TRAFFIC ANALYSIS IN THE VICINITY OF PROPOSED PORT AT VADHAVAN

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Contents

1. Introduction

1.1 Overview

Jawaharlal Nehru Port (JNP) is one of the major ports, handling about 55% of the total containers demand in India. Mumbai port has constraint in the evacuation of cargo for the past several decades due to the city's development around it and due to the availability of limited depths in the harbour. JNP was developed to cope with the container demand in the region; it became the country's largest container port. JNP was commissioned in 1989, and in the year 2016-17, it handled about 4.5 million TEUs of container traffic since then. A major expansion plan of increasing container traffic to more than 10 million TEUs is currently being implemented. It is not easy to expand the capacity of JNPT beyond 10 to 11 million TEUs. Considering the future needs, it is necessary to facilitate a new major port in Mumbai region. Thus, a new port has been proposed to be developed at Vadhavan in Palaghar district. This is expected to boost port-led development that can strengthen the economic activities and contribute to the country's GDP.

Vadhavan is located in Dahanu taluka of Palghar district in the state of Maharashtra. Palghar district adjoins the southern border of Gujarat state. Thus, the proposed port can serve Maharashtra, Gujarat, Madya Pradesh and other neighbouring states. Since it may not be feasible to increase the capacity of JNPT further, any additional demand can be diverted to the proposed port. The proposed port could also be used as a gateway port for importing and exporting cargo for Tarapur industrial area in Maharashtra. The cargoes that are likely to be handled at Vadhavan port are steel rods, steel coils, scrap, etc. The traffic for the Vadhavan port is projected to be around 8.3 mnT in FY 2021-25, increasing to around 505.2 mnT in FY 2046-50 as per DPR prepared by ~~Rohal~~ Haskoning DHV. The development of such a mega project is expected to stimulate developments in the neighbourhood. Thus, it is essential to analyze the traffic impact and assess the adequacy of the existing road network to cater the future demand. This study aims to understand the transportation connectivity of the Vadhavan port for truck movement and map the existing road and rail network in the region area using an appropriate simulation tool and perform congestion analysis for more future scenarios to suggest strategies to reduce congestion.

1.2 Container traffic in India

Total cargo traffic handled at Indian ports during 2001-02 was 287.565 Million Tonnes which became 581.344 Million Tonnes in 2014-15. Containerized traffic handled at the major Indian ports during 2014-15 was 119.443 Million Tonnes, which was 37.229 Million Tonnes during 2001-02. Rapidly ascending international trade is developing pressure on the Indian ports. Country's 12 public port trusts cumulatively handled 8.2 Million TEUs during 2015-16, compared to 7.96 Million TEUs in the fiscal year 2014-15. Also, containerized tonnage was 3 percent to 123 Million Tonnes. Container traffic in India has increased at a compounded annual growth rate (CAGR) of 11.5% over the last 15 years from 2.4 MTEUs in FY2001-02 to 12.5 MTEUs in FY2015-16.

Around 58% of container cargo is handled by the ports on the west coast of India. These ports serve the states of Punjab, Haryana, Uttar Pradesh, Delhi, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, and parts of Andhra Pradesh and Karnataka. The import of container traffic movement is mainly influenced by the shipping lines while the export container traffic movement is influenced by the freight forwarders.

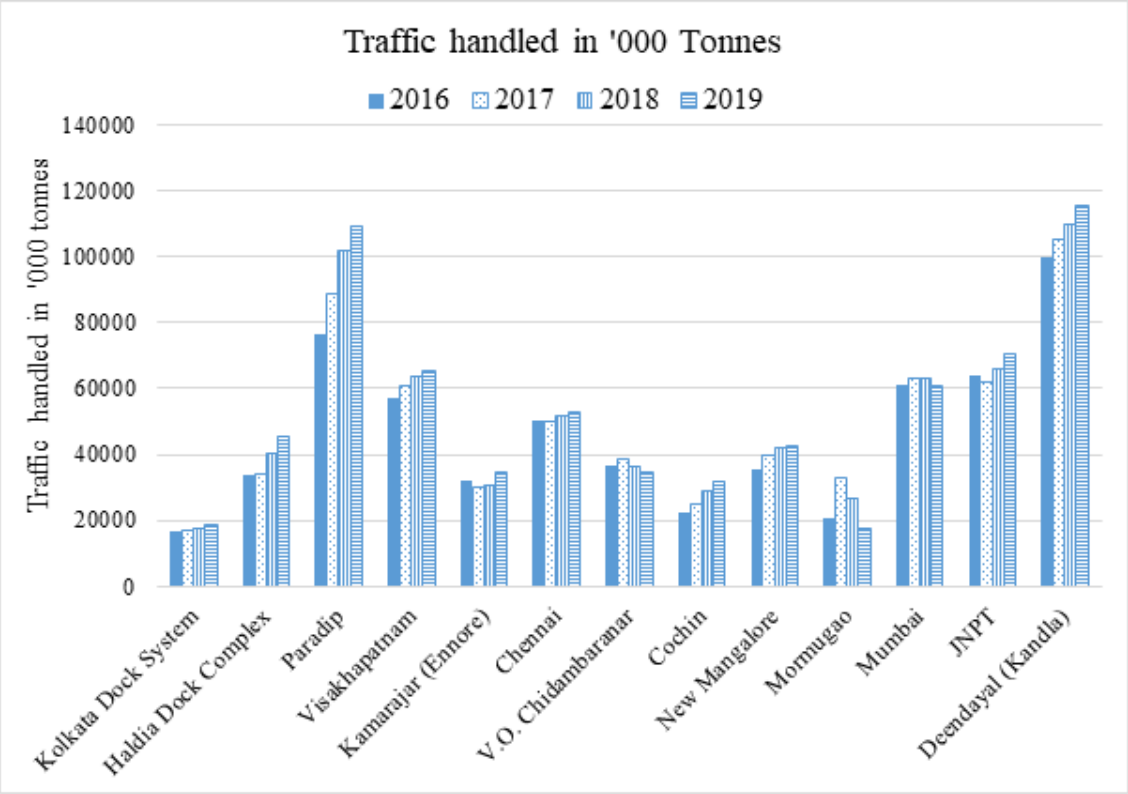

Figure 1.1 Traffic handled at Major Ports of India from 2016 to 2019

Figure 1.1 reveals mostly increase in traffic on major port from 2016 to 2019, and when total cargo handled by JNP increased from 64.02 to 70.70 Million Tonnes. However, the increase in demand is slow in JNP as compared to some of the other major port such as Paradip, Deendayal, Visakhapatnam, and Haldia dock. The previously growth recorded from 2014-15 to 2015-16 was 4.47 to 4.49 Million TEUs (0.5% increase), whereas it was 6,30,000 TEUs to 6,62,000 TEUs (5%) for Kolkata port, 5,60,000 TEUs to 6,12,000 TEUs (9%) for Tuticorin port, 3,66,000 TEUs to 4,21,000 TEUs (15%) for Cochin port and 2,48,000 TEUs to 2,93,000 TEUs (18%) for Visakhapatnam port. These numbers suggest an increase in demand at major ports in India.

1.3 Objectives and scope

The objectives of this project are listed below:

1. Understand current road traffic levels in the vicinity of the proposed port
2. Map the existing road network and proposed roads in the vicinity of the proposed port using an appropriate simulation tool.
3. Develop a simulated network showing port and non-port surface traffic for the year 2023 and perform congestion analysis.
4. Perform congestion analysis for additional future scenarios for the years 2028, 2033, 2038,2043 and 2048 using simulation
5. Identify the future bottlenecks in the neighbourhood area and propose appropriate measures taking inputs from JNPT officials

1.4 Organization of the report

This report is divided into seven chapters, including this chapter which introduces the proposed Vadhavan port and lists the objectives of the study. Chapter 2 discussed the transportation network in the vicinity of the proposed port. The road inventory and field travel speed results are presented in chapter 3. Traffic analysis based on traffic count survey and v/c ratio analysis is discussed in Chapter 4. Chapter 5 presents traffic simulation for a do-nothing scenario. The proposed improvements are presented in Chapter 6, and Chapter 7 concludes the study.

2. Transportation network connectivity

2.1 General

Vadhavan is located in Dahanu taluka of Palghar district in the state of Maharashtra. Vadhavan port is planned to be constructed on reclaimed land on the intertidal zone at Vadhavan Point as per the pre-feasibility study, which was further affirmed in the DPR prepared by Royal Haskoning DHV. Figure 2.1 shows the location of Vadhavan port with reference to JNP and Mumbai Port.

