport plays a pivotal role in facilitating efficient and cost-effective passenger and freight movement, bringing several significant advantages to the transportation industry. One of the key benefits is the potential for reduced transport costs. Railways can carry large volumes of passengers and freight over long distances, offering economies of scale. By consolidating a substantial number of individuals or goods into a single train, rail transport allows for cost savings compared to individual vehicles or smaller-scale transportation methods. This leads to lower per-unit transport costs and improved affordability for both passengers and businesses.

Figure 2-10 provides some insights into the railway access of the people in Sahiwal Division. It presents data on the distribution of individuals based on the time it takes for them to reach the nearby railway station. The population is categorized into four-time ranges: 0-10 minutes, 10-20 minutes, 20-30 minutes, and 30-40 minutes. The analysis reveals that a significant proportion of the population, approximately 42.65%, enjoys convenient railway access, requiring only 0-10 minutes to reach the nearest railway station. This suggests that a large portion of the population resides near the railway infrastructure, enabling them to easily utilize rail transportation for their commuting needs.

Railway Access		
Time (Min)	Population	%age
0-10	3019167	42.65%
10-20	2077914	29.35%
20-30	1599644	22.60%
30-40	380964	5.38%

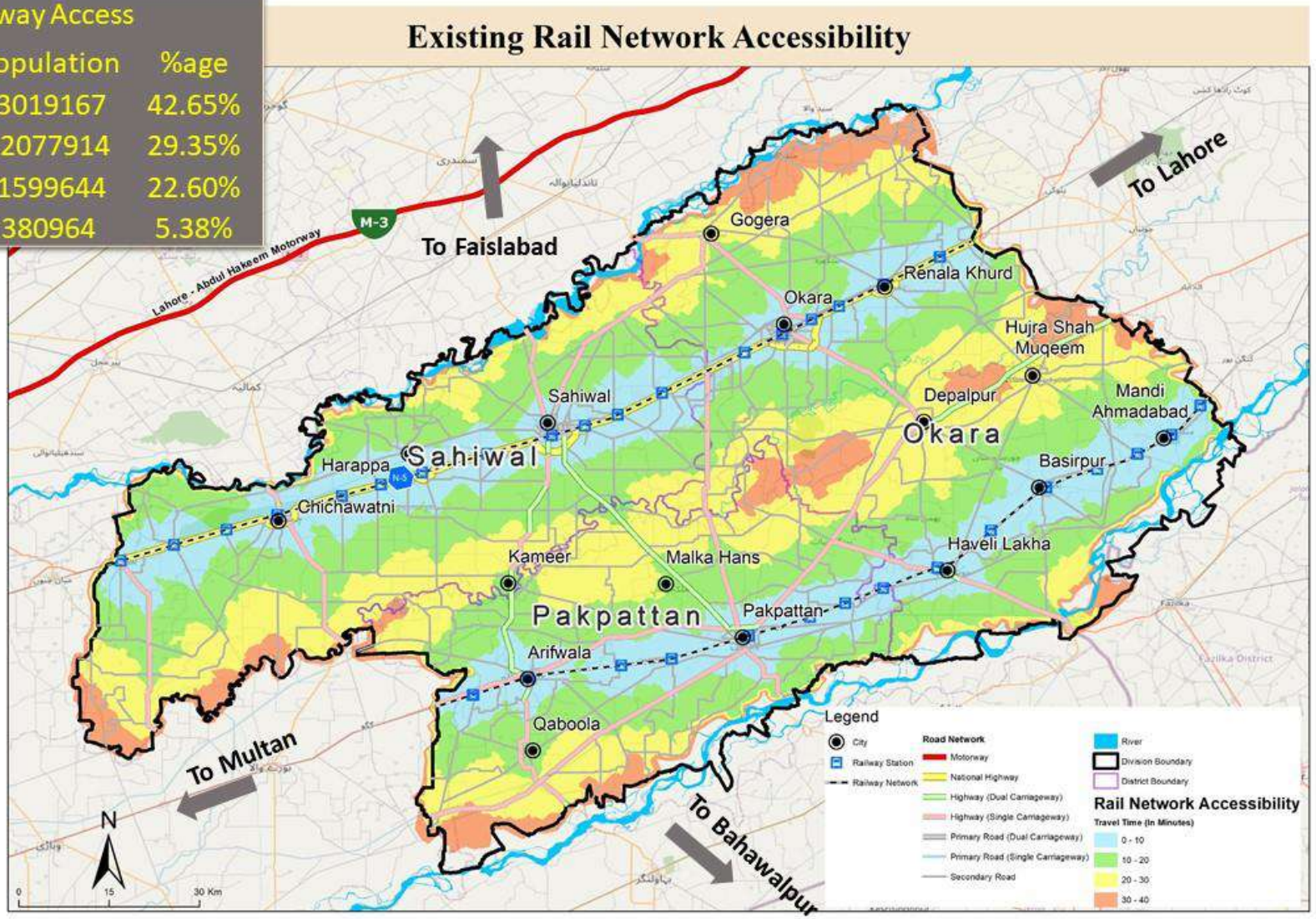


Figure 2-10: Existing Rail Network Accessibility, Sahiwal

2.8 Limitations

There exist some limitations that hinder the implementation of connectivity plans. These are elucidated below.

2.8.1 Delays in Repair

The roads requiring immediate maintenance are ignored, which leads to increase in cost of repair. Delays can occur due to several reasons, for instance, lack of availability of funds, delays in the issuance of funds, and in official approval of the repair of road. These are major limitations that are left unaddressed.

2.8.2 Lack of Availability of Funds

In most cases, the authority that repairs or constructs roads lack funds to do so. This deteriorates the condition of the roads further and augments the problem of connectivity for the locals. Often, the funds are issued with delay and without consideration of increase in the cost that takes place due to inflation during the delay. Thus, the insufficiency of funds prevails in such a scenario as well.

2.8.3 Choosing the right policy option

It is also essential for the body that is taking the responsibility to construct a road to choose the right policy option or relevant rules. For instance, in many cases, according to the policy of the Communication and Works Department, Government of Punjab, there is a need to dualize the roads to accommodate high traffic volumes. On the other hand, the P&D Board recommends considering those provincial roads (arterials) which witness more than 8000 vehicles per day (P&D Board, 2018).

2.8.4 Lack of Asset Management Tools

The road asset management (RAM) tool can equip decision-makers to foresee road repair and maintenance needs and arrange for budgeting in advance. Delaying the timely repair of roads leads to increasing the cost of the repair. Moreover, a RAM tool can help distribute the road sector funding among various schemes in a justified way.

3 ANALYSIS OF MISSING CONNECTIVITY LINKS

Analysis of the missing connectivity links that are crucial for passenger and freight transport in the Sahiwal division is vital and undertaken in this section. This analysis will lead to the identification of the transport and connectivity schemes for the division. In particular, the focus of the proposed interventions will be road sector schemes (dualizations or Widening/improvement), freight transport schemes (truck terminals), and public transport schemes (mass transit). The analysis aims to compare the extant status of transport and connectivity infrastructure with transport demand, thereby identifying the missing transport infrastructure that the public agencies must provide to completely realize the potential of the division.

3.1 Identification of Road Schemes

With reference to section 2.5, there is a clear indication that most of the provincial roads, that play a key role in the regional transport and connectivity of the division, are single (undivided) roads. Not only do such roads fail to fulfil the mobility need of the regional traffic, but also present a safety hazard due to the possibility of a head-on collision. In addition to mobility and safety, other road functions such as accessibility also play a role in the identification of new road schemes. Here, a methodology for identification of road network schemes is presented that considers all these factors as well as the cost benefit ratio of the investment.

Figure 3-1 explains how to identify road schemes that can help obtain the highest rate of return both in economic and social terms. Identification of links is based on the analysis of the directness index, travel speed, connectivity to CPEC and motorways of Pakistan, public transport infrastructure accessibility index (PTIAI), consultation with experts, and quality, and reliability of existing road network. Each identified link is then subjected to a detailed cost-benefit analysis to ensure that the project is financially sound.

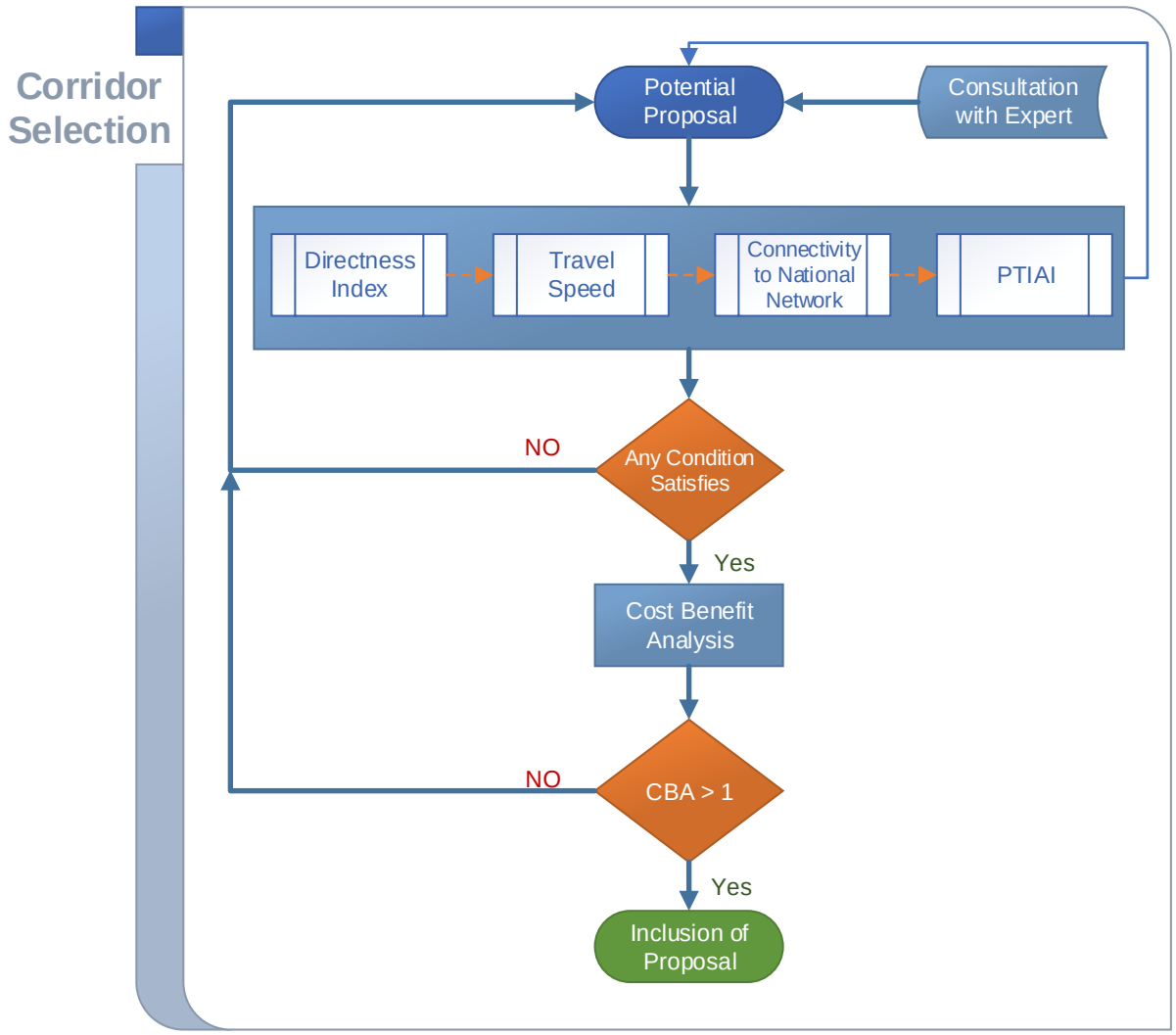


Figure 3-1: Identification and Selection of Proposed Road Corridors

3.1.1 Directness Index

The directness index measures the ratio of network distance between two points and the Euclidean distance between the same points. It is a common indicator to measure the accessibility of the two points. The index has the lowest limit of 1 but the upper limit is not fixed. A ratio of 1 indicates that a direct possible corridor is available between two points. Various studies have been carried out to identify the benchmark value of the ratio but factors such as geography and topology of the area limit selection of absolute value. Nevertheless, some researchers through empirical analyses have found that a value of 1.2 holds for various settings[1]. Keeping in view past studies a value of 1.2 is selected as the threshold for connectivity, therefore any OD pair that has a value higher than 1.2 is considered as indirect

[1] Ballou, R., Rahardja, H. and Sakai, N. (2002), "Selected country circuity factors for road travel distance estimation", Transportation Research Part A , Vol. 36(9), Elsevier, pp. 843– 848.
Love, R. and Morris, J. (1979), "Mathematical models of road travel distances", Management Science, Institute of Management Sciences, pp. 130–139.

connection and a new corridor that reduces this value is considered feasible. The indicator is calculated on ArcGIS using a network analyst tool to determine the shortest corridor between origin and destination.

3.1.2 Travel Speed

Travel speed is based on the type, width, quality, and class of the road network available between the origin and destination under free flow conditions. It determines the quality of the road network available and identifies a poor link even if it provides direct accessibility. Travel speed is calculated for the identified corridor using the ArcGIS network analyst tool. Free flow speeds based on road class is tabulated in Table 3-1.

Table 3-1: Road Speed in km/hr for different road classes

Road Class	Dual Carriageway	Single Carriageway
Expressway/Motorway	120	-
Highways	100	80
Primary Road	70	60
Secondary Road	50	40
Local Road	-	30

3.1.3 Connectivity to National Network

The national road network of Pakistan is developed by the National Highway Authority funded by the federal government. It comprises a network of motorways and national highways that are aimed at improving mobility. A high-speed motorway network passes through Punjab via a network of M2, M3, M4, M-5, and M-14. To utilize the benefits of this network, it is crucial to connect cities and industries away from motorways with a high-speed and reliable road link to these motorways. Hence links that provide connection with already built or under construction national networks are considered as a viable option and proceed for Benefit Cost Analysis (BCA).

3.1.4 Public Transport Infrastructure Accessibility Index

Public Transport Infrastructure Accessibility Index (PTIAI) is an index developed by the Urban Unit based on Transport Accessibility Index (TAI)[2]. PTIAI is a modified form of TAI developed to identify and estimate the population being deprived by transport and to identify future improvement areas where transport provision is to be enhanced. The detailed methodology of the index can be read in the Urban Unit Publication of Public Transport Infrastructure Accessibility Index. Highlights of the results of the Index for Sahiwal Division are given in Figure 3-2.

[2] Towards the Development of Transport Accessibility Index, Gamma and Trutz Haase, 2007

District	Tehsil	PTIAI
Sahiwal	Sahiwal	28.8
	Chichawatni	30.0
Pakpattan	Arifwala	39.3
	Pakpattan	62.7
Okara	Okara	72.0
	Depalpur	44.0
	Renala Khurd	53.3

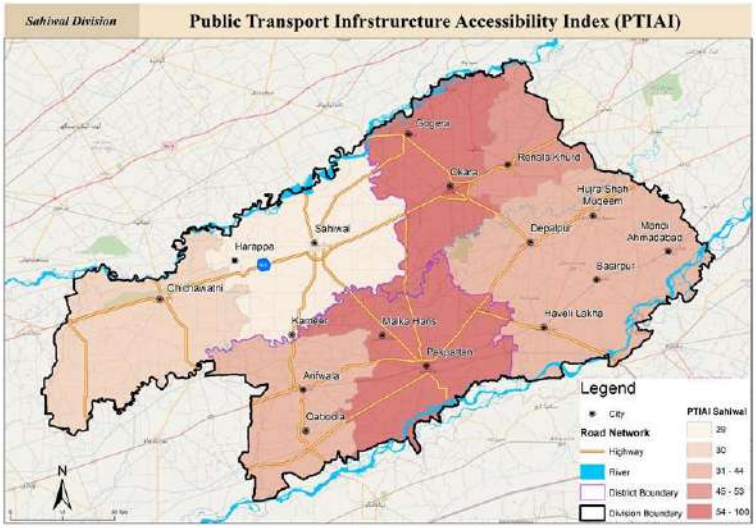


Figure 3-2: Results of PTIAI for Tehsils of Sahiwal

3.1.5 Benefit-Cost Analysis

Benefit-cost analysis (BCA) calculates a benefit-cost ratio (BCR) that identifies the relationship between the cost and benefits of a proposed project. The ratio is used to measure both the quantitative and the qualitative factors since sometimes the benefits and the costs cannot be measured exclusively in financial terms. When possible, the qualitative factors should be translated into quantitative terms for the results to be easily understandable and tangible. The BCR is calculated by dividing the total discounted benefits of a project by the total discounted costs of the project. In order to calculate the discounted values of benefits and costs, Net Present Value (NPV) is used, in which the values are divided by the sum of 1, and the discount rate raised to the number of periods. This will give the net present values of future benefits and costs.

$$NPV\ of\ Benefits = \sum_{t=0}^{n} \left\{ \frac{Benefits_t}{(1+r)^t} \right\}$$

$$NPV\ of\ Costs = \sum_{t=0}^{n} \left\{ \frac{Costs_t}{(1+r)^t} \right\}$$

Where:

r = Discount rate
t = Number of years
n = Total number of years (design life)

Once the accumulated values of benefits and costs are calculated then just by dividing them BCR can be calculated.

$$BCR = \frac{NPV\ of\ Benefits}{NPV\ of\ Costs}$$

After calculating the BCR of proposed projects, if the value of BCR is greater than 1 then the proposed project is assumed to be economically feasible and if the value of BCR is less than 1 then the proposed project is assumed to be economically not feasible.

Using the above methodology, 12 road network schemes were tested for preliminary economic feasibility (Table 3-2). These schemes primarily aim to improve the provincial roads to fulfil the regional transport needs. Most of the proposed schemes aim to dualize provincial roads to meet the eligibility standards as discussed above. Widening/improvement is recommended for those road projects where current operating speeds are lower than the design speeds, but the traffic count is not enough to justify adding more lanes to the existing roads. For a detailed BCA, please refer to Annexure-I.

Table 3-2: Summary of Benefit Cost Ratio Analysis of Potential Road Schemes

Sr. No	Linkage	Accumulated Benefits (Rs. Million)	Accumulated Costs (Rs. Million)	B/C Ratio
1	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	34,688.61	7,945.45	**4.4**
2	Dualization of Burewala Road from Chichawatni to Kamand	13,507.84	5,959.09	**2.3**
3	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	8,102.59	8,144.08	**1.0**
4	Widening of Chichawatni Harapa Road	13,731.47	10,627.04	**1.3**
5	Pavement upgradation of Kmir Chichawatni Road	7,705.89	5,422.77	**1.4**
6	Dualization of Okara Depalpur Road	17,147.05	961.71	**17.8**
7	Dualization of Okara-Syedwala-Jarranwala Road	24,474.00	11,719.53	**2.1**
8	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	17,858.80	13,904.53	**1.3**
9	Dualization of Haveli Lakha to Hujra shah	29,671.53	6,952.27	**4.3**
10	Dualization of road from Renala Khurd to Kot Shaukat	13,284.60	5,502.22	**2.4**
11	Dualization of Arifwala Pakpattan Road	11,663.74	1,162.07	**10.0**
12	Dualization of Depalpur Road	21,503.87	1,642.93	**13.1**

3.2 Identification of Truck Terminal Sites

As discussed above, the existing truck terminals, especially those under the patronage of government, are not enough to meet the freight transport needs of the region. The following methodology has been used for identification of potential truck terminal sites in Sahiwal division.

3.2.1 Methodology

The connectivity of the potential sites has been modelled mathematically. Let C_j be the connectivity score of location *j* that depends on *k* factors, then it can be written as follows:

$$C_j = 1/\sum_{k=1}^{5} C_{jk}$$

For a given location *j*, we can calculate the corresponding C_k values as follows:

C_{j1}= $C_{\mathrm{jN}}/C_{\mathrm{maxN}}$ = Distance of location '*j*' from National Highway/Distance of the farthest location from the Highway.

Similarly,

C_{j2}= $C_{\mathrm{jM}}/C_{\mathrm{maxM}}$ = Distance of location '*j*' from Motorway/Distance of the farthest location from Motorway.

Three new terminals have been identified for the three district-headquarters (Table 3-3). To ensure equity, each of the four districts gets one model truck terminal. The purpose of these potential sites is to enhance the accessibility of the goods transport services to the entire division.

Table 3-3: Potential Truck Terminal Sites.

Sr.No	Site Location	District
1	Near Highway check post on N-5 (Multan Road)	Sahiwal
2	Near Pak Qadri Goods transport company on Okara Depalpur road	Okara
3	Near Karam Farid CNG Station on Pakpattan Sahiwal road	Pakpattan

Figure 3-3 shows the spatial distribution and accessibility of the potential truck terminal sites. The sites are located near provincial highways for smooth movement of truck traffic. Moreover, care has been taken to select such sites that minimize the distance of the district headquarters to the major divisional, regional, and national connectivity corridors such as national highways and motorways.

With the proposed truck terminals, the goods transport accessibility would significantly improve in comparison to the existing freight transport accessibility of the districts (Figure 3-3).

Most of the industries, particularly those in the district headquarters, would get rapid goods transport coverage (20-40 minutes availability of trucking service). Specifically, when the time range is increased to 80 minutes, 8% of the industrial units are served with the construction of proposed truck terminals. Alternatively, an improved road infrastructure can help shorten the travel time between truck terminals and industrial units. It implies that the truck terminal sites will be accessible to the majority of the industrial units of the division at a reasonable travel distance.

Time (Min)	Area (Km2)	%age
0-20	2256.24	21.56%
20-40	4554.57	43.52%
40-60	2428.49	23.02%
60-80	845.01	8.07%
80-100	380.47	3.6%

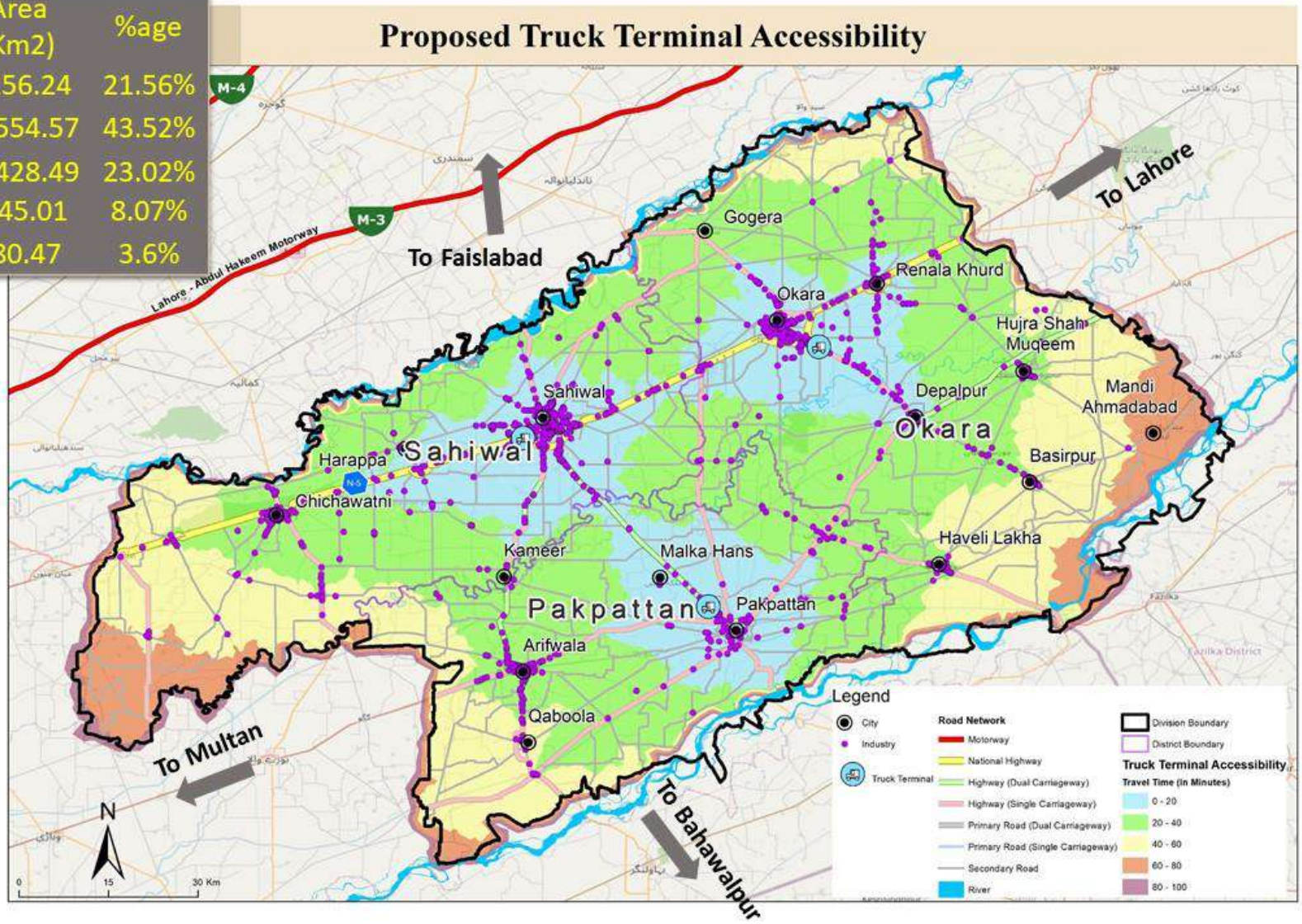


Figure 3-3: Accessibility Analysis of the Proposed Truck Terminal Locations

3.3 Identification of Public Transport Schemes

A GIS-based Public Transport Accessibility analysis of inter-city transport terminals is presented in this section. For this purpose, areas accessible within the 10, 20, and 40 minutes drive time threshold are considered for analysis from each bus terminal. Figure 3-4 illustrates the area served based on drive time by each bus terminal.

Most of the residents (35.25%) have access to intercity public transport terminals in 10 minutes. When the time range is increased to 40 minutes, the significant population of the division is served as illustrated in Table 3-4 by the cumulative percentage of population. It implies that inter-city public transport is accessible to most of the population of the division at a reasonable travel distance.

Table 3-4: Inter-city Public Transport Accessibility

Intercity Bus Coverage			
Time (minutes)	**Population**	**%Age**	**Cumulative %Age**
0-10	2448443	35.25%	35.25%
10-20	2423489	34.90%	70.15%
20-30	1617865	23.30%	93.45%
30-40	455200	6.55%	100%

Intercity Bus Coverage		
Time (Min)	Population	%age
0-10	2448443	35.25%
10-20	2423489	34.90%
20-30	1617865	23.30%
30-40	455200	6.55%

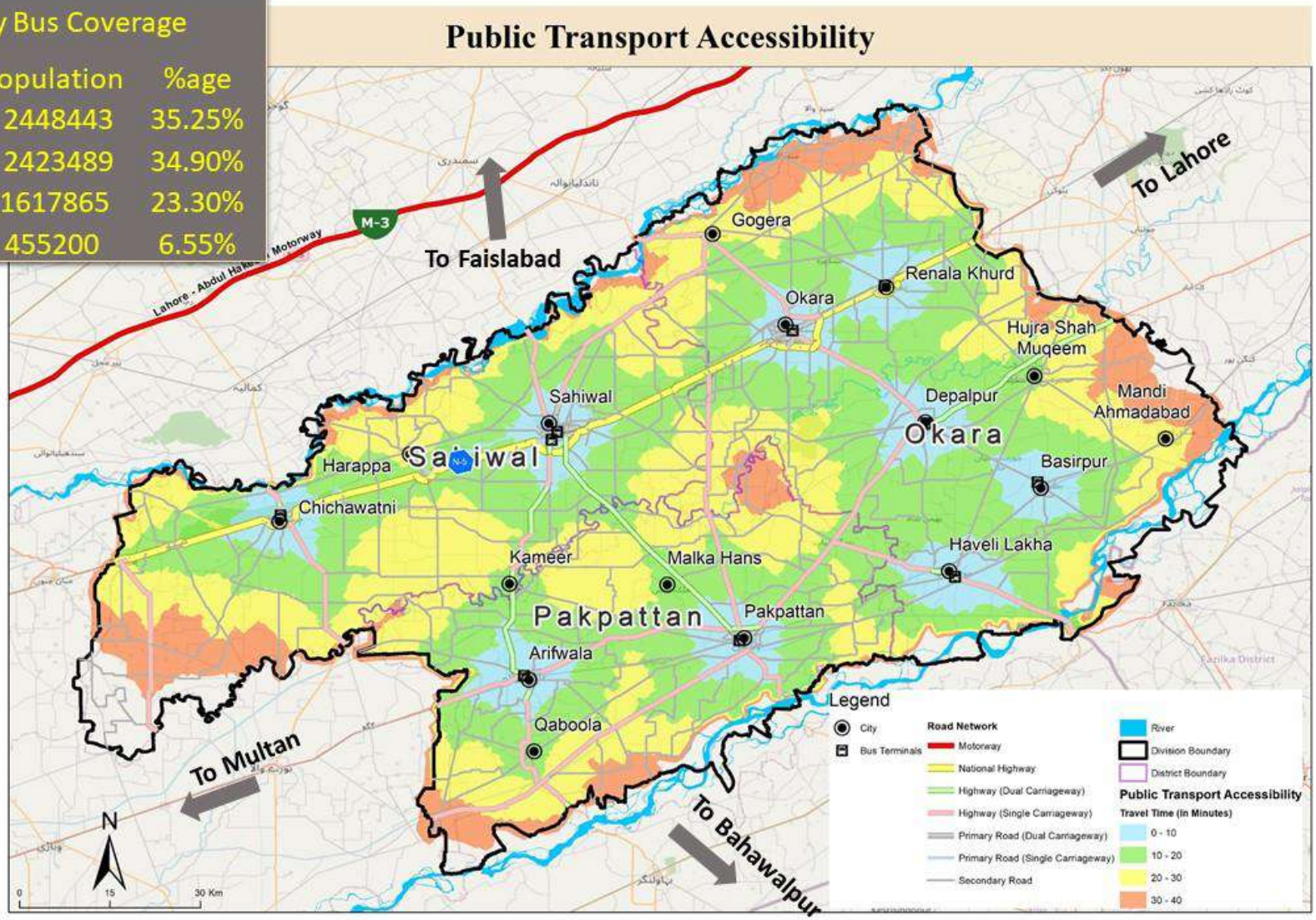


Figure 3-4. Public Transport Accessibility in Sahiwal Division

4 PROPOSED INTERVENTIONS

The proposed interventions for the upcoming ADPs target a 10-year planning horizon from the year 2024 to 2034. The proposed interventions encompass road and transport sectors. The road sector schemes include dualization and widening schemes while the transport sector schemes include urban transport interventions as well as the construction of new model truck terminals in the district headquarters. A preliminary cost estimate and the target implementation timelines for each of the projects have been proposed. It should be noted that these cost estimates rely on the average cost of similar road and transport schemes that have been completed recently in Punjab. Therefore, the reader should expect the possibility of large variations in the cost estimates when detailed design of the proposed facilities is conceived in the future.