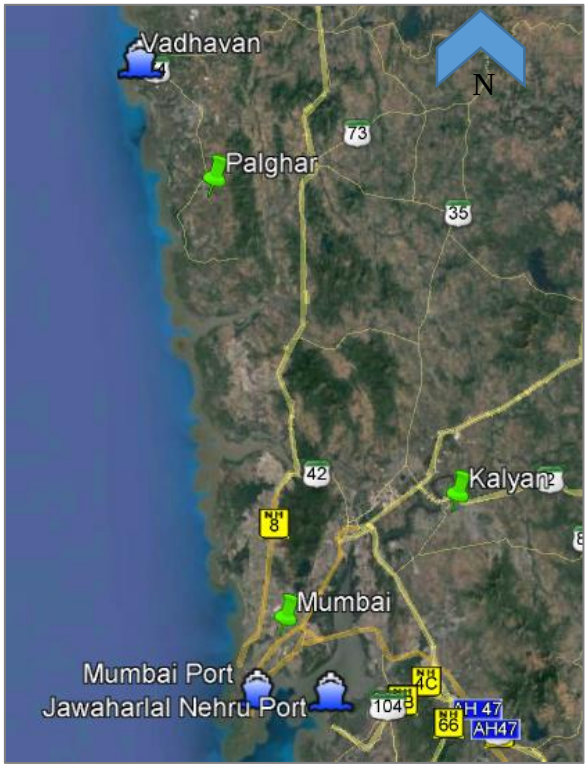

Figure 2.1 Vadhavan Location with reference to JNP & Mumbai Port

The population of Dahanu taluka is 4,02,095 as per 2011 census. The increase in decadal population from 2001-2011 is 18.1% in Dahanu taluka as per 2011 census. Dahanu is a coastal town and a municipal council in Palghar district of Maharashtra state. The population of Dahanu town is 50,287 as per the 2011 census, with an increase in decadal population from 2001-2011 is 13.26%. Dahanu tehsil is divided into 174 villages, 84 gram panchayats and Dahanu municipal council. It is observed that from towns/villages with a population greater than 3000 depicted in Figure 2.2, the Dahanu town has a significant conglomeration of population and forms the most populated town in the study area, which is located on one of the

major roads (Dahanu to Ashagad link). The other populated towns or settlements in the area are Chinchani, Vangaon, Tarapur, Dhakti Dahanu, Charoti, Ashagad, Agwan, BhisenagarDehane and Vanai in the descending order of population. The relatively high urban sprawl in Dahanu and Chinchani adds to the traffic and possible future congestion in the road sections towards Ashagad as well as towards Badepokharan and Vadhavan, the proposed location for the port. Vadhavan is a coastal village, and as per the Census of India 2011, it has a total population of 1278 from 296 households.

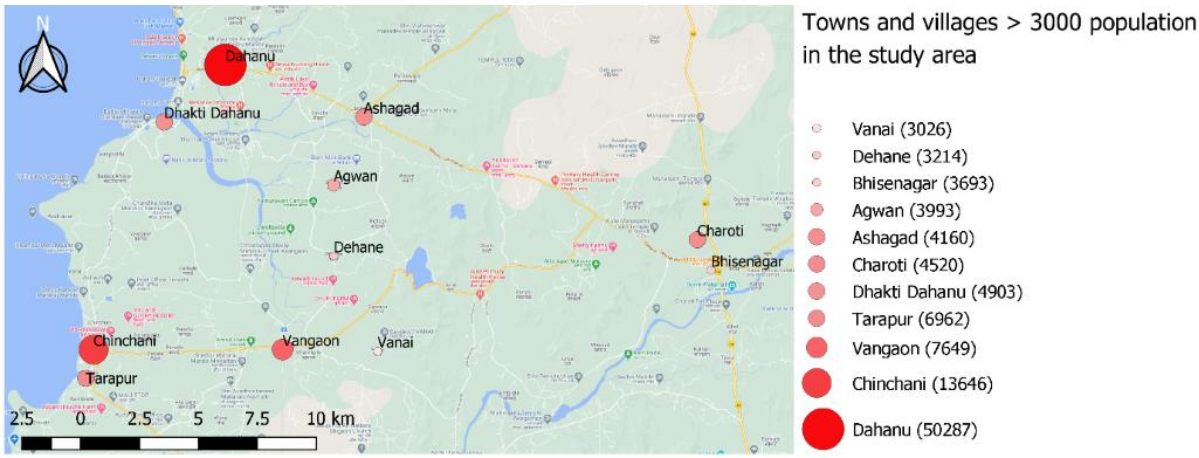

Figure 2.2 Towns/villages with population>3000 in the study area

Palghar is the 36th district of Maharashtra. Palghar district's total population as per the 2011 census is 29,95,428. The district has a total of 8 talukas: Jawhar, Mokhada, Talasari, Vasai, Vikramgad, Palghar, Dahanu and Wada. Palghar district has 4,69,699 hectares of the total geographical area, total 1007 villages, 467 gram panchayats. The district has developed one Maharashtra Industrial Development Corporation (MIDC), three Government Cooperative industrial colonies, 5757 small registered Industries, 1883 temporary small registered industries and 427 large/medium industries (*Industrial Information | District Palghar, Government of Maharashtra | India*, no date). The vehicle ownership per 1000 population in Palghar district is 85 in the year 2016.

2.2 Road connectivity to the proposed port site

Vadhavan port area is situated approximately 34 km from NH 8, newly named as NH 48, which is a 4-lane national highway connecting Mumbai and Delhi. NH48 is a part of the Golden Quadrilateral and is a key connector to the port. MSH 4 or the coastal highway, between Dahanu and Chinchani forms an important component of north-south connectivity in the

vicinity of the port. Dahanu and Chinchani in the north and south side of the port respectively are well connected by roads. Dahanu- Bordi coastal highway and Jawahar- Dahanu road, also known as SH 30 being the major roads meeting MSH4 at Dahanu. SH 30 is a 2-lane highway situated in the northern side of the port which connects the MSH 4 to NH 48 at Kasa junction. This state highway passes through the municipal council area of Dahanu. Major roads conveying the traffic from Chinchani are the Chinchani- Vangaon road, also known as SH 31 and Boisar road via Tarapur. The SH 31 is a 2-lane road that connects to NH 48 at Kasa junction after joining SH 30 in Ganjad junction. The latter road through Boisar passes through habitation and is further connected to Palghar and NH 48.

Figure 2.3 Roads connecting in the vicinity of the proposed road

The other roads in the region with reasonable traffic and can form alternate routes from port to NH48 include Badapokharan- Vangaon road, Kambhale- Dehane –Savata road and Kambhale-Dehane- Ashagad road. Figure 2.3 shows the roads in port vicinity, including those that constitute the last mile port location connectivity from MSH 4, like Vadhavan road. Most of the other village roads shown in Figure 2.4 are single lane unpaved roads.

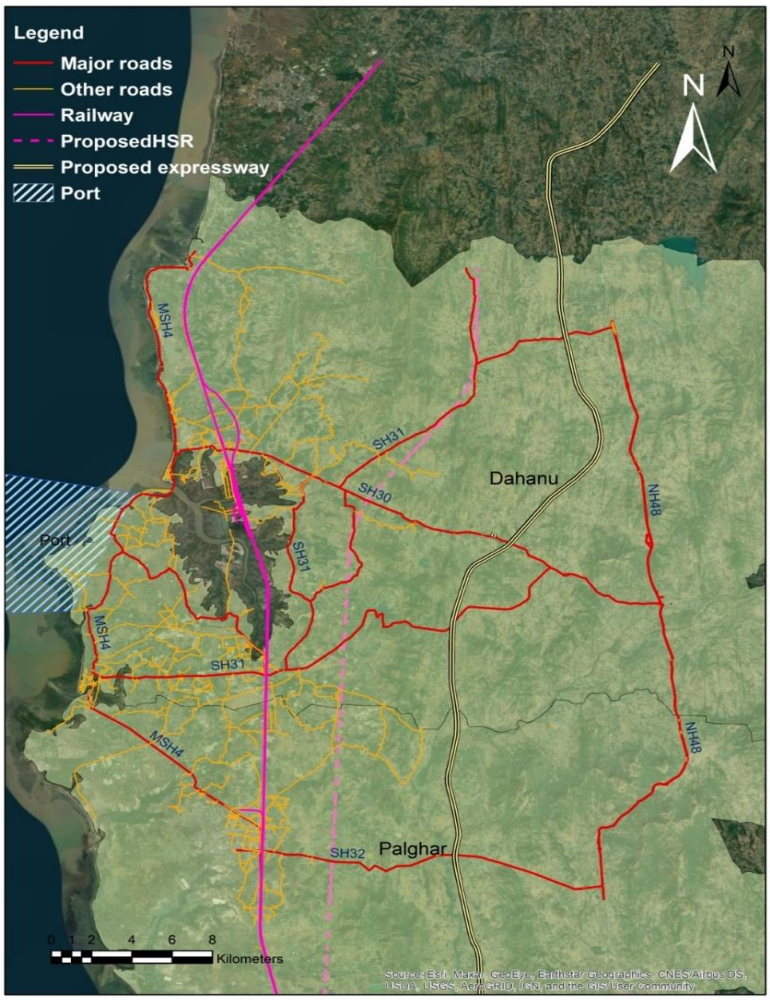

Figure 2.4 Existing and proposed major transportation network in the region

2.3 Rail connectivity

The landside connectivity to port by road and the rail are mapped using ArcGIS with satellite imagery superimposed as a base map to relate to the actual site conditions. Figure 2.4 presents road network and railway lines in the study area with each category data stored in separate layers. The western railway mainline connecting Mumbai and Delhi is approximately 10 km from the proposed port site. The nearest railway stations are Dahanu road and Vangaon which are about 12 km from Vadhavan.