4.1 Road Schemes

These road schemes are aimed at improving the provincial road network for better regional connectivity. As discussed in the previous chapters, many provincial roads in Sahiwal Division are single-lane, despite an ADT of more than 8000. The evaluation of the benefit-cost ratio of these roads, as discussed in the previous chapter, gives 12 road schemes that should be completed over the next ten years to ensure the required mobility and accessibility on the road network. These road schemes are summarized in Table 4-1. A detailed cost-benefit analysis of these roads is presented in Annexure I. The benefit-cost ratio of these projects might form the basis of their funding priority. That is, a road scheme with a higher benefit-cost ratio gets funding earlier as compared to a road scheme with a lower benefit-cost ratio.

There are eight proposed dualization and three widening schemes and one is upgradation. In terms of implementation timeline, five schemes have been proposed for implementation in the medium to long term (2030-2034) while the remaining seven schemes have been proposed for implementation in the short to medium term (2024-2030). The total cost of short to medium-term projects is PKR 43.30 billion and 36.65 billion for medium to long-term projects. Thus, the Sahiwal Division will be requiring approximately PKR 79.94 billion over the next ten years to dualize and improve road infrastructure.

Table 4-1: Proposed Road Schemes Sahiwal Division.

District	Proposed Road Schemes	Length (Km)	ADT Projections				Timeline
			2024	2027	2030	2034	
Sahiwal	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	40	8799	9270	9741	10370	Short to Medium Term
	Dualization of Burewala Road from Chichawatni to Kamand	30	9320	9819	10318	10984	Short to Medium Term
	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	41	2734	2880	3027	3222	Medium to Long Term

	Widening of Chichawatni Harapa Road	54	2131	2246	2360	2512	Medium to Long Term
	Upgradation of Kamir Chichawatni Road	27	2184	2301	2418	2574	Medium to Long Term
Okara	Dualization of Okara Depalpur Road	24	12031	12676	13320	14179	Short to Medium Term
	Dualization of Okara-Syedwala-Jarranwala Road	59	6593	6947	7300	7771	Short to Medium Term
	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	70	3435	3619	3803	4048	Short to Medium Term
	Dualization of Road from Haveli Lakha to Hujra Shah	35	5514	5809	6105	6498	Medium to Long Term
	Dualization of Road from Renala Khurd to Kot Shaukat	27.7	6512	6861	7209	7674	Medium to Long Term
Pakpattan	Dualization of Arifwala Pakpattan Road	29	7127	7508	7890	8399	Short to Medium Term
	Dualization of Depalpur Road	41	7358	7753	8147	8672	Short to Medium Term

The spatial distribution of the proposed road network schemes is shown in Figure 4-1. The proposed network is spread across the division connecting the region with high-speed road links at Tehsil Level and beyond. Moreover, high-speed connectivity with national roadways has been ensured. For example, the proposed dualization of Sahiwal Faisalabad road improves the link of both the cities with Lahore – Abdul Hakeem Motorway (M-3) as well as the Lahore Multan Road (N-5). Likewise, the dualization of Okara – Jaranwala Road improves the link with the Lahore – Abdul Hakeem Motorway (M-3).

Moreover, the interconnectivity of THQs and DHQs will be significantly improved when the proposed interventions are implemented. For instance, the busy road connection between Pakpattan, Depalpur, Okara, and Sahiwal would become much faster after its proposed dualization is completed.

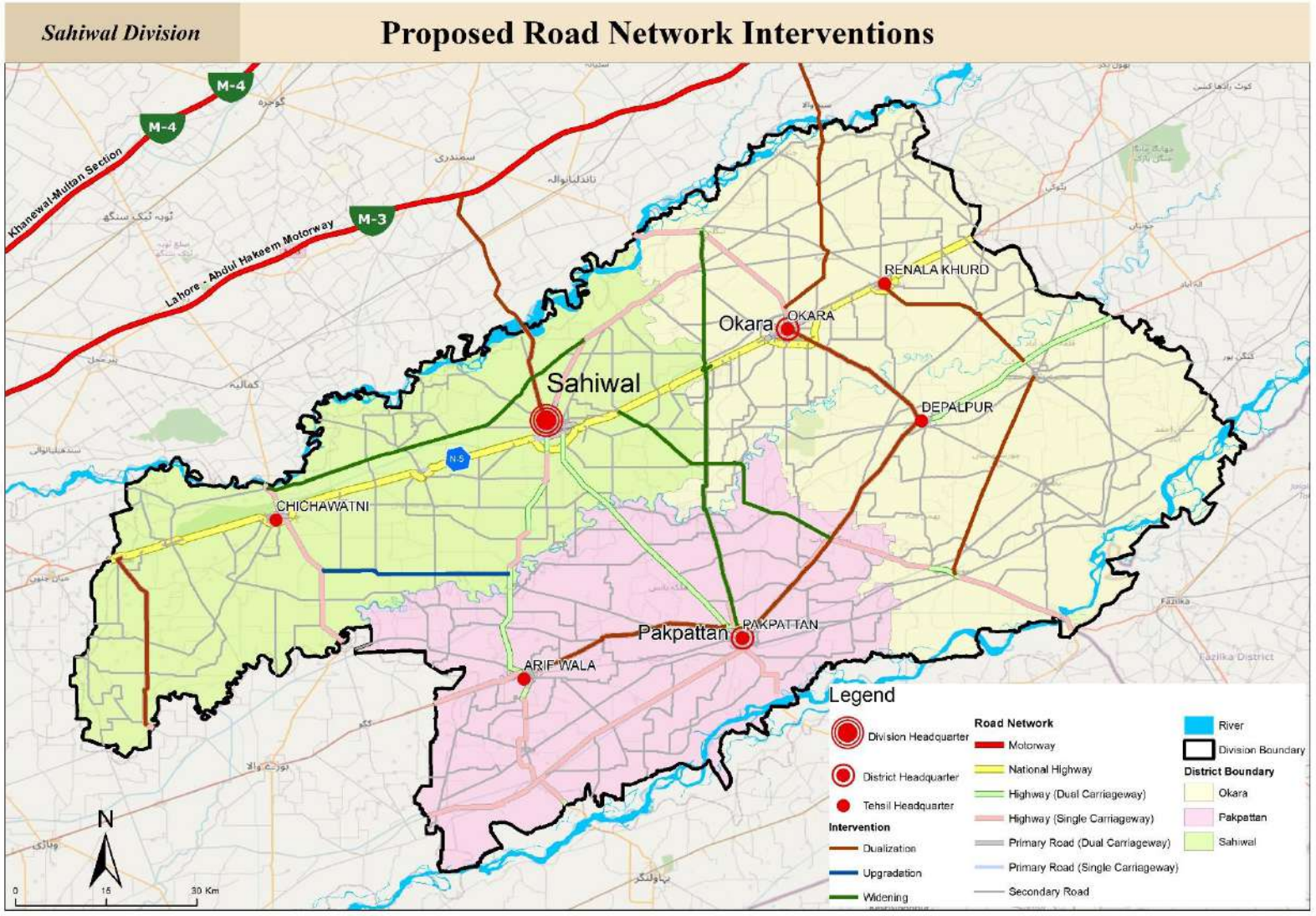


Figure 4-1: Spatial Distribution of Proposed Road Network Schemes

A district-wise analysis is presented in the following paragraphs. Sahiwal District is proposed to develop five of its existing roads in the next ten years totaling PKR 38.10 billion (Table 4-2). These projects aim to improve the road infrastructure by implementing dualization and Widening/improvement schemes. The combined length of all the listed road projects is 192 kilometers, which will contribute to better connectivity and transportation efficiency in the district.

The road schemes serve a significant number of PCUs ranging from 3892 to 13,584, indicating the potential reduction in traffic congestion and travel times. The Benefit/Cost (B/C) ratios of the schemes range from 1.0 to 4.4, indicating their economic viability and potential for positive returns on investment. The total cost of the listed road development projects is PKR 38,098.42 million. This includes expenses associated with dualization and Widening/improvement of the roads.

Table 4-2: Proposed Road Schemes, District Sahiwal

Proposed Road Schemes	Intervention		ADT Projections				Cost (PKR Millions)	B/C Ratio	Timeline	Phase
		PCUs	2024	2027	2030	2034				
1- Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	Dualization	10646	8799	9270	9741	10370	7945.45	4.4	2024-2030	Short to Medium-term
2- Dualization of Burewala Road from Chichawatni to Kamand	Dualization	13584	9819	10318	10984	12474	5959.09	2.3	2024-2030	Short to Medium-term
3- Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	Widening	4136	2880	3027	3222	13889	8144.08	1.0	2030-2034	Medium to Long Term
4- Widening of Chichawatni Harapa Road	Widening	4032	2246	2360	2512	16182	10627.04	1.3	2030-2034	Medium to Long Term
5- Pavement Upgradation of Kamir Chichawatni Road	Upgradation	3892	2184	2301	2418	2574	5422.77	1.4	2030-2034	Medium to Long Term
	Total Cost (PKR Millions)						**38,098.42**			

Figure 4-2 shows the spatial distribution of proposed road schemes in Sahiwal District. In the Northern part of the district, the proposed dualization of Sahiwal Faisalabad road would connect the Lahore-Abdul Hakeem motorway (M-3). In the center of the region, key proposed roads are Harappa Road, Kamir Chichawatni Road, and Yousaf Wala Road.

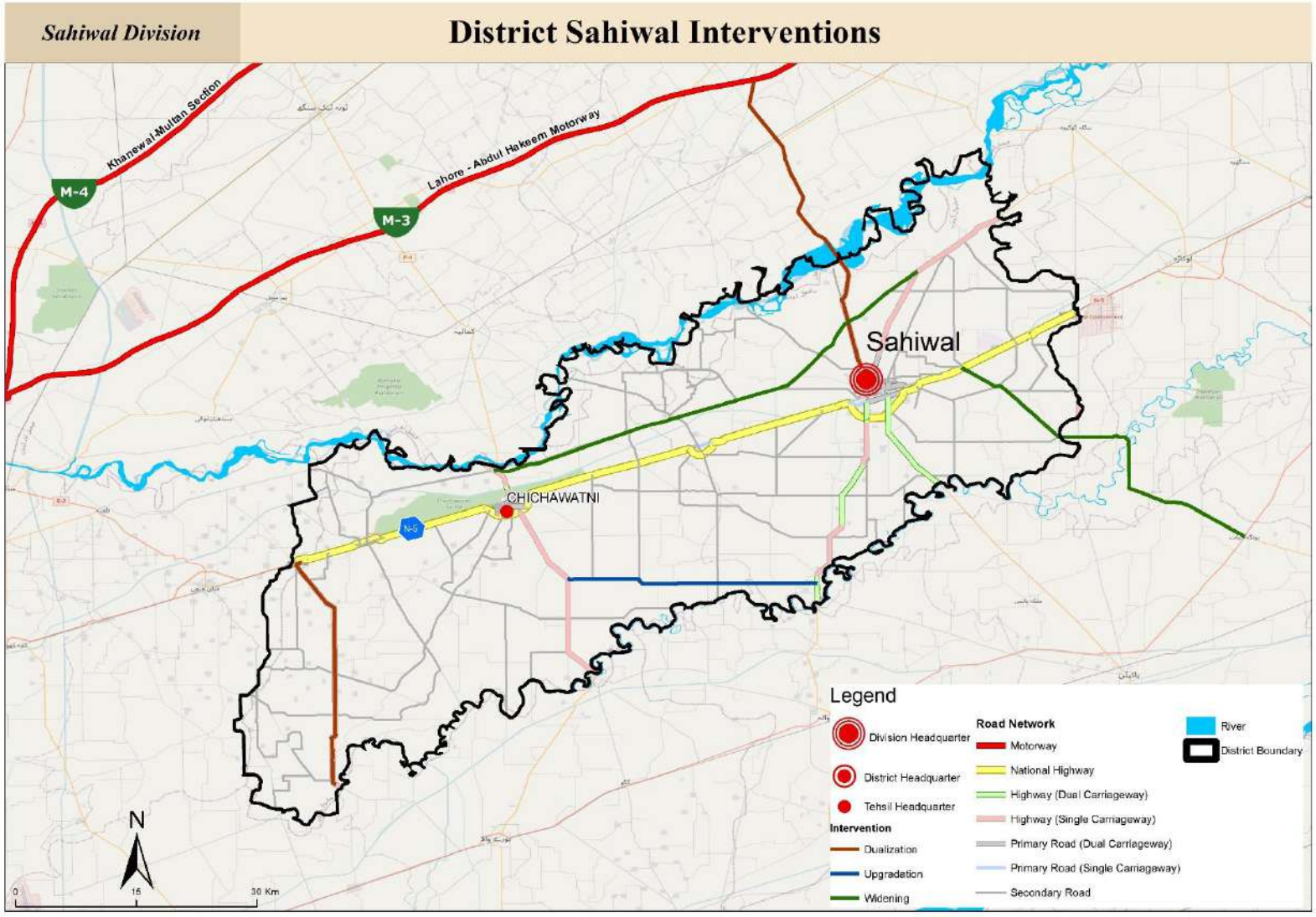


Figure 4-2: Spatial Distribution of Proposed Roads in Sahiwal

Figure 4-3 shows the implementation timeline of the proposed schemes in Sahiwal. The dualization of Sahiwal Faisalabad road is proposed to be a short to medium-term intervention (2024-2030). Likewise, the dualization of Burewala road from Chichawatni Iqbal nagar to Kamand is also proposed to be short to Medium term intervention (2024-2030). Similarly, the Harapa Road, Yousaf Wala Road, and Kamir Chichawatni Road are proposed to be completed in the medium to long term i.e., up to the year 2034 because the projected traffic seems to be served well by the extant road infrastructure till that period of time. It implies that Sahiwal would require PKR 13.90 billion in short to medium term and the remaining PKR 24.19 billion in medium to long term to complete the road infrastructure improvement.

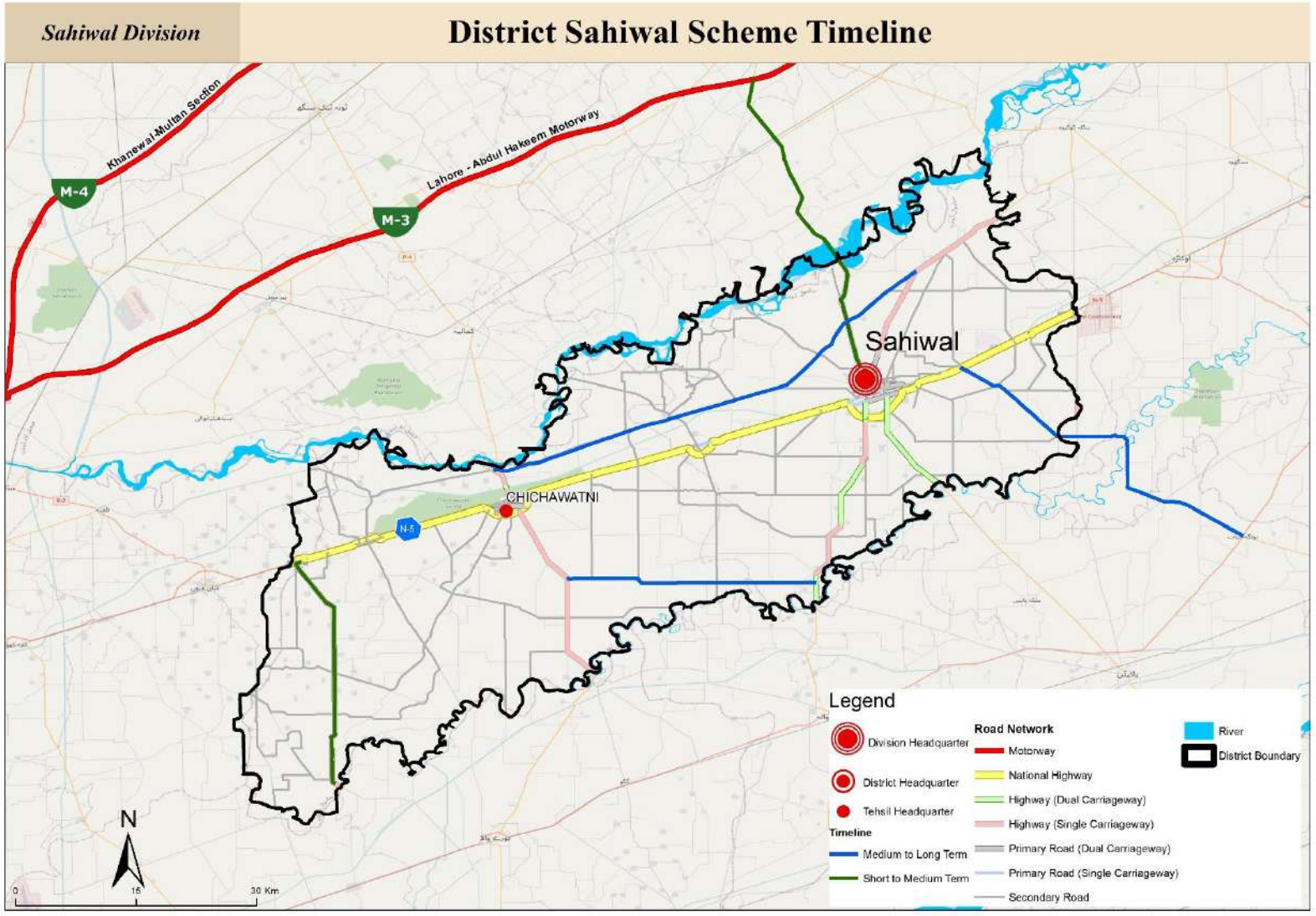


Figure 4-3: Timeline of Proposed Roads in Sahiwal

The total cost of the proposed road schemes in Okara is PKR 39.04 billion. This includes four dualization schemes and one Widening/improvement scheme. Among five proposed schemes, two roads would require medium to long-term implementation (2030-2034) which implies that the extant road widths are enough to serve traffic adequately for the next six years on these roads. The remaining three schemes are proposed to be implemented in the short to medium-term (2024-2030) timeline.

Table 4-3: Proposed Road Schemes, District Okara

Proposed Road Schemes	Intervention		ADT Projections				Cost (PKR Millions)	B/C Ratio	Timeline	Phase
		PCUs	2024	2027	2030	2034				
6- Dualization of Okara Depalpur Road	Dualization	12031	12031	12676	13320	14179	961.71	17.8	2024-2030	Short to Medium Term
7- Dualization of Okara-Syedwala-Jarranwala Road	Dualization	8737	6593	6947	7300	7771	11,719.53	2.1	2024-2030	Short to Medium Term
8- Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	Widening	5284	3435	3619	3803	4048	13,904.53	1.3	2024-2030	Short to Medium Term
9- Dualization of Road from Haveli Lakha to Hujra Shah	Dualization	8239	5514	5809	6105	6498	6,952.27	4.3	2030-2034	Medium to Long Term
10- Dualization of Road from Renala Khurd to Kot Shaukat	Dualization	8355	6512	6861	7209	7674	5,502.22	2.4	2030-2034	Medium to Long Term
		Total Cost (PKR Millions)					**39,040.26**			

Figure 4-4 shows the spatial distribution of the proposed road schemes in Okara. The dualization schemes will provide the much-needed North connectivity for Okara with Jaranwala. Lahore Abdul Hakeem Motorway (M-3) also passes nearby reinforcing the North-connectivity of the district. The weaker links are road connections with Pakpattan, Depalpur Road, Haveli Lakha Hujra Shah and Renala Khurd Shergarh have been proposed to dualize in this study.

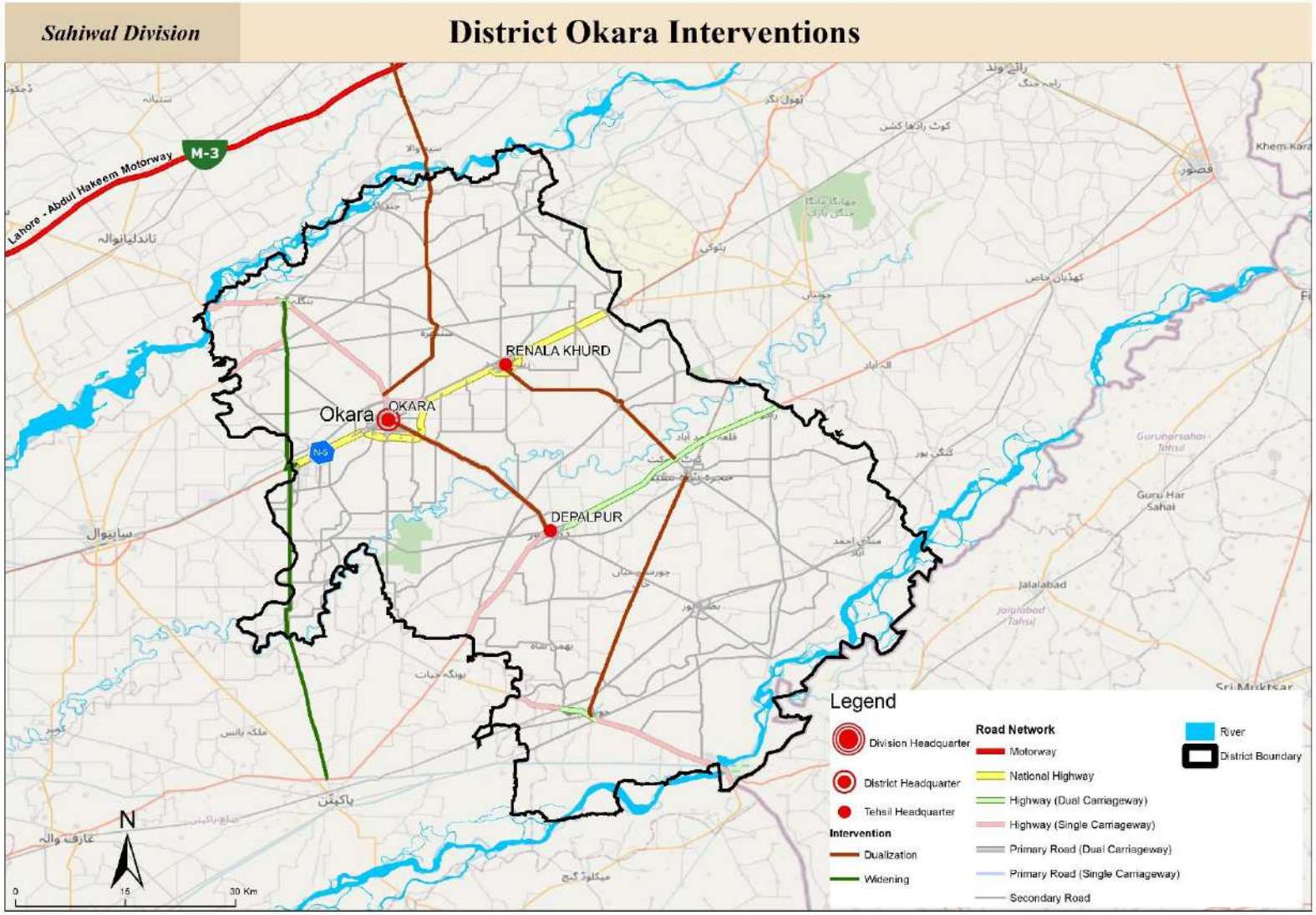


Figure 4-4: Spatial Distribution of Proposed Roads in Okara

Figure 4-5 shows the proposed implantation timeline of the schemes. Out of five schemes, three Road projects are proposed for Dualization in the short to medium term (2024-2030), and one is proposed for widening in the short to medium term (2024-2030) while the remaining two dualization schemes are proposed as a medium to long term intervention (2030-2034).

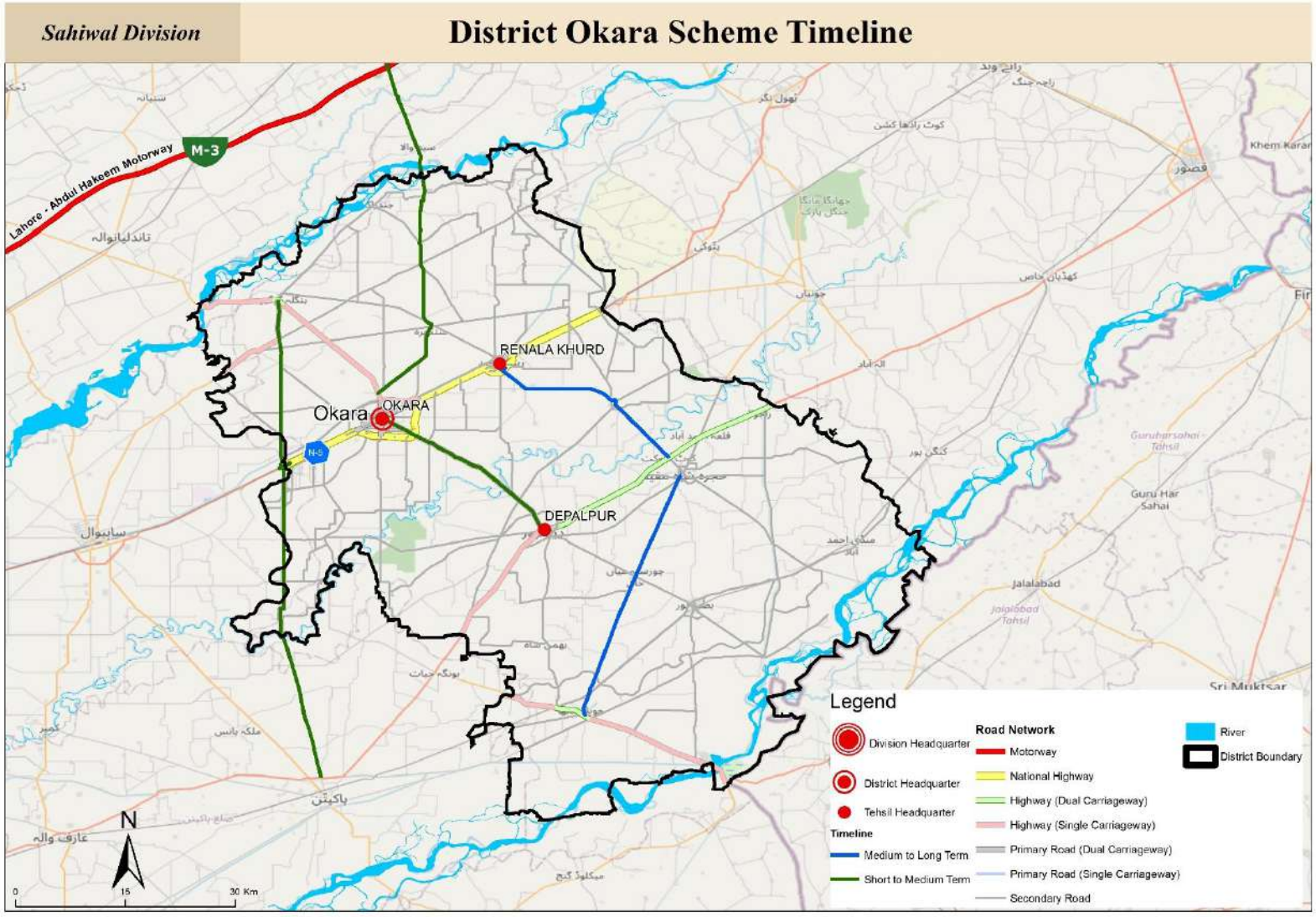


Figure 4-5: Timeline of Proposed Roads in Okara

Table 4-4 lists the proposed road schemes in Pakpattan District. There are two roads that have been proposed for dualization or Rehabilitation/improvement programs in the next 10 years. The total cost of all the proposed schemes is around PKR 2.81 billion. The only 2.81 billion would be incurred on the dualization of roads that connect key parts of the district and feature heavy traffic volumes.

Table 4-4: Proposed Road Schemes, District Pakpattan

Proposed Road Schemes	Intervention		ADT Projections				Cost (PKR Millions)	B/C Ratio	Timeline	Phase
		PCUs	2023	2026	2029	2033				
11- Dualization of Arifwala Pakpattan Road	Dualization	11017	7127	7508	7890	8399	1,162.07	10.0	2024-2030	Short to Medium Term
12- Dualization of Depalpur Road	Dualization	7358	7358	7753	8147	8672	1,642.93	13.1	2024-2030	Short to Medium Term
						Total Cost (PKR Millions)	**2,805.00**			

Figure 4-6 shows the spatial distribution of the proposed road schemes. It can be seen that the proposed interventions cover almost all the key roads in the district strengthening connectivity within and beyond the district.

Likewise, Figure 4-7 shows the implementation timeline of the proposed projects. All of the two proposed interventions are short-term schemes (2024-2030).