2.4 Study network for traffic analysis

The road network considered in the study area for traffic analysis is depicted in Figure 2.5. This is also the network used for simulating. The major roads included are as follows:

- Coastal highway or MSH 4 between Dahanu and Chinchani
- Dahanu- Jawahar road or SH 30 from Dahanu to Kasa joining MSH4 to NH 48
- Chinchani- Vangaon road or SH 31
- Badepokharan- Vangaon road
- Kambhale- Dehane –Sarvali road
- Kambhale- Dehane- Ashagad road.

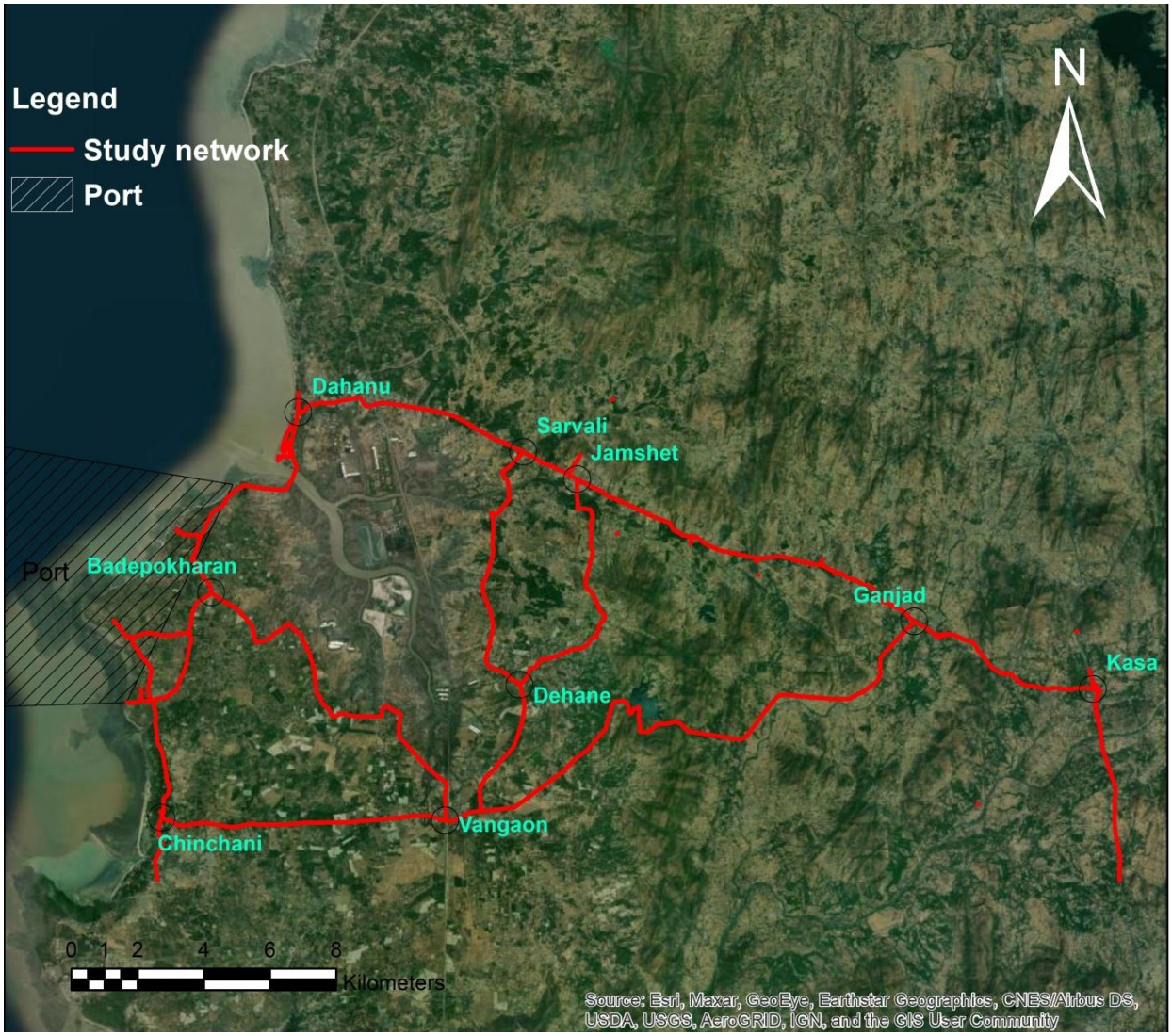

Figure 2.5 Road network considered in the study

2.5 Future rail and road networks

The proposed greenfield road alignment to carry port traffic directly to NH 48, takes off from port area in Vadhavan and joins NH at Tawa village. The new road is being planned as an 8-lane highway. Western railway mainline is proposed to be linked to the port through a new dedicated freight corridor to the port, taking off at Newale village, parallel to the greenfield road alignment, with a station yard also proposed at the junction. (See Figure 2.6)

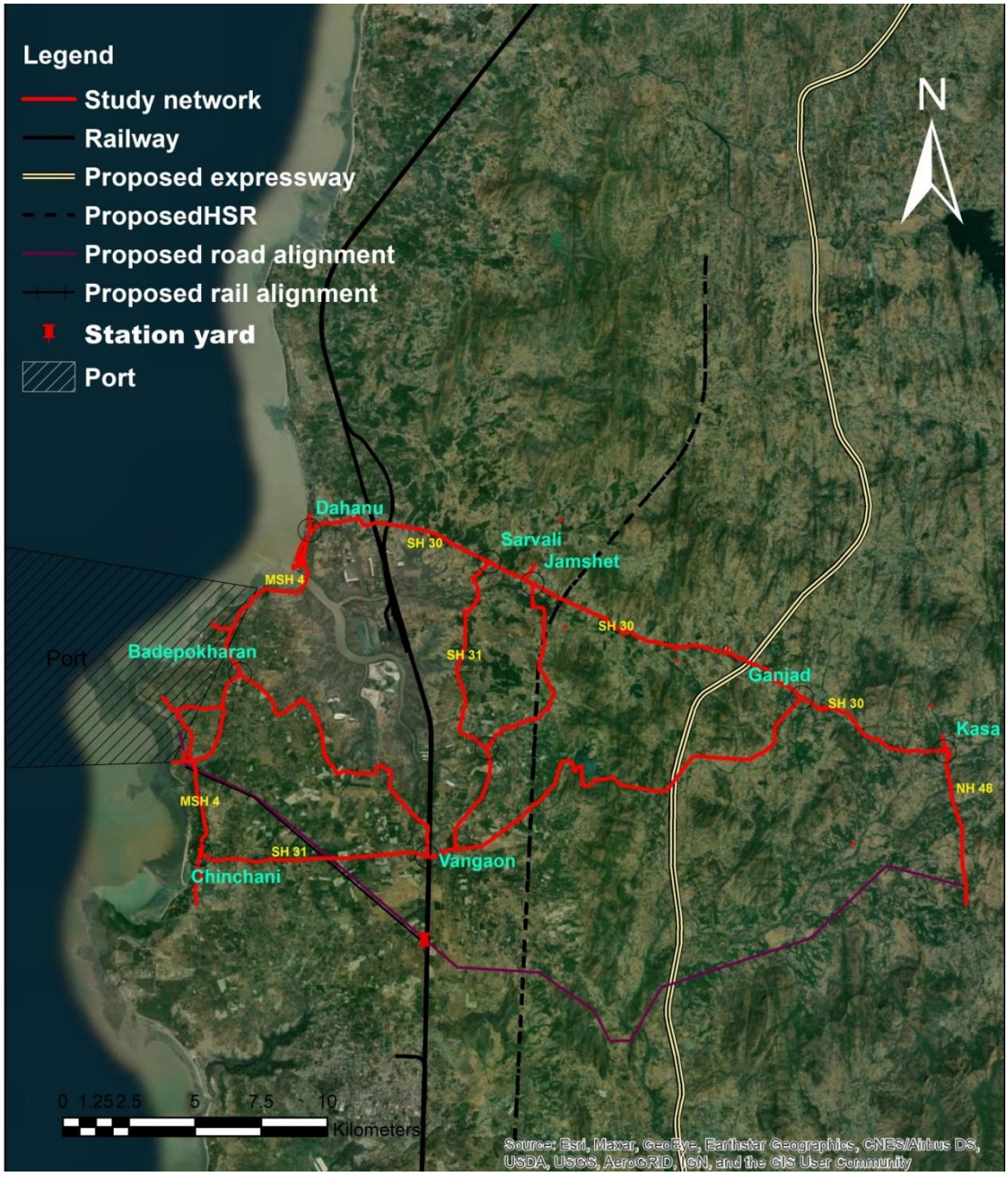

Figure 2.6 Proposed road alignment for the Vadhavan port

The study area is also set to witness large transportation infrastructural development with a few projects already in the pipeline. The high-speed railway line between Mumbai and Ahmedabad passes through the study area and the nearest proposed station is at Boisar which is 20 km from Vadhavan. The western dedicated freight corridor connecting Delhi and Mumbai is aligned parallel to existing western railway mainline and is expected to be completed in 2022. The access-controlled 8 lane Mumbai- Vadodara expressway which is under construction, also falls in the study area approximately 22 km from the port and is expected to be completed in 2022. This expressway lies within the Delhi Mumbai Industrial corridor which is being planned as hub of industrial and urban activity. When completed, the expressway can serve the travel demand from textile industries, gems and jewellery, petrochemical & fertilizer and other industrial complexes that have been established along this corridor. The corridor is also bound to serve the JNPT port in Mumbai and the proposed port in Vadhavan.