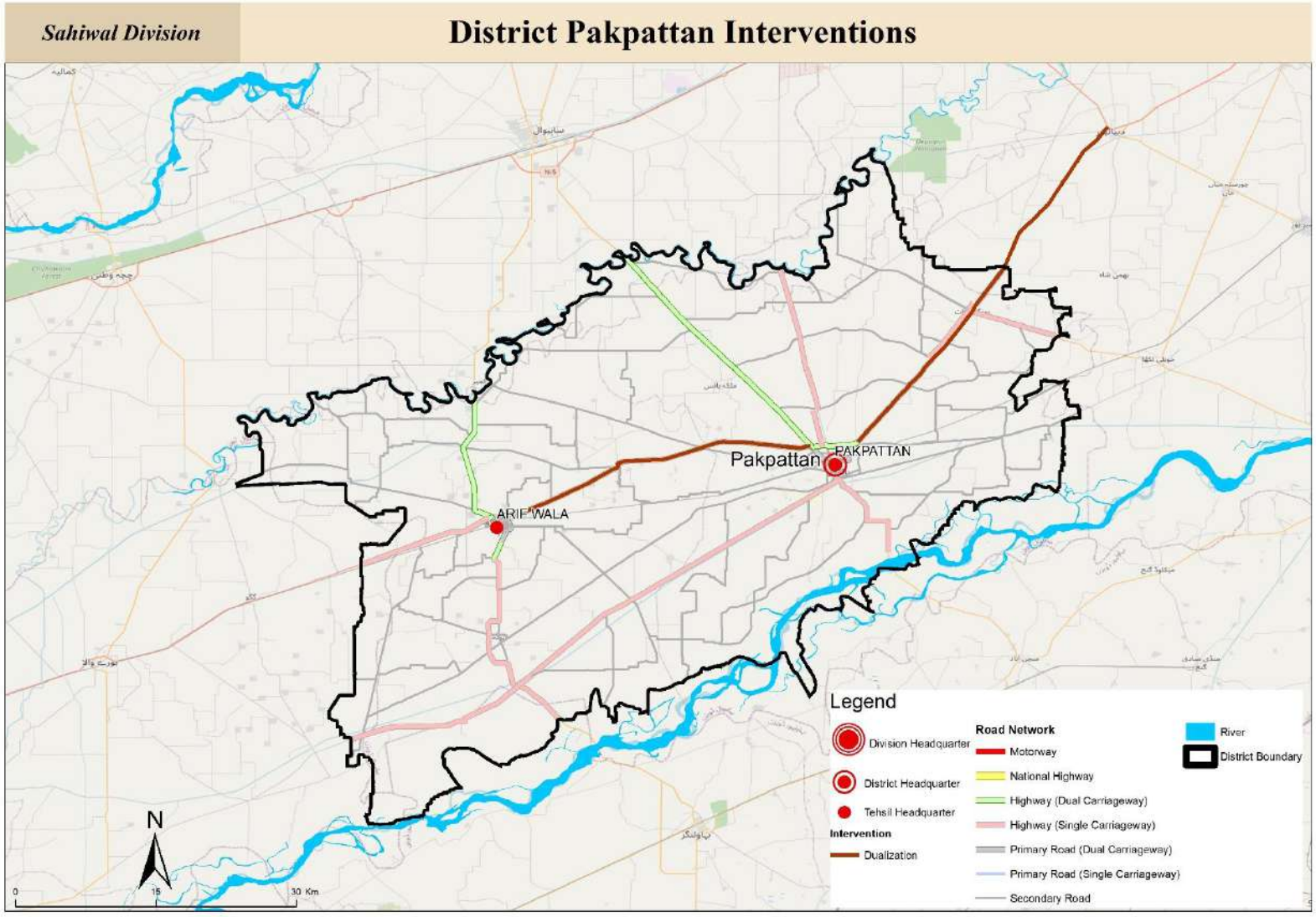


Figure 4-6: Spatial Distribution of Proposed Roads in Pakpattan

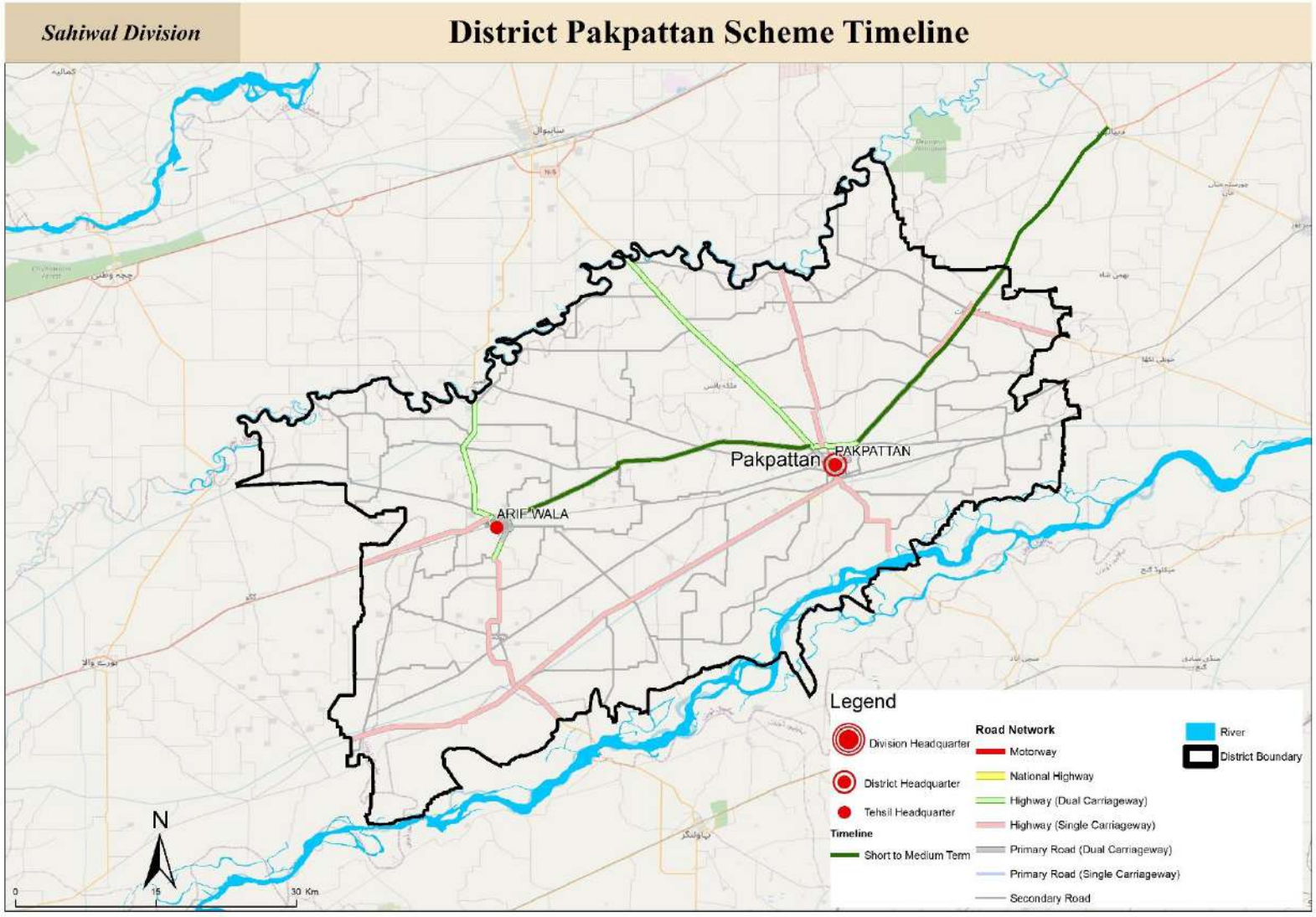


Figure 4-7: Timeline of Proposed Roads in Pakpattan

4.2 Truck Terminals

Table 4-5 provides information on the implementation timeline of three projects related to the construction of modal truck terminals in Sahiwal division. These projects are scheduled to be implemented between 2024 and 2034.

The first project, “Construction of Modal Truck Terminal Near Highway Check Post on N-5” is planned for Sahiwal district. This truck terminal aims to cater to the needs of the transport industry in the area, offering a designated space for truck parking, loading, and unloading activities. It is expected to improve logistics operations and contribute to the overall development of the transport sector in the district.

The second project, “ Construction of Modal Truck Terminal Near Pak Qadri Goods Transport Company” is planned for the Okara district and the third project, “Construction of Modal Truck Terminal Near Karam Farid CNG Station on Pakpattan Sahiwal Road” is planned for the Pakpattan district. The construction of these truck terminals aims to provide a dedicated facility for handling truck traffic and logistics operations. It is expected to enhance the efficiency of transportation services in the area and contribute to improved trade and commerce. These truck terminals will serve as a centralized hub for truck operations. By providing modern facilities and infrastructure, it will help streamline the movement of goods and support the local industry. The proposed interventions would be able to serve 88% of the Division Area within a one-hour travel time window.

Table 4-5: Proposed Truck Terminals

Sr. No	Project Name	District/ Sector	Implementation Timeline
1	Construction of Modal Truck Terminal Near Highway check post on N-5 (Multan Road) in Sahiwal City	Sahiwal	2024-2030
2	Construction of Modal Truck Terminal Near Pak Qadri Goods transport company on Okara Depalpur Road	Okara	2024-2030
3	Construction of Modal Truck Terminal Near Karam Farid CNG Station on Pakpattan Sahiwal Road	Pakpattan	2030-2034

4.3 Intracity Public Transport

The intercity transport service is found to be satisfactory during this study, therefore, no new schemes have been proposed in this regard. The proposed public transport schemes (Table 4-6) target urban transport in Sahiwal city. These proposals are based on a study by the Punjab transport company and cater to the mass movement of passengers in the divisional headquarters of Sahiwal.

These public transport facilities are expected to ease traffic congestion in Sahiwal City while providing a cheaper way to commute for different activities such as shopping, business, education, etc.

Table 4-6: Intracity Public Transport Routes for Sahiwal City

S. No.	Proposed Interventions	Implementation Timeline
1	Development of Integrated operations of Intracity Public Transport Routes	2024-2030

Spatial Distribution of the routes in Sahiwal is shown in Figure 4-8. The Purple color line is 12.3 km, it starts at GBS Arifwala Chowk via high street Pakpattan Kot Khadim and ends at McDonalds. The light blue color line is 13.4 km, starting from Sarwar Chowk via College Chowk Joggi chowk and ending at McDonald's.

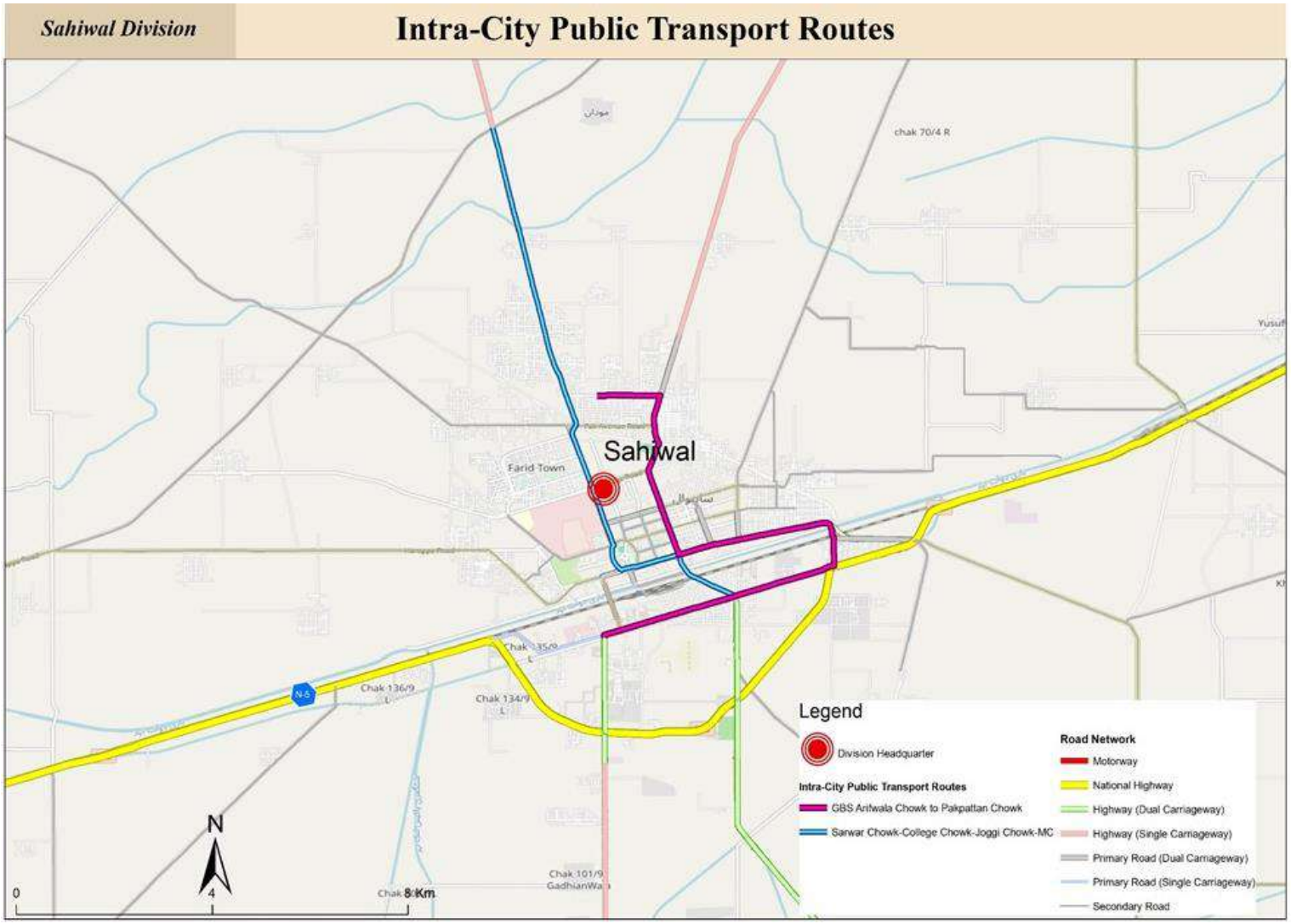


Figure 4-8: Spatial Distribution of Intracity Routes

4.4 Parking Plazas

The parking supply was found unsatisfactory during this study, therefore, one parking plaza has been proposed in Pakpattan (Figure 4-9). The proposed parking plaza (Table 4-7) targets urban areas and caters to the parking demand in the district headquarters of Pakpattan. This proposal is based on a study by the Metropolitan Corporation Pakpattan /Punjab PPPA. The parking facilities are expected to ease traffic congestion in Pakpattan city while providing commuters with a safe and reliable facility.

Table 4-7 Parking Plaza Implementation Timeline in Pakpattan

Sr. No	Proposed Intervention	Implementation Timeline
1	Construction of Parking Plaza A in Pakpattan	2030-2034

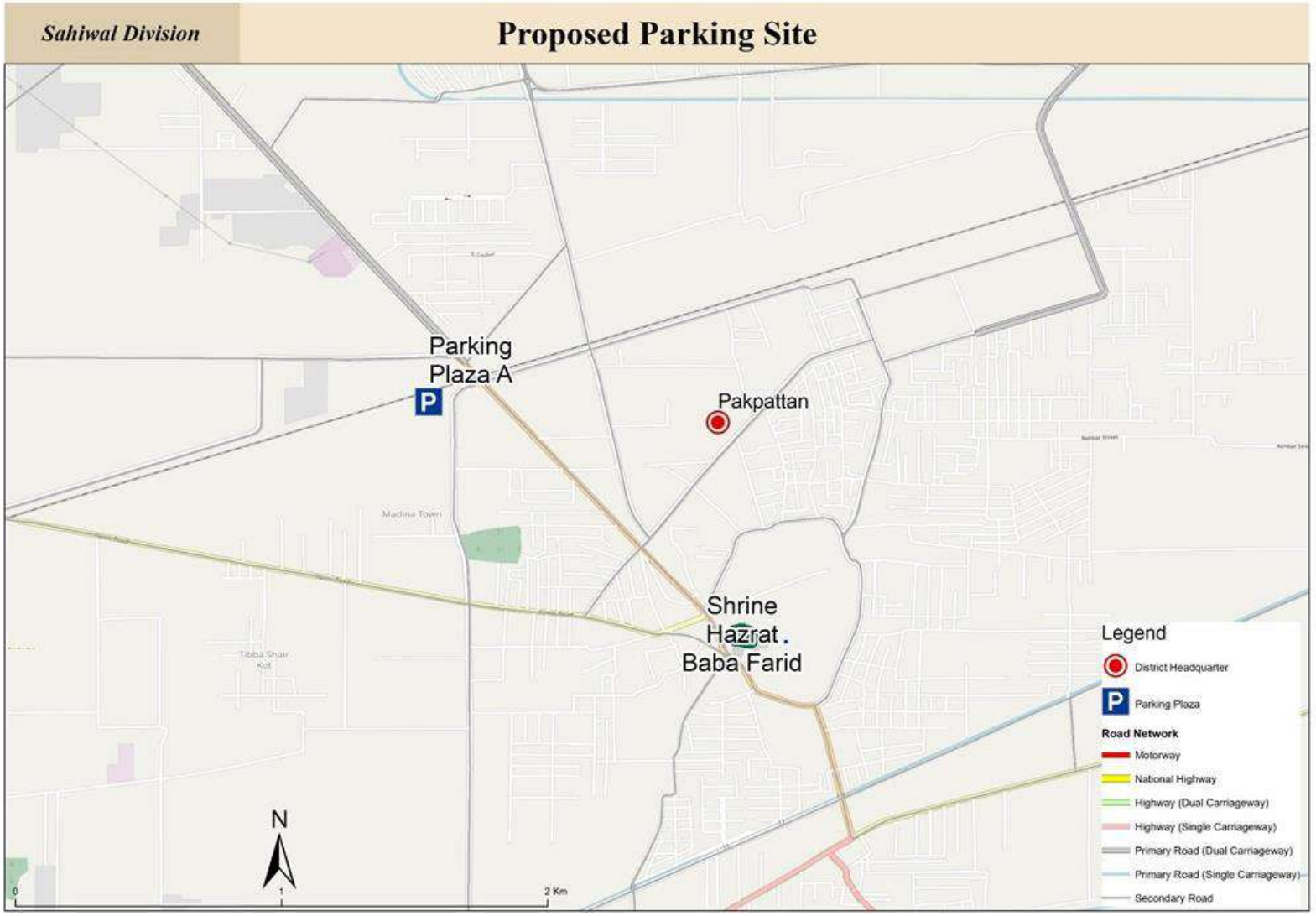


Figure 4-9: Proposed Parking Sites in Pakpattan

4.5 Sectoral Targets

To facilitate the implementation of the proposed projects and visualize their impact, details of sectoral targets have been presented in the following sections. In the base year 2024, the share of dual carriageways in the entire road network of the Sahiwal division is only 1.49%. The proposed interventions would enhance it to 2.48% by 2030 and 2.73% by 2034. Currently, there is no formal truck terminal in the division. This would increase to three by 2034. Thus, the proposed interventions would have a multi-prong effect on enhancing the road and transport sector infrastructure in Sahiwal.

4.5.1 Base Line Year 2024

In the base year 2024, transport infrastructure stands at the following statistics in the Sahiwal division.

1. **Road Network (Except Local Roads)**
    - Dual Carriageways: 1.49%

Key institutions that played a crucial role in the implementation of these plans include Regional Transport Authority

4.5.2 Short to Medium Term (2024 to 2030)

The execution of proposed transport project in a short to medium-term timeline in different sectors would enhance transport infrastructure to the following statistics till year 2030.

1. **Road Network (Except Local Roads)**
    - Dual Carriageways: 2.48%
2. **Urban Transport**
    - Integrated Operations of Intracity Public Transport Routes
3. **Freight Transport**
    - 2 Truck Terminal

The Key Institutions that would achieve the targets include the Regional Transport Authority (RTA), and Punjab Transport Company (PTC).

4.5.3 Medium to Long Term (2030 to 2034)

The execution of the proposed transport project in medium to long-term timelines in different sectors would enhance transport infrastructure to the following statistics till year 2034.

1. **Road Network (Except Local Roads)**
    - Dual Carriageways: 2.73%
2. **Urban Transport**
    - Integrated Operations of Intracity Public Transport Routes

3. **Parking**
    - 1 Parking Plaza
4. **Freight Transport**
    - 3 Truck Terminal

The Key Institutions that would achieve the targets include the Regional Transport Authority (RTA), and Punjab Transport Company (PTC).

ANNEXURE I

COST-BENEFIT ANALYSIS OF THE POTENTIAL ROAD SCHEME

Sheet 1 Candidate Links and Proposed Improvements

Sr#	Linkage	Existing Link				Proposed Link			
-	-	Carriageway	Distance (Km)	Speed (kph)	TT (Hrs)	Carriageway	Distance (Km)	Speed (kph)	TT (Hrs)
1	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	Dual	0	80	0	Dual	40	80	0.5
		Single	40	40	1	Single	0	50	0
		Total	40	-	1	Total	40	-	0.5
2	Dualization of Burewala Road from Chichawatni to Kamand	Dual	0	80	0	Dual	30	80	0.375
		Single	30	40	0.75	Single	0	50	0
		Total	30	-	0.75	Total	30	-	0.375
3	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	Dual	0	80	0	Dual	0	80	0
		Single	41	40	1.025	Single	41	50	0.82
		Total	41	-	1.025	Total	41	-	0.82
4	Widening of Chichawatni Harapa Road	Dual	0	80	0	Dual	0	80	0
		Single	53.5	40	1.3375	Single	53.5	50	1.07
		Total	53.5	-	1.3375	Total	53.5	-	1.07
5	Pavement upgradation of Kmir Chichawatni Road	Dual	0	80	0	Dual	0	80	0
		Single	27.3	40	1.3375	Single	27.3	50	1.07
		Total	27.3	-	1.3375	Total	27.3	-	1.07
6	Dualization of Okara Depalpur Road	Dual	0	80	0	Dual	24	80	0.3
		Single	24	40	0.6825	Single	0	50	0
		Total	24	-	0.6825	Total	24	-	0.3
7	Dualization of Okara-Syedwala-Jarranwala Road	Dual	0	80	0	Dual	59	80	0.7375
		Single	59	40	1.475	Single	0	50	0
		Total	59	-	1.475	Total	59	-	0.7375
8	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	Dual	0	80	0	Dual	0	80	0
		Single	70	40	1.75	Single	70	50	1.4
		Total	70	-	1.75	Total	70	-	1.4
9	Dualization of Haveli Lakha to Hujra shah	Dual	0	80	0	Dual	35	80	0.4375
		Single	35	40	0.875	Single	0	50	0
		Total	35	-	0.875	Total	35	-	0.4375
10	Dualization of road from Renala Khurd to Kot Shaukat	Dual	0	80	0	Dual	27.7	80	0.34625
		Single	27.7	40	0.725	Single	0	50	0
		Total	27.7	-	0.725	Total	27.7	-	0.34625
11	Dualization of Arifwala Pakpattan Road	Dual	0	80	0	Dual	29	80	0.3625
		Single	29	40	0.725	Single	0	50	0
		Total	29	-	0.725	Total	29	-	0.3625
12	Dualization of Depalpur Road	Dual	0	80	0	Dual	41	80	0.5125
		Single	41	40	1.025	Single	0	50	0
		Total	41	-	1.025	Total	41	-	0.5125

Sheet 2 Travel Time Savings

Sr No	Linkage	Existing Travel Time (Hrs)	Travel Time After Improvement (Hrs)	Travel Time Saved per PCU per Day (Hrs)	PCU per Day	Total Time Saved per Day (Hrs)	Total Time Saved per Year (Hrs)	Time Value of Occupants (Rs./Hr)	Total Amount Saved Annually (Rs.)	Total Amount Saved Annually (Million Rs.)
1	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	1.00	0.50	0.50	13,810	6,905.2	2,520,414.4	1,749.0	4,408,204,712.5	**4,408.20**
2	Dualization of Burewala Road from Chichawatni to Kamand	0.75	0.38	0.38	7,041	2,640.3	963,719.6	1,749.0	1,685,545,558.9	**1,685.55**
3	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	1.03	0.82	0.21	6,493	1,331.2	485,875.5	1,749.0	849,796,168.3	**849.80**
4	Widening of Chichawatni Harapa Road	1.34	1.07	0.27	8,730	2,335.2	852,352.5	1,749.0	1,490,764,552.0	**1,490.76**
5	Pavement upgradation of Kmir Chichawatni Road	0.68	0.55	0.14	9,721	1,326.9	484,304.3	1,749.0	847,048,238.7	**847.05**
6	Dualization of Okara Depalpur Road	0.60	0.30	0.30	11,325	3,397.6	1,240,133.1	1,749.0	2,168,992,761.2	**2,168.99**
7	Dualization of Okara-Syedwala-Jarranwala Road	1.48	0.74	0.74	6,547	4,828.7	1,762,457.9	1,749.0	3,082,538,851.6	**3,082.54**
8	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	1.75	1.40	0.35	8,395	2,938.3	1,072,477.2	1,749.0	1,875,762,624.7	**1,875.76**

Annexures

Sr No	Linkage	Existing Travel Time (Hrs)	Travel Time After Improvement (Hrs)	Travel Time Saved per PCU per Day (Hrs)	PCU per Day	Total Time Saved per Day (Hrs)	Total Time Saved per Year (Hrs)	Time Value of Occupants (Rs./Hr)	Total Amount Saved Annually (Rs.)	Total Amount Saved Annually (Million Rs.)
9	Dualization of Haveli Lakha to Hujra shah	0.88	0.44	0.44	13,536	5,921.8	2,161,450.5	1,749.0	3,780,376,884.3	**3,780.38**
10	Dualization of road from Renala Khurd to Kot Shaukat	0.69	0.35	0.35	7,598	2,630.7	960,220.3	1,749.0	1,679,425,217.9	**1,679.43**
11	Dualization of Arifwala Pakpattan Road	0.73	0.36	0.36	6,307	2,286.4	834,528.8	1,749.0	1,459,590,854.0	**1,459.59**
12	Dualization of Depalpur Road	1.03	0.51	0.51	8,302	4,254.8	1,552,994.3	1,749.0	2,716,186,946.0	**2,716.19**

SHEET 3- Vehicle Operating Costs Savings

Sr No	Linkage	Distance (km)		VOC (Rs./km/ PCU/Day)		PCU per Day	Vehicle Operating Cost (Rs./Year)		VOC Per Annum	
		Existing	New	Before	After		Before	After	PKR	(Million)
1	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	40.0	40.0	52.8	52.4	10,646	8,203,717,152	8,144,686,257	59,030,894	**59.03**
2	Dualization of Burewala Road from Chichawatni to Kamand	30.0	30.0	52.8	52.4	13,584	7,850,786,243	7,794,294,908	56,491,335	**56.49**
3	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	41.0	41.0	52.8	50.5	4,136	3,266,845,622	3,127,777,464	139,068,158	**139.07**
4	Widening of Chichawatni Harapa Road	53.5	53.5	52.8	50.5	4,032	4,155,645,863	3,978,741,875	176,903,987	**176.90**
5	Pavement upgradation of Kmir Chichawatni Road	27.3	27.3	52.8	50.5	3,892	2,046,914,506	1,959,778,270	87,136,236	**87.14**

Sr No	Linkage	Distance (km)		VOC (Rs./km/ PCU/Day)		PCU per Day	Vehicle Operating Cost (Rs./Year)		VOC Per Annum	
		Existing	New	Before	After		Before	After	PKR	(Million)
6	Dualization of Okara Depalpur Road	24.0	24.0	52.8	52.4	12,031	5,562,591,831	5,522,565,491	40,026,340	**40.03**
7	Dualization of Okara-Syedwala-Jarranwala Road	59.0	59.0	52.8	52.4	8,737	9,930,670,506	9,859,213,099	71,457,408	**71.46**
8	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	70.0	70.0	52.8	50.5	5,284	7,125,659,637	6,822,323,491	303,336,147	**303.34**
9	Dualization of Haveli Lakha to Hujra shah	35.0	35.0	52.8	52.4	8,239	5,555,290,476	5,515,316,674	39,973,802	**39.97**
10	Dualization of road from Renala Khurd to Kot Shaukat	27.7	27.7	52.8	52.4	8,355	4,458,517,221	4,426,435,391	32,081,830	**32.08**
11	Dualization of Arifwala Pakpattan Road	29.0	29.0	52.8	52.4	11,017	6,154,964,785	6,110,675,950	44,288,835	**44.29**
12	Dualization of Depalpur Road	41.0	41.0	52.8	52.4	9,576	7,563,663,848	7,509,238,539	54,425,309	**54.43**

SHEET 4-A Existing Link Fuel Cost

Sr No	Link	Carriageway	Distance (Km)	Speed (kph)	Fuel Consumption (Rs./km/veh/day)	Fuel Consumption (Rs./veh/day)	Vehicles ADT (PCU)	Total Fuel Cost (Rs./Day)	Total Fuel Cost Annually (Million Rs.)
1	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	Dual	0	80	19.94	0.00	0	0	**4373.42**
		Single	40	40	21.69	867.60	13,810	11,981,981	
		Total	**40**	**-**	**-**	**867.60**	**13,810**	**11,981,981**	
2	Dualization of Burewala Road from Chichawatni to Kamand	Dual	0	80	19.94	0.00	0	0	**1672.25**
		Single	30	40	21.69	650.70	7,041	4,581,497	
		Total	**30**	**-**	**-**	**650.70**	**7,041**	**4,581,497**	
3	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	Dual	0	80	19.94	0.00	0	0	**2107.73**
		Single	41	40	21.69	889.29	6,493	5,774,596	
		Total	**41**	-	-	**889.29**	**6,493**	**5,774,596**	
4	Widening of Chichawatni Harapa Road	Dual	0	80	19.94	0.00	0	0	**3697.51**
		Single	53.5	40	21.69	1160.42	8,730	10,130,151	
		Total	**53.5**	-	-	**1160.42**	**8,730**	**10,130,151**	
5	Pavement upgradation of Kmir Chichawatni Road	Dual	0	80	19.94	0.00	0	0	**2100.91**
		Single	27.3	40	21.69	592.14	9,721	5,755,924	
		Total	**27.3**	-	-	**592.14**	**9,721**	**5,755,924**	
6	Dualization of Okara Depalpur Road	Dual	0	80	19.94	0.00	0	0	**2151.88**
		Single	24	40	21.69	520.56	11,325	5,895,559	
		Total	**24**	-	-	**520.56**	**11,325**	**5,895,559**	