As per the feasibility report for the development of Vadodara Mumbai Expressway (Phase-II) from km.26.320 to km.104.700 (km.390.864 of NH-8) of Main Expressway in the state of Maharashtra (NHAI, 2016), the highway has 2 crossings planned in the study area. One is a diamond interchange across the Dahanu-Jawahar road (SH30) to cater for the traffic to and from the Surat side at chainage 78. 650. Mumbai-Vadodara Expressway also crosses the proposed freight expressway from the port at chainage 66.350 near Chinchare village. (Figure 2.7)

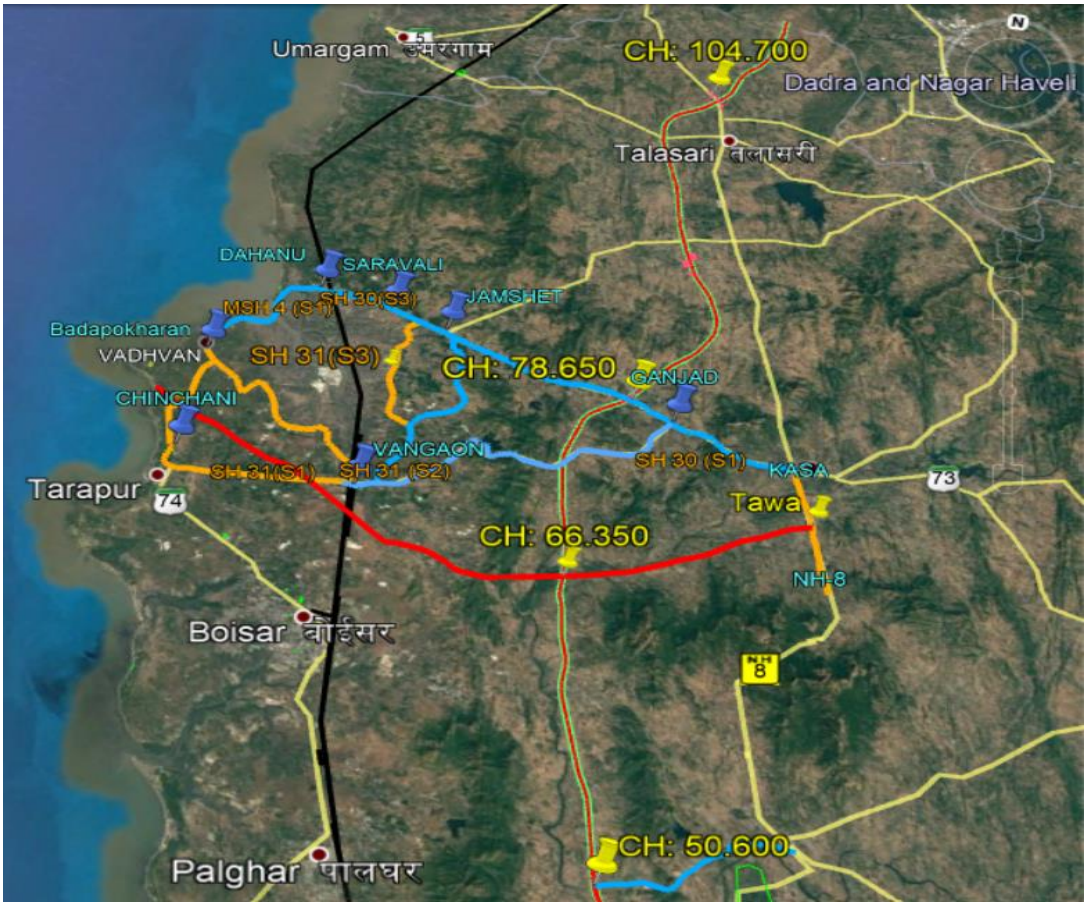

Figure 2.7 Connectivity of Vadodara Mumbai Expressway in the study area

The sectional AADT (2021) in the expressway within the study area provided by the consultant is given in Table 2.1. The relevant drawing at CH:78.650 is also provided. (Figure 2.8)

Table 2.1 Sectional AADT (pcu/day) on the expressway in the study area

Stretch		Car	LGV	Bus & Mini Bus	2-Axle Truck	3-Axle Truck	MAV	Container	Total
From	To								
26+320	78+650	7,374	3,150	828	4,227	4,649	1,982	3,072	**25,282**

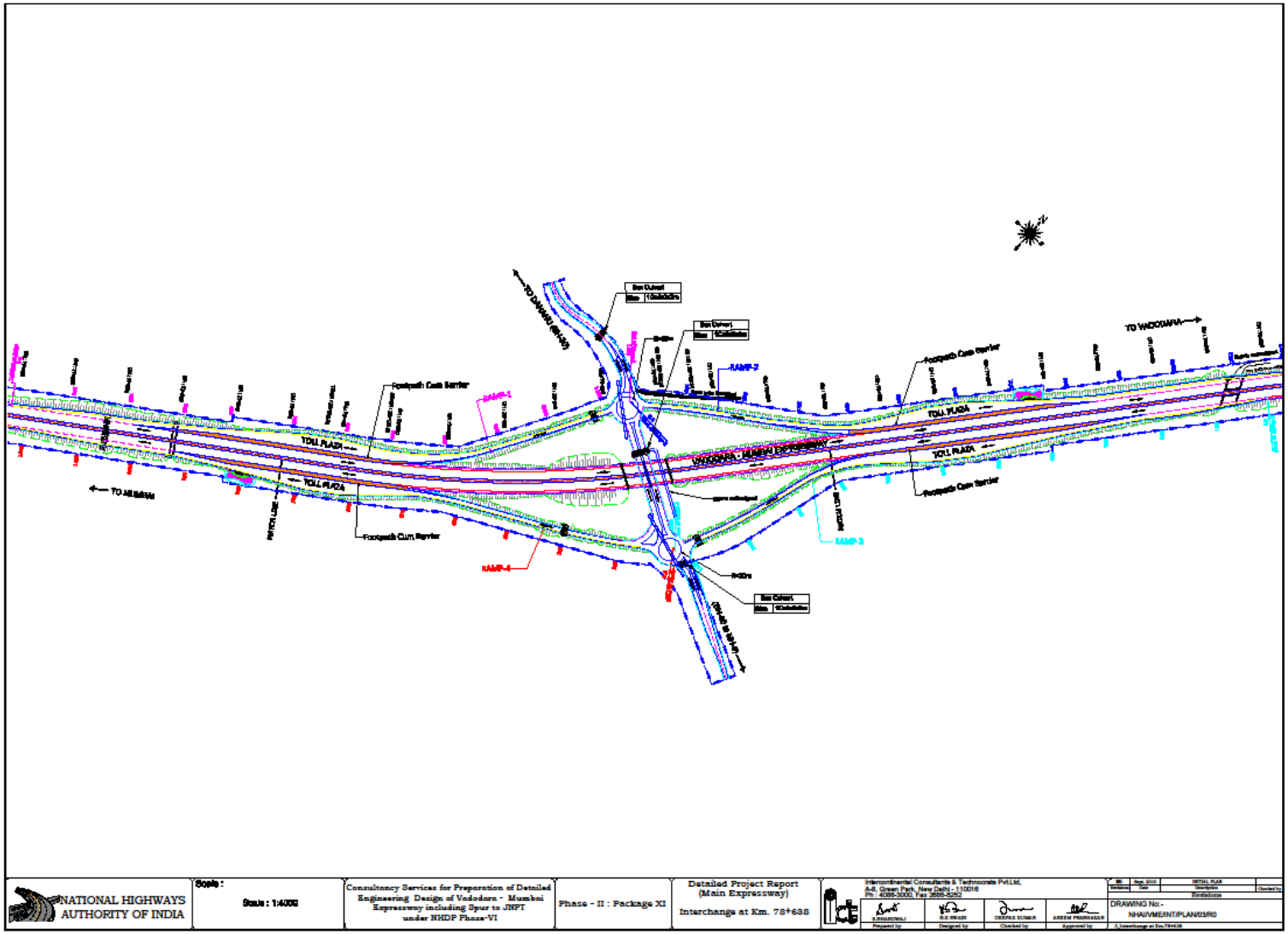

Figure 2.8 Plan at chainage 78+650 where Vadodara Mumbai expressway crosses SH 30 (Dahanu Jawahar road)

3. Road inventory and travel speed

3.1 General

The field data collected for the study include 1) Road inventory, 2) traffic volumes, 3) link speed. All these data are collected on the study road network shown in Figure 2.5. The road inventory and speed study were conducted by IIT Bombay staff. The location presented in Table 3.1 acted as the reference point while collecting road inventory data by the surveyor in the study area.