Sr No	Link	Carriageway	Distance (Km)	Speed (kph)	Fuel Consumption (Rs./km/veh/day)	Fuel Consumption (Rs./veh/day)	Vehicles ADT (PCU)	Total Fuel Cost (Rs./Day)	Total Fuel Cost Annually (Million Rs.)
7	Dualization of Okara-Syedwala-Jarranwala Road	Dual	0	80	19.94	0.00	0	0	**3058.22**
		Single	59	40	21.69	1279.71	6,547	8,378,677	
		Total	**59**	-	-	**1279.71**	**6,547**	**8,378,677**	
8	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	Dual	0	80	19.94	0.00	0	0	**4652.41**
		Single	70	40	21.69	1518.30	8,395	12,746,318	
		Total	**70**	-	-	**1518.30**	**8,395**	**12,746,318**	
9	Dualization of Haveli Lakha to Hujra shah	Dual	0	80	19.94	0.00	0	0	**3750.55**
		Single	35	40	21.69	759.15	13,536	10,275,476	
		Total	**35**	-	-	**759.15**	**13,536**	**10,275,476**	
10	Dualization of road from Renala Khurd to Kot Shaukat	Dual	0	80	19.94	0.00	0	0	**1666.17**
		Single	27.7	40	21.69	600.81	7,598	4,564,861	
		Total	**27.7**	-	-	**600.81**	**7,598**	**4,564,861**	
11	Dualization of Arifwala Pakpattan Road	Dual	0	80	19.94	0.00	0	0	**1448.07**
		Single	29	40	21.69	629.01	6,307	3,967,327	
		Total	**29**	-	-	**629.01**	**6,307**	**3,967,327**	
12	Dualization of Depalpur Road	Dual	0	80	19.94	0.00	0	0	**2694.76**
		Single	41	40	21.69	889.29	8,302	7,382,892	
		Total	**41**	-	-	**889.29**	**8,302**	**7,382,892**	

SHEET 4-B Proposed-Link Fuel Cost

Sr No	Link	Carriageway	Distance (Km)	Speed (kph)	Fuel Consumption (Rs./km/veh/day)	Fuel Consumption (Rs./veh/day)	Vehicles ADT (PCU)	Total Fuel Cost (Rs./Day)	Total Fuel Cost Annually (Million Rs.)
1	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3	Dual	40	80	19.94	797.60	13,810	11,015,247	**4020.56**
		Single	0	50	20.28	0.00	0	0	
		Total	**40**	-	**-**	**797.60**	**13,810**	**11,015,247**	
2	Dualization of Burewala Road from Chichawatni to Kamand	Dual	30	80	19.94	598.20	7040.87	4,211,851	**1537.33**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**30**	**-**	**-**	**598.20**	**7040.87**	**4,211,851**	
3	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal	Dual	0	80	19.94	0.00	0.00	0	**1970.71**
		Single	41	50	20.28	831.48	6493.49	5,399,208	
		Total	**41**	**-**	-	**831.48**	**6493.49**	**5,399,208**	
4	Widening of Chichawatni Harapa Road	Dual	0	80	19.94	0.00	0.00	0	**3457.14**
		Single	53.5	50	20.28	1084.98	8729.77	9,471,621	
		Total	**53.5**	**-**	-	**1084.98**	**8729.77**	**9,471,621**	
5	Pavement upgradation of Kmir Chichawatni Road	Dual	0	80	19.94	0.00	0.00	0	**1964.34**
		Single	27.3	50	20.28	553.64	9720.59	5,381,749	
		Total	**27.3**	**-**	-	**553.64**	**9720.59**	**5,381,749**	
6	Dualization of Okara Depalpur Road	Dual	24	80	19.94	478.56	11325.42	5,419,891	**1978.26**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**24**	**-**	-	**478.56**	**11325.42**	**5,419,891**	

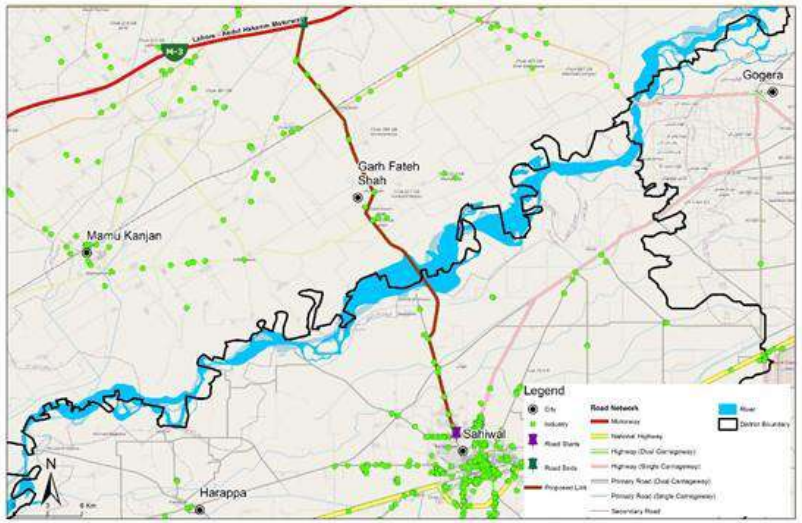
Sr No	Link	Carriageway	Distance (Km)	Speed (kph)	Fuel Consumption (Rs./km/veh/day)	Fuel Consumption (Rs./veh/day)	Vehicles ADT (PCU)	Total Fuel Cost (Rs./Day)	Total Fuel Cost Annually (Million Rs.)
7	Dualization of Okara-Syedwala-Jarranwala Road	Dual	59	80	19.94	1176.46	6547.32	7,702,665	**2811.47**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**59**	**-**	-	**1176.46**	**6547.32**	**7,702,665**	
8	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera	Dual	0	80	19.94	0.00	0.00	0	**4349.97**
		Single	70	50	20.28	1419.60	8395.12	11,917,719	
		Total	**70**	**-**	-	**1419.60**	**8395.12**	**11,917,719**	
9	Dualization of Haveli Lakha to Hujra shah	Dual	35	80	19.94	697.90	13535.50	9,446,427	**3447.95**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**35**	**-**	-	**697.90**	**13535.50**	**9,446,427**	
10	Dualization of road from Renala Khurd to Kot Shaukat	Dual	27.7	80	19.94	552.34	7597.81	4,196,557	**1531.74**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**27.7**	**-**	-	**552.34**	**7597.81**	**4,196,557**	
11	Dualization of Arifwala Pakpattan Road	Dual	29	80	19.94	578.26	6307.26	3,647,234	**1331.24**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**29**	**-**	-	**578.26**	**6307.26**	**3,647,234**	
12	Dualization of Depalpur Road	Dual	41	80	19.94	817.54	8302.01	6,787,223	**2477.34**
		Single	0	50	20.28	0.00	0.00	0	
		Total	**41**	**-**	-	**817.54**	**8302.01**	**6,787,223**	

ANNEXURE II

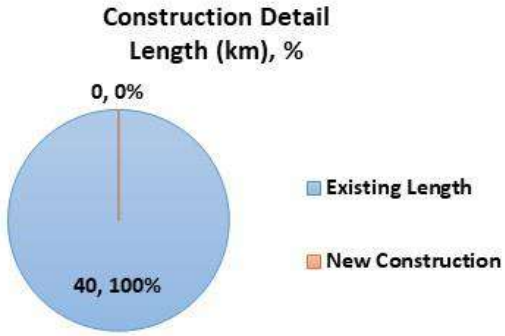
PROPOSED ROAD SCHEMES

1: Sahiwal Faislabad Road

Project Name	Dualization of Sahiwal Faisalabad Road from Sahiwal to M-3
Districts	Sahiwal
Phase	Short To Medium Term (2024-2030)
Total Cost (PKR Millions)	7945.45
Benefit Cost Ratio	4.4

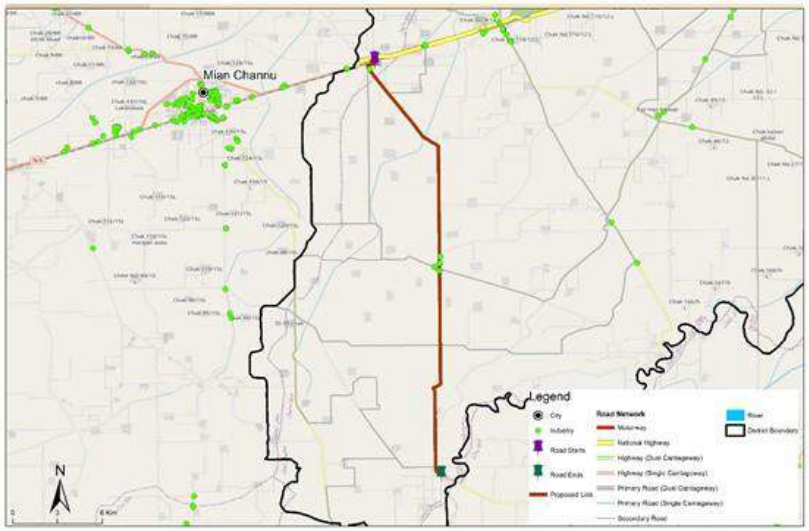


District	Industrial Produce	Agriculture Produce	Tourism Site
Sahiwal	Pharmaceuticals, Textile Spinning, Textile Weaving, Tobacco and Woolen Textile Spinning/Weaving	Wheat, Sugarcane, Maize and Cotton	Harrapa Museum, Sahiwal Coal Power plant. Zafar Ali stadium, Masjid-e-Shuhada



2: Burewala Road

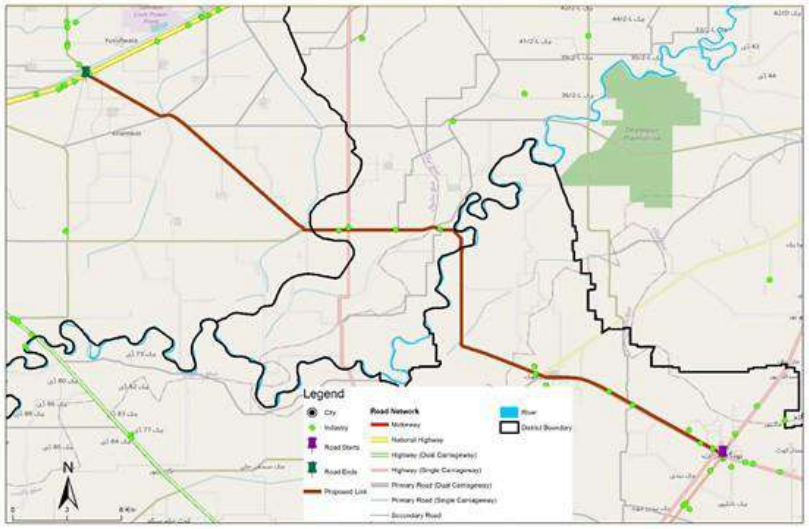
Project Name	Dualization of Burewala Road from Chichawatni to Kamand
Districts	Sahiwal
Phase	Short To Medium Term (Year 2024-2030)
Total Cost (PKR Millions)	5959.05
Benefit Cost Ratio	2.3



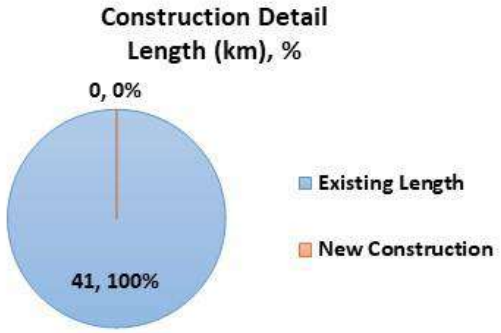
District	Industrial Produce	Agriculture Produce	Tourism Site
Sahiwal	Pharmaceuticals, Textile Spinning, Textile Weaving, Tobacco and Woolen Textile Spinning/Weaving	Wheat, Sugarcane, Maize and Cotton	Harrapa Museum, Sahiwal Coal Power plant. Zafar Ali stadium, Masjid-e-Shuhada

3: Sahiwal Bonga Hayat Road

Project Name	Widening of Sahiwal Bonga Hayat road from Bonga hayat to Yousaf wala sahiwal
Districts	Sahiwal
Phase	Medium to Long Term (Year 2030 – 2034)
Total Cost (PKR Millions)	8144.08
Benefit Cost Ratio	2.2

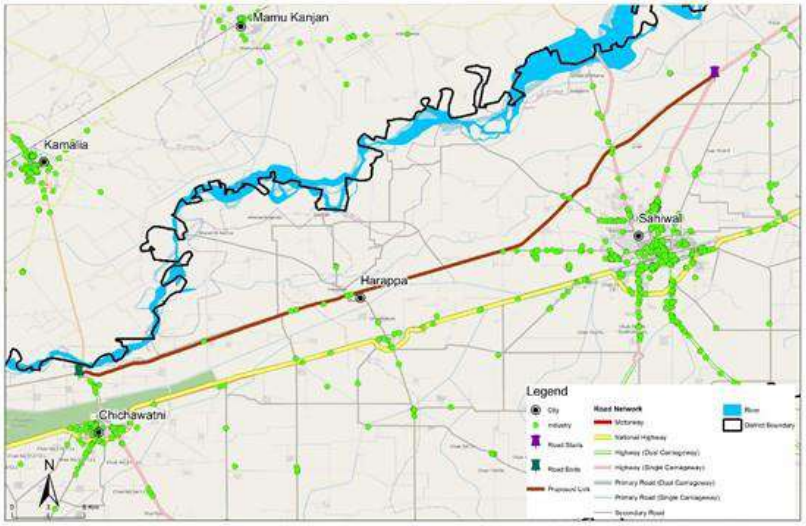


District	Industrial Produce	Agriculture Produce	Tourism Site
Sahiwal	Pharmaceuticals, Textile Spinning, Textile Weaving, Tobacco and Woolen Textile Spinning/Weaving	Wheat, Sugarcane, Maize and Cotton	Harrapa Museum, Sahiwal Coal Power plant. Zafar Ali stadium, Masjid-e-Shuhada

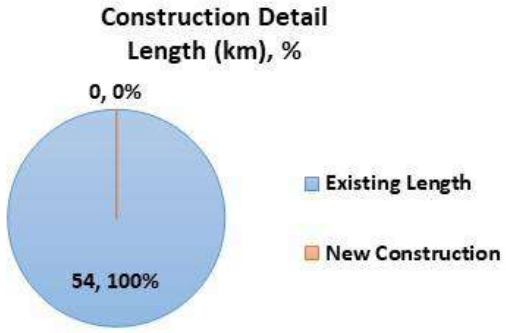


4: Chichawatni-Harapa Road

Project Name	Widening of Chichawatni Harapa Road
Districts	Sahiwal
Phase	Medium To Long Term (Year 2030 – 2034)
Total Cost (PKR Millions)	10627.04
Benefit Cost Ratio	1.3