Table 3.1 Coordinates of important locations

Sr. No.	Location	Latitude	Longitude
1	Kasa, NH 48	19° 54’ 36.3’’ N	72° 56’ 24.6’’ E
2	Dahanu	19° 59’ 16.6’’ N	72° 43’ 33.1’’ E
3	Badepokharan	19° 56’ 13.5’’ N	72° 41’ 57.1’’ E
4	Vangaon	19° 52’ 30.3’’ N	72° 45’ 45.7’’ E
5	Chinchani	19° 52’ 33.6’’ N	72° 41’ 08.6’’ E
6	Khambale	19° 52’ 39.7’’ N	72° 46’ 21.1’’ E
7	Dehane	19° 54’ 43.2’’ N	72° 46’ 58.5’’ E
8	Sarvali	19° 58’ 30.8 ‘’ N	72° 47’ 02.2’’ E
9	Jamshet	19° 58’ 04.4’’ N	72° 47’ 55.2’’ E
10	Gunjad	19° 55’ 45.3’’ N	72° 53’ 24.4’’ E

3.2 Road inventory

The study road network was travelled in a car to perform road inventory. V-Box was installed in a vehicle that gives GPS location along the route of travel. V-Box comes with cameras that can be fitted outside the vehicle to record video as the vehicle travels. The number of lanes and road widths were noted along with all links in the study network. Figure 3.1 shows the number of lanes for the road network in the study area. Primary roads are two-lane wide, but some roads are one and a half lane wide. A detailed section-wise description is given below.

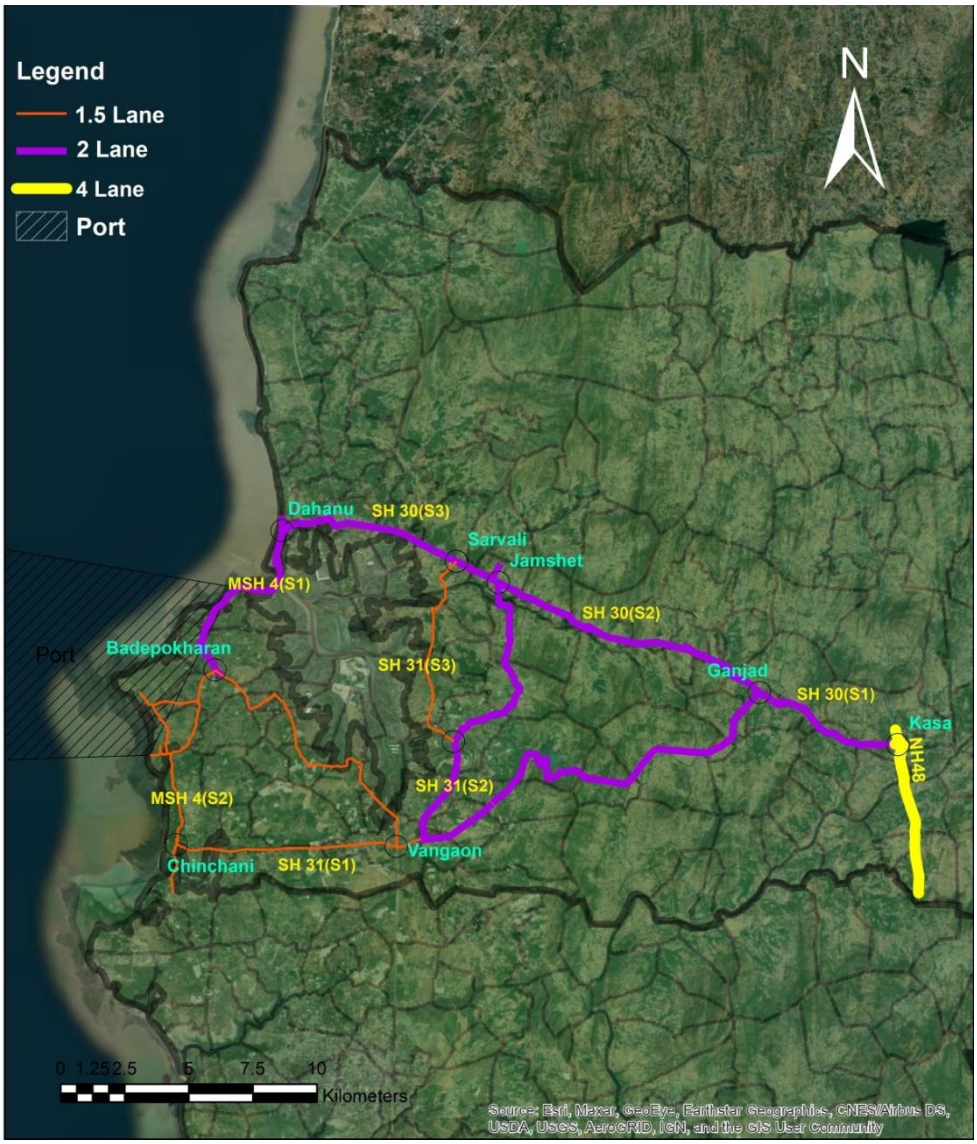

Figure 3.1 Study network with classification based on road width

3.2.1 SH 30 (Dahanu- Jawahar road)

SH30 or Dahanu- Jawahar road is a 2-lane road and is the busiest section in the network. The pavement surface condition of the road is fair with 5 m to 7 m width (varying at separate places), with shoulder provisions on either side of the road. There are signs of pavement distresses at regular intervals on road edges. At intersections, there is encroachment by the street vendors, with the absence of a clear pathway for pedestrians and the absence of zebra crossings. The shared autos/tum-tums/taxis hinder the freeway movement of vehicles at intersections and marketplaces. Ashagad near Jamshet, and Ganjad are two important intersections in SH 30 between Dahanu and Kasa. A couple of diversions are observed due to road repair and maintenance works. The chowk (roundabout) before reaching the Dahanu point

(700 meters from point), is an u19nsignalized intersection, 2-lane divided road with a width of 10-11m.

Figure 3.2 Tilak Chowk (roundabout) in SH 30 in Dahanu

3.2.2 MSH 4 (Coastal highway between Dahanu- Badepokharan -Chinchani)

Section MSH 4(S1)

The pavement surface conditions of the road are fair with 4 m to 6 m width (varying at separate places); it is a 2-lane road with shoulder provisions on either side of the road for approximately 70 percent of the section (see Figure 3.3). There are signs of pavement distresses at regular intervals on road edges. The 280 m long Dahanu Khadi bridge connecting Dahanu and Dakati Dahanu also belong to this section.

Section MSH 4(S2)

The pavement surface conditions of the road are fair with 3 m to 5 m width (varying at separate places). The road width is considerably reduced due to encroachment on either side near areas of increased build-up with auto/taxis parked on the street. There are signs of pavement distresses at regular intervals on road edges. Roads diverging from this section connect Vadhavan, the proposed port location.

Figure 3.3 Narrow roads and diversions in road section of MSH 4

3.2.3 SH 31 (Chinchani-Modgaon-Udhawa road)

Section SH 31 (S1)

The Chinchani- Vangaon section of SH 31 has 4m to 5m width (varying at places), with shoulder provisions on either side of the road (see Figure 3.4). There are signs of pavement distresses at regular intervals on road edges. There are many diversions due to road repair and maintenance works. The presence of a railway crossing hinders the free movement of vehicles at Vangaon. The stoppage time due to the railway crossing (manned and gated) ranges from 10 to 15 min, and it is very frequent due to the high rail traffic on the Western mainline. At the crossing, there is encroachment by the street vendors, with the absence of a clear pathway for pedestrians and absence of zebra crossings. At the section before crossing, the shared autos/tum-tums/taxis hinder the freeway movement of vehicles.

Figure 3.4 SH 31, Chinchani- Vangaon section of road in deteriorated condition

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Figure 3.5 Vehicles at Chinchani naka going towards Vangaon

Section SH 31 (S2)

The pavement surface conditions of the Vangaon-Dehane road have deteriorated with 5 m to 6 m width (varying at separate places), it is a 2-lane road with shoulder provisions on either side of the road. There are potholes and signs of pavement distress at regular intervals on this stretch of the road.

Section SH 31 (S3)

Section SH 31(S3) constitutes the Dehane-Sarvali section of SH31, and the pavement surface conditions of the road are fair with 3 m to 4.5 m width (varying at separate places). It is an

intermediate lane road with shoulder provisions on either side of the road. There are signs of pavement distresses at regular intervals on road edges.

Figure 3.6 Dehane- Sarvali section joining SH 30 near Ashagad

3.2.4 Other roads

Badepokharan-Vangaon road

The pavement surface conditions of the road are fair with 4 m to 5.5 m width (varying at separate places); it is an intermediate lane road with shoulder provisions on either side of the road for most of the section. There are signs of pavement distresses at regular intervals on road edges. The pavement width comes down to 2 m at some stretches of the road, and in some stretches, shoulder provisions are minimal. This road predominantly passes through rural areas with less build-up.

Figure 3.7 Very narrow road in Badepokharan- Vangaon section

Vangaon-Ganjad road

This road section's pavement surface conditions, which links SH30 at Vangaon to SH31 at Ganjad, is fair with 5 m to 7 m width (varying at separate places). It is a two-lane road with adequate shoulder provisions on either side of the road. There are signs of pavement distresses at regular intervals on road edges. A couple of diversions are observed due to road repair and maintenance works. These stretches of road encompass a ghat section with lots of curves and turns; however, there are no clear instructions or warnings to the road user of the upcoming road topography (see Figure 3.8).

Figure 3.8 Ghat section in section Vangaon-Gunjad

3.3 Speed studies in the network

Travel time and speed characteristics of the roads in the network were obtained using Google maps, during peak as well as non-peak hours on multiple days to understand the variations. Speeds were also obtained with the help of V-box installed in a vehicle. The study was conducted during evening and morning peak hours on 16 December 2020 and 17 December 2020. Section-wise speed characteristics indicate that the overall study network belongs to the low traffic volume category with average speeds in the range of 30 kmph to 55 kmph except at certain bottlenecks (see Figure 3.15).

3.3.1 Speed measurement using V-Box

SH 30 (Dahanu- Jawahar road)

SH30 or Dahanu- Jawahar road is a 2-lane road. The average speed over the entire section of 24.98 km was measured during the evening peak hour as 38.78 kmph and morning peak hour as 40.20 kmph. Speeds fall in range of 40 kmph to 55 kmph along the road while passing through village areas while the instantaneous speeds fall under 25 kmph while passing through the town of Dahanu. Average speed in section SH 30 (S1) and SH 30 (S2) were recorded as 42.13 kmph and 48.74 kmph respectively while that at section SH 30 (S3) passing through Dahanu is 28.45 kmph (Figure 3.15).

Figure 3.9 Dahanu- Jawahar road, SH 30

MSH 4 (Coastal highway between Dahanu- Badepokharan -Chinchani)

Section MSH 4(S1)

Average speed in 7.988 km section MSH 4(S1) in the coastal highway between Dahanu and Chinchani were computed from V-box data as 37.20 kmph (see Figure 3.15). Although the road width ranges only between 4-5 m along major portions of the section, less vehicular traffic enables unhindered flow in selected regions with speeds above 50 kmph occasionally.

Figure 3.10 Less traffic in section MSH4(S1)

Section MSH 4(S2)

The Badepokharan-Chinchani section of MSH4 or coastal highway is expected to carry the port traffic south of Vadhavan and has an average speed of 41.90 kmph (Figure 3.15). The repair and maintenance work at some places increase the travel time in the section.

Figure 3.11 Narrow coastal road section with diversions

SH 31 (Chinchani-Modgaon-Udhawa road)

Section SH 31(S1)

The average speed over the entire section is recorded as 30.63 kmph during peak hour survey using V-box (see Figure 3.15). Lower travel speeds are witnessed in Chinchani, at the junction joining SH 31. Instantaneous speeds more than 45 kmph were recorded in some stretches with less traffic along the section before reaching Vangaon. The presence of Western mainline railway crossing and encroachment on roads by street vendors hinder free traffic movement in Vangaon to Kambhale section.

Figure 3.12 Railway crossing at Vangaon. This is a bottleneck causing 10 to 15 minutes delay frequently and demands attention

Section SH 31(S2)

This short stretch from Kambhale to Dehane is traversed with an average speed of 33.79 kmph (see Figure 3.15).

Section SH 31(S3)

Travel speeds consistently crossed 40 kmph in the section of SH 31 from Dehane to Saravali in SH 30, with average speed over the entire section recorded at 37.04 kmph (see Figure 3.15). The traffic in the section is less but the deteriorated road conditions result in lower speeds than expected.

Figure 3.13 Deteriorated roads of section of SH 31 between Dehane and Dahanu-Jawahar road

Other roads

Badepokharan-Vangaon road

Average speed measured in this stretch is 32.84 kmph (see Figure 3.15). This road caters mainly for rural traffic as well as for vehicles by-passing Chinchani and Tarapur to Vangaon from

Badepokharan. Intermediate lane width and encroachment at certain sections reduce average travel speeds.

Jamshet- Dehane road

The 2-lane road section from point near Jamshet in SH 30 to Dehane carries very less traffic. The fair road conditions also favour quicker traffic movement with average speed for the 8.4 km section recorded as 49.34 kmph (see Figure 3.15). This road composes an alternate route from Dahanu-Jawahar road to Dehane and further to Vangaon.

Figure 3.14 Less traffic on the road favouring lesser travel time in section

Vangaon-Ganjad road

This section which links Vangaon to SH 30 and further onto the NH 48 via Ganjad, is a 2-lane road with average travel speed of 51.20 kmph during morning peak hour (see Figure 3.15). Owing to less traffic on the road, speeds in excess of 65 kmph are also observed in the section very frequently.

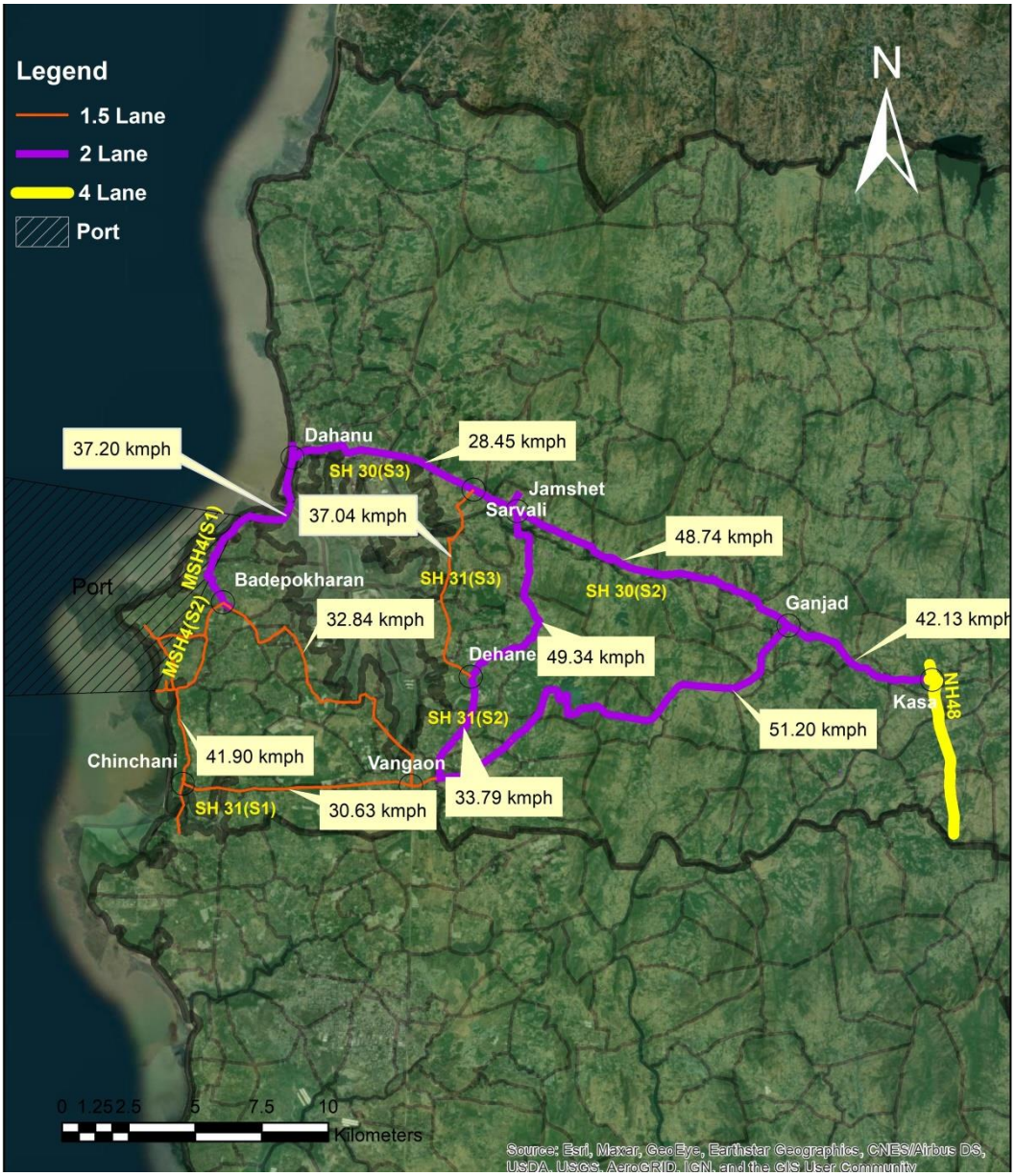


Figure 3.15 Average speeds recorded by V-box on different road links

3.3.2 Speed using Google maps

Table 3.2 below shows the average speed computed from average travel times and distances during the morning and evening peak hours on 17 December 2020 and 18 December 2020 and during non-peak hours on 20 December 2020.