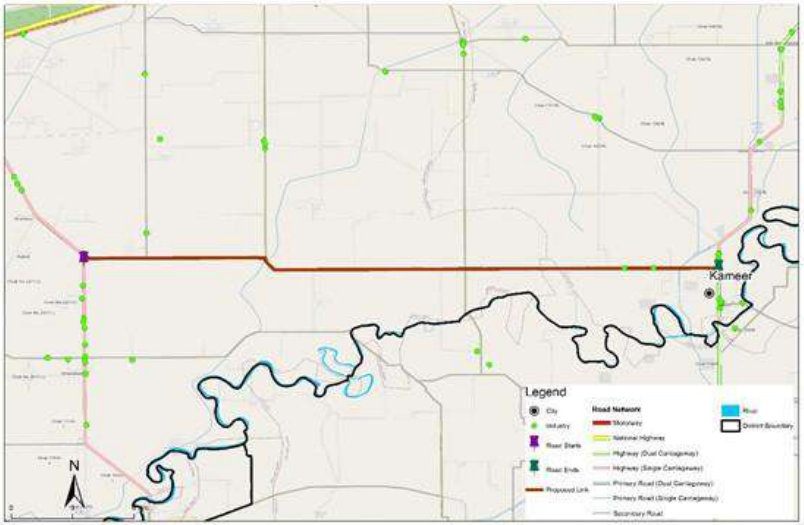


District	Industrial Produce	Agriculture Produce	Tourism Site
Sahiwal	Pharmaceuticals, Textile Spinning, Textile Weaving, Tobacco and Woolen Textile Spinning/Weaving	Wheat, Sugarcane, Maize and Cotton	Harrapa Museum, Sahiwal Coal Power plant. Zafar Ali stadium, Masjid-e-Shuhada

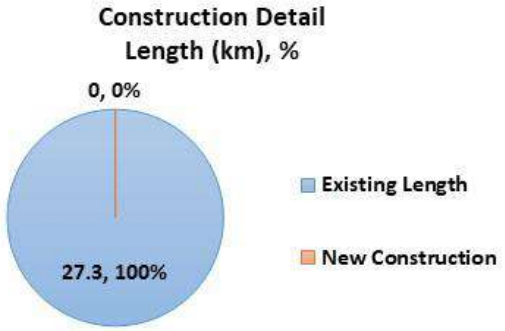


5: Kamir-Chichawatni Road

Project Name	Upgradation of Kamir Chichawatni Road
Districts	Sahiwal
Phase	Medium To Long Term (Year 2030 – 2034)
Total Cost (PKR Millions)	5422.77
Benefit Cost Ratio	1.4



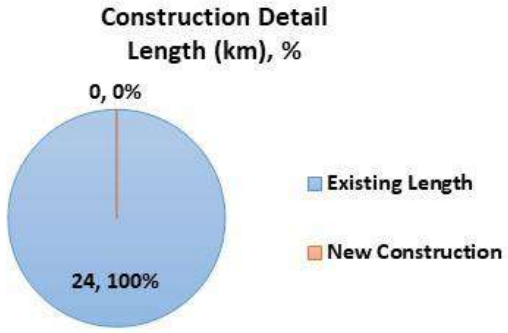
District	Industrial Produce	Agriculture Produce	Tourism Site
Sahiwal	Pharmaceuticals, Textile Spinning, Textile Weaving, Tobacco and Woolen Textile Spinning/Weaving	Wheat, Sugarcane, Maize and Cotton	Harrapa Museum, Sahiwal Coal Power plant. Zafar Ali stadium, Masjid-e-Shuhada



6: Okara-Depalpur Road

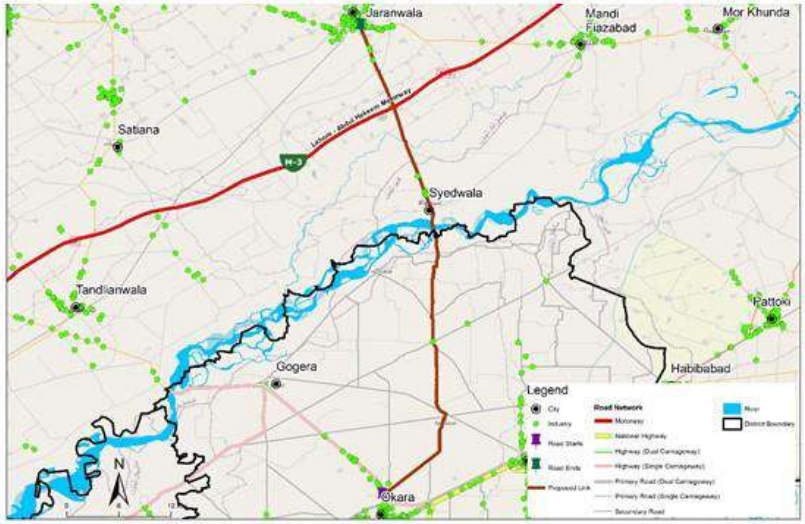
Project Name	Dualization of Okara Depalpur Road
Districts	Okara
Phase	Short To Medium Term (Year 2024 – 2030)
Total Cost (PKR Millions)	961.71
Benefit Cost Ratio	17.8

District	Industrial Produce	Agriculture Produce	Tourism Site
Okara	Ghee Mill, Brick Kilns, Flour Mills, Cold Storage	Wheat, cotton. Maize, rice, bajra and other crops	Bhoman shah. Goal Masjid, Mir Chakar-e-Azam Rind



7: Okara-Syedwala-Jarranwala Road

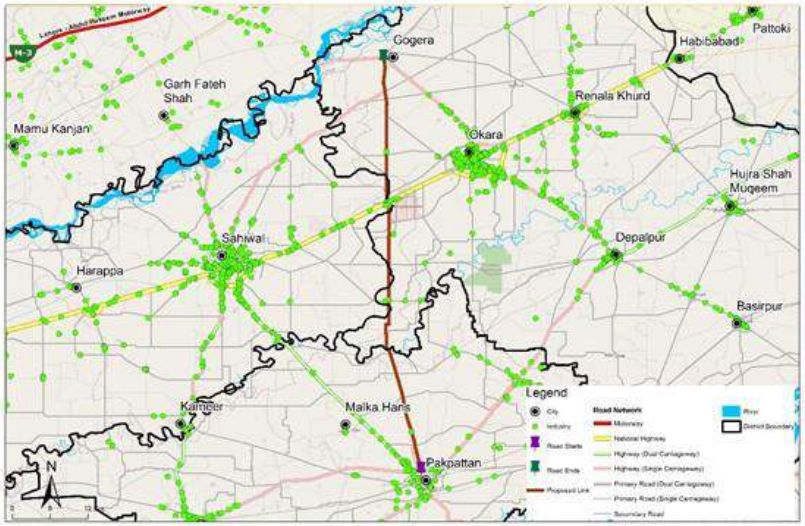
Project Name	Dualization of Okara-Syedwala-Jarranwala Road
Districts	Okara
Phase	Short To Medium Term (Year 2024 – 2030)
Total Cost (PKR Millions)	11719.53
Benefit Cost Ratio	2.1



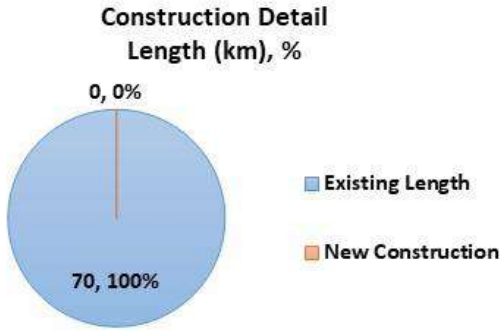
District	Industrial Produce	Agriculture Produce	Tourism Site
Okara	Ghee Mill, Brick Kilns, Flour Mills, Cold Storage	Wheat, cotton. Maize, rice, bajra and other crops	Bhoman shah. Goal Masjid, Mir Chakar-e-Azam Rind

8: Pakpattan Gamber Road

Project Name	Widening of Pakpattan Gamber Road from Pakpattan to Bangla Gogera
Districts	Okara
Phase	Short To Medium Term (Year 2024 – 2030)
Total Cost (PKR Millions)	13904.53
Benefit Cost Ratio	1.3

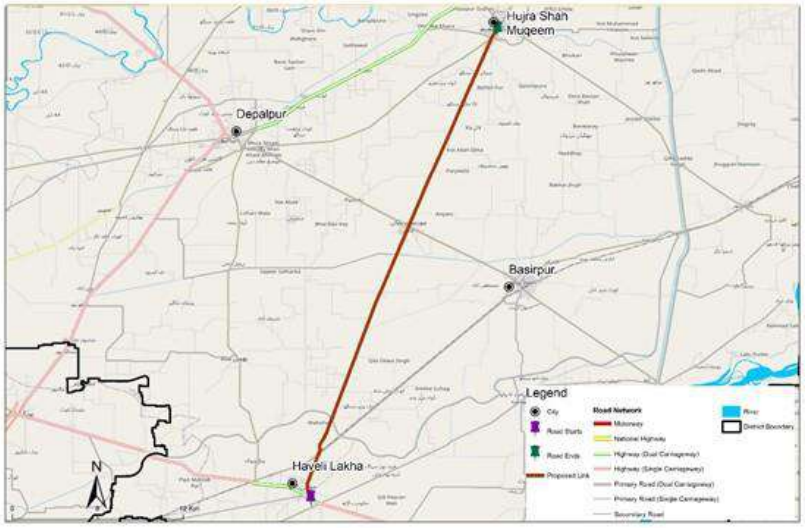


District	Industrial Produce	Agriculture Produce	Tourism Site
Okara	Ghee Mill, Brick Kilns, Flour Mills, Cold Storage	Wheat, cotton. Maize, rice, bajra and other crops	Bhoman shah. Goal Masjid, Mir Chakar-e-Azam Rind



9: Haveli Lakha Hujra Shah Road

Project Name	Dualization of Road from Haveli Lakha to Hujra Shah
Districts	Okara
Phase	Medium to Long Term (Year 2030 – 2034)
Total Cost (PKR Millions)	6952.27
Benefit Cost Ratio	4.3

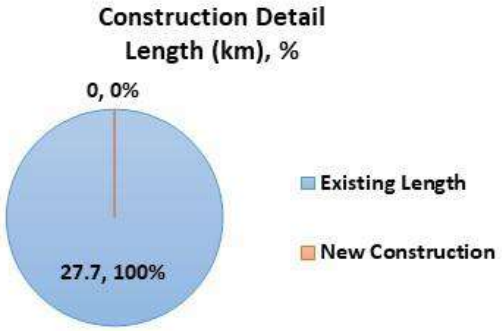


District	Industrial Produce	Agriculture Produce	Tourism Site
Okara	Ghee Mill, Brick Kilns, Flour Mills, Cold Storage	Wheat, cotton. Maize, rice, bajra and other crops	Bhoman shah. Goal Masjid, Mir Chakar-e-Azam Rind

10: Renala Khurd Shergarh Road

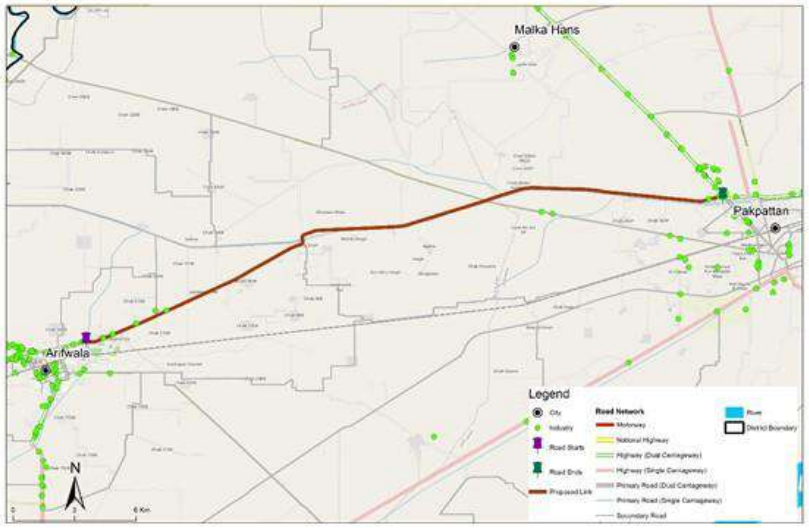
Project Name	Dualization of Road from Renala Khurd to Kot Shaukat
Districts	Okara
Phase	Medium to Long Term (Year 2030 – 2034)
Total Cost (PKR Millions)	5502.22
Benefit Cost Ratio	2.4

District	Industrial Produce	Agriculture Produce	Tourism Site
Okara	Ghee Mill, Brick Kilns, Flour Mills, Cold Storage	Wheat, cotton. Maize, rice, bajra and other crops	Bhoman shah. Goal Masjid, Mir Chakar-e-Azam Rind



11: Arifwala-Pakpattan Road

Project Name	Dualization of Arifwala Pakpattan Road
Districts	Pakpattan
Phase	Short To Medium Term (Year 2024 – 2030)
Total Cost PKR Millions	1162.07
Benefit Cost Ratio	10.0



District	Industrial Produce	Agriculture Produce	Tourism Site
Pakpattan	Textile, Poultry, Flour, Cold storage, seed processing	Sugarcane. Maize, wheat, rice, oilseeds and other crops	Shrine Hazrat Baba Farid R.A, Masjid Waris shah

12: Depalpur Road

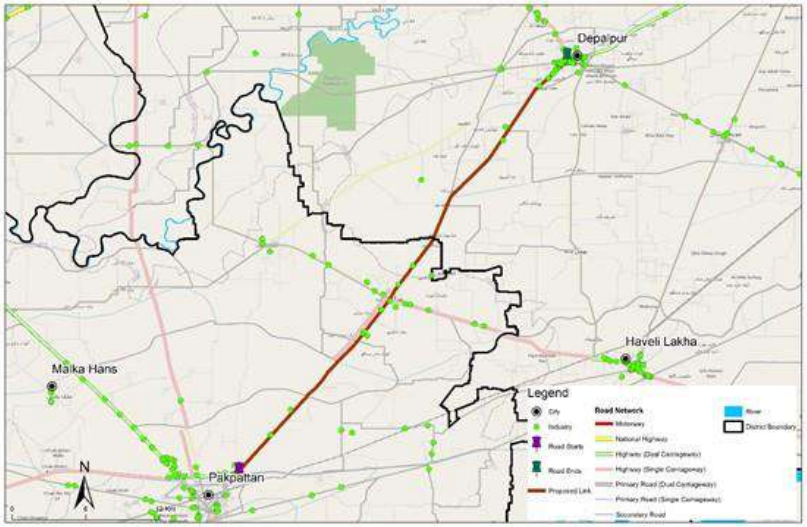
Project Name Dualization of Depalpur Road

Districts Pakpattan

Phase Short To Medium Term (Year 2024 - 2030)

Total Cost PKR Millions 1642.93

Benefit Cost Ratio 13.1



District	Industrial Produce	Agriculture Produce	Tourism Site
Pakpattan	Textile, Poultry, Flour, Cold storage, seed processing	Sugarcane. Maize, wheat, rice, oilseeds and other crops	Shrine Hazrat Baba Farid R.A, Masjid Waris shah

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Annexures