Table 3.2 Travel time and average speed in road stretches during morning peak hour,evening peak and off peak hours.

Section	Distance (km)	Morning peak hour(9am-10am)		Evening peak hour(5pm-6pm)		Non-peak hour(2pm-3pm)	
		Time (min)	Speed (kmph)	Time (min)	Speed (kmph)	Time (min)	Speed (kmph)
SH 30(S1)	6.1	8	45.75	8	45.75	8	45.75
SH 30(S2)	11	12	55.00	12	55.00	11	60.00
SH 30(S3)	8.4	18	28.00	16	31.50	15	33.60
MSH4(S1)	7.9	13	36.46	11	43.09	11	43.09
MSH4(S2)	7.7	12	38.50	11	42.00	12	38.50
SH 31(S1)	9.3	20	27.90	19	29.36	20	27.90
SH31(S2)	4.2	8	31.50	8	31.50	8	31.50
SH31(S3)	8.3	12	41.50	12	41.50	12	41.50
Jamshet-Dehane	8.2	16	30.75	16	30.75	15	32.80
Vangaon-Ganjad	17	23	44.34	23	44.34	21	48.57
Badepokharan-Vangaon	12	21	34.28	21	34.28	21	34.28

The roads in the network considered falls in the low traffic volume category and are associated with average travel speed between 30 kmph and 55 kmph except at certain stretches in SH30(S3) passing through the municipal area of Dahanu. The SH30 stretch between Dahanu and Kasa has a couple of intersections that warrants attention in the future to cater for the increased travel due to port, one at Ashagad junction and the other a chowk (roundabout) 700m from the intersection of MSH4 with SH30. The road width of the section MSH4(S2) between Badepokharan and Chinchani is only 3m-4.5m. However, the low traffic volume favours quicker travel through the stretch. SH 31(S1) section hinders free traffic flow because of narrow road width, diversions due to repair, encroachment by street vendors, auto/taxi, etc. and experiences lower travel speeds. Crossing of SH 31 across the western main rail line in Vangaon is an important bottleneck causing 10-15 minutes delay at very frequent intervals. The road section SH 31(S3), which links Dehane to SH 31, also experiences lesser travel speeds due to deteriorated road conditions.

The data collected from Google map confirms that the difference in peak and non-peak hour traffic is not very significant in most of the roads constituting the network. A difference in

travel times by 2-3 minutes is observed in section SH30(S3), section MSH4(S1) and Vangaon-Ganjad section.

4. Traffic Volume Analysis

4.1 Traffic at major intersections near the port area

JNPT arranged the enumerators for the traffic volume study. IIT Bombay team provided all necessary data collection forms and instructions. As discussed in the network section of the study area, the major roads identified in the study area are presented in Figure 4.1. Traffic data count was collected at 6 major intersections. These intersections are: 1) Chinchani Naka, 2) Kambale Naka, 3) Dahanu Fishmarket, 4) Ranshet 5) Dehane and 6) Ashagad. The traffic count data was collected at these intersections for every 15 minutes time interval during morning period from 8:00 AM to 11:00 AM and during the evening period from 4:00 PM to 7:00 PM on two days. The data collection capture both morning peak and evening peak.

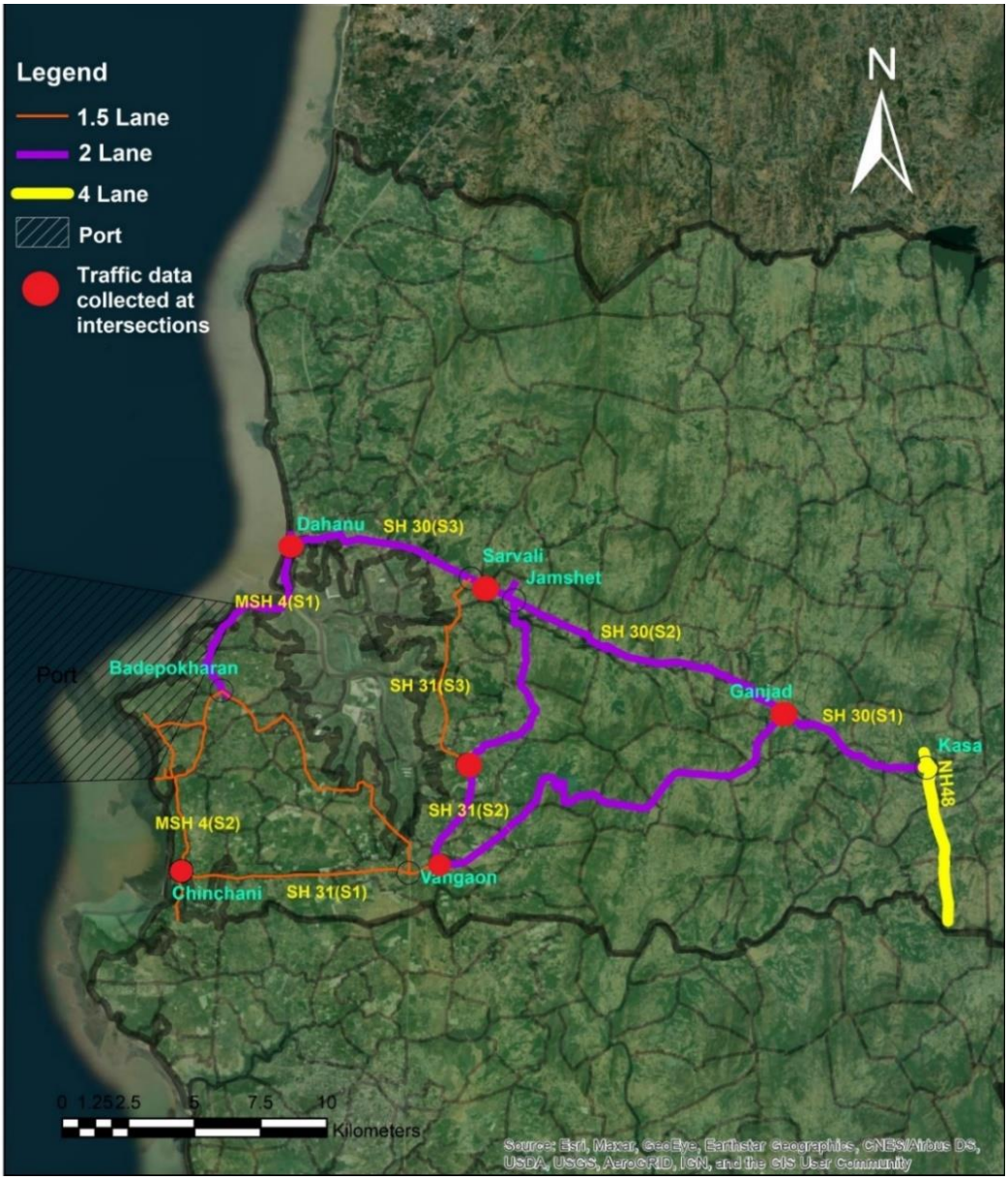


Figure 4.1 Location of major intersection where the classified traffic volume data is collected

Trained enumerators collected the data at each intersection (Figure 4.2). An example of collected data is presented in Table 4.1. Classified turning movements at every 15 minutes were recorded manually during both morning peak and evening peak periods. The vehicles were classified into 6 categories: i) 2-Wheeler, ii) 3-Wheelers, iii) Car, iv) Light commercial vehicle (LCV), v) Heavy commercial vehicle (HCV), and vi) Bus.

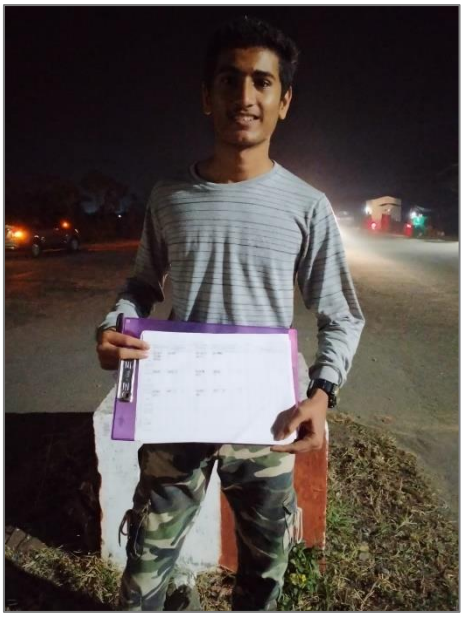


Figure 4.2 Survey enumerators

Table 4.1 Classified traffic data count collected at Chinchni Naka

Name of Enumerator:					Date:	19-12-2020	Survey Location: **Chinchni Naka**						Approach: **Chinchni Road**					
Traffic movement		Traffic going towards _____						Traffic going towards **Vadhavan**						Traffic going towards **Vangaon**					
To		**Left turning traffic**						**Through traffic**						**Right turning traffic**					
Time Interval		2W	3W	Car	LCV (tempo)	HCV (truck)	Bus	2W	3w	Car	LCV (tempo)	HCV (truck)	Bus	2W	3W	Car	LCV (tempo)	HCV (truck)	Bus
8.00	8.15							50	15	10	18	8	2	52	17	18	16	3	0
8.15	8.30							37	14	20	12	5	0	58	13	23	8	5	0
8.30	8.45							32	19	16	13	3	1	45	9	20	7	3	1
8.45	9.00							35	20	28	19	3	0	60	22	12	12	12	2
9.00	9.15							42	16	18	27	8	0	65	19	19	9	17	0
9.15	9.30							52	17	9	18	11	0	58	18	8	3	0	0
9.30	9.45							37	22	11	12	8	2	47	16	17	7	2	0
9.45	10.00							42	12	18	13	3	1	53	8	9	9	8	1
10.00	10.15							48	5	8	10	6	1	61	12	20	11	4	0
10.15	10.30							30	10	20	18	7	0	57	8	12	8	2	1
10.30	10.45							35	8	22	13	3	0	63	15	17	5	5	0
10.45	11.00							53	12	19	10	6	0	48	12	9	7	2	0

The turning traffic volumes at all intersections are converted in passenger car units/ hr (PCU/hr) using PCU values from IRC:64 (1990). The PCU values used in the analysis are presented in Table 4.2.

Table 4.2 PCU values for various type of vehicle

Type of vehicles	PCU values
Two-Wheeler	0.5
Three-Wheeler	0.75
Car	1
Light commercial vehicle (LCV)	1.5
Heavy commercial vehicle (HCV) and Bus	3

Peak Hour Volumes are important to assess the performance of a road network. The morning and evening peak hour volumes at each intersection are presented in Figure 4.3. The maximum traffic volume is observed at Dahanu intersection (near Dahanu fish market). The morning peak hour period is observed from 9:00 AM to 10: AM, and the evening peak period is observed from 5:45 PM to 6:45 PM. At the network level, the morning peak hour flow is observed to be higher than the evening peak hour flow. Hence, the morning peak hour volume was further used for volume to capacity analysis and develop a traffic simulation model.

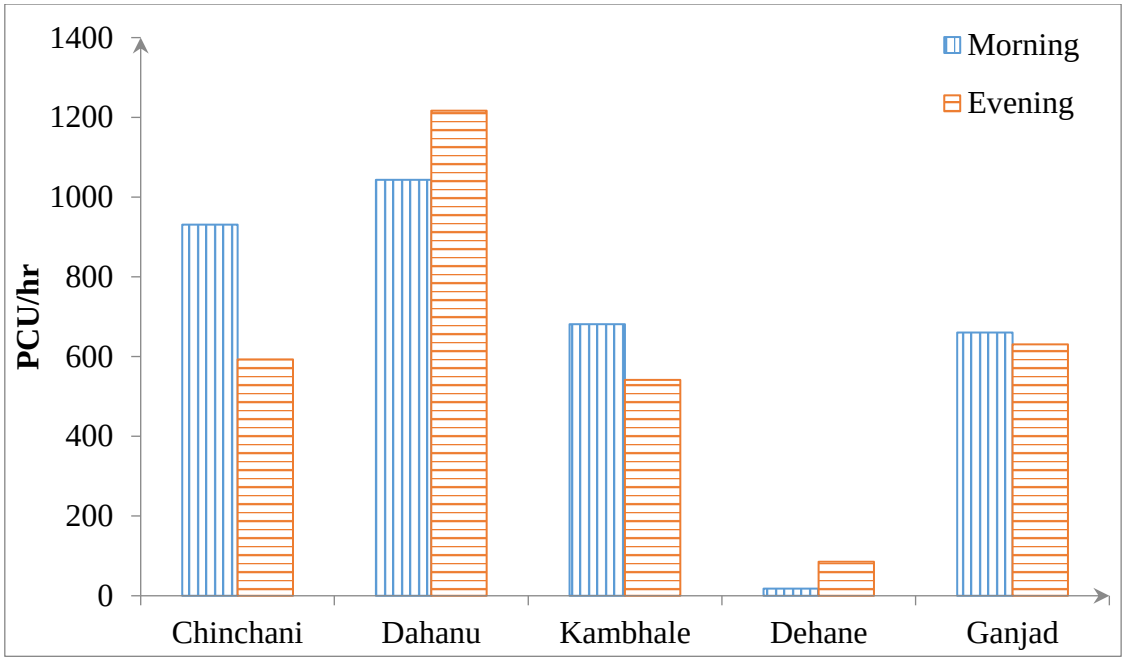


Figure 4.3 Comparison of traffic flow into five intersections in the study network during morning and evening peak

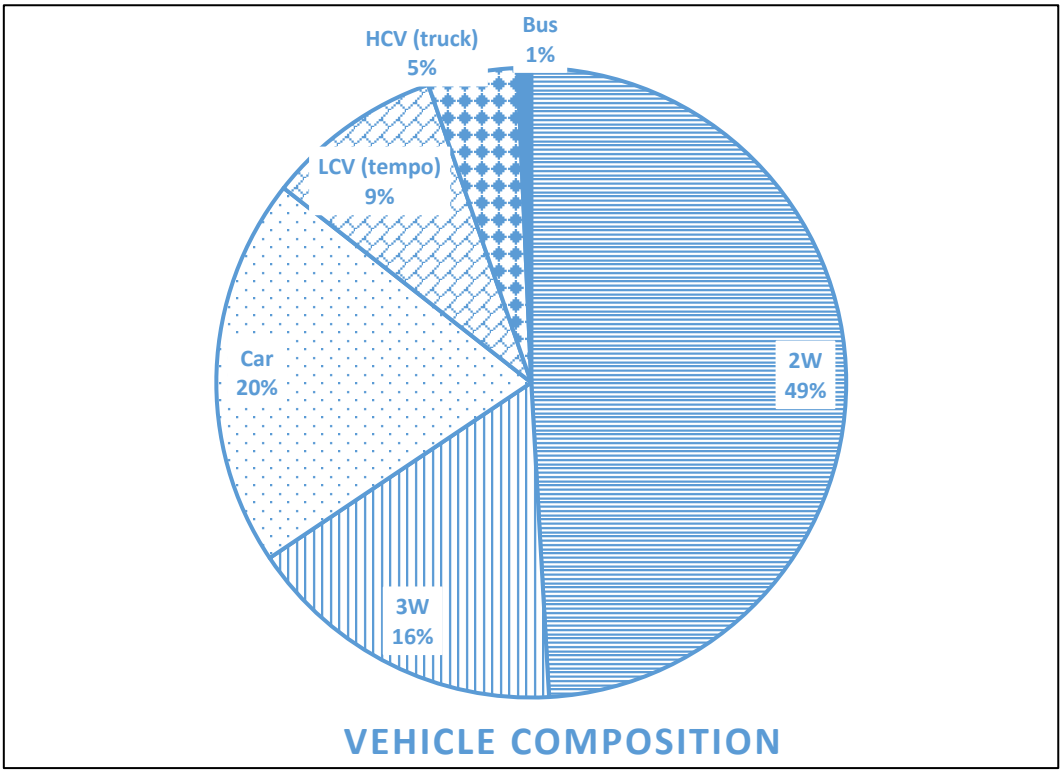


Figure 4.4 Vehicle composition in the network at morning peak hour

The vehicle composition at morning peak hour is presented in Figure 4.4. It is observed that 49% of the traffic constitutes two-wheelers. Car and Three-wheeler contribute 20% and 16% of traffic respectively during morning peak hour. Using the turning movement at intersections,

traffic volumes on all links of the study network are computed. The peak hour link flows are shown in Figure 4.5.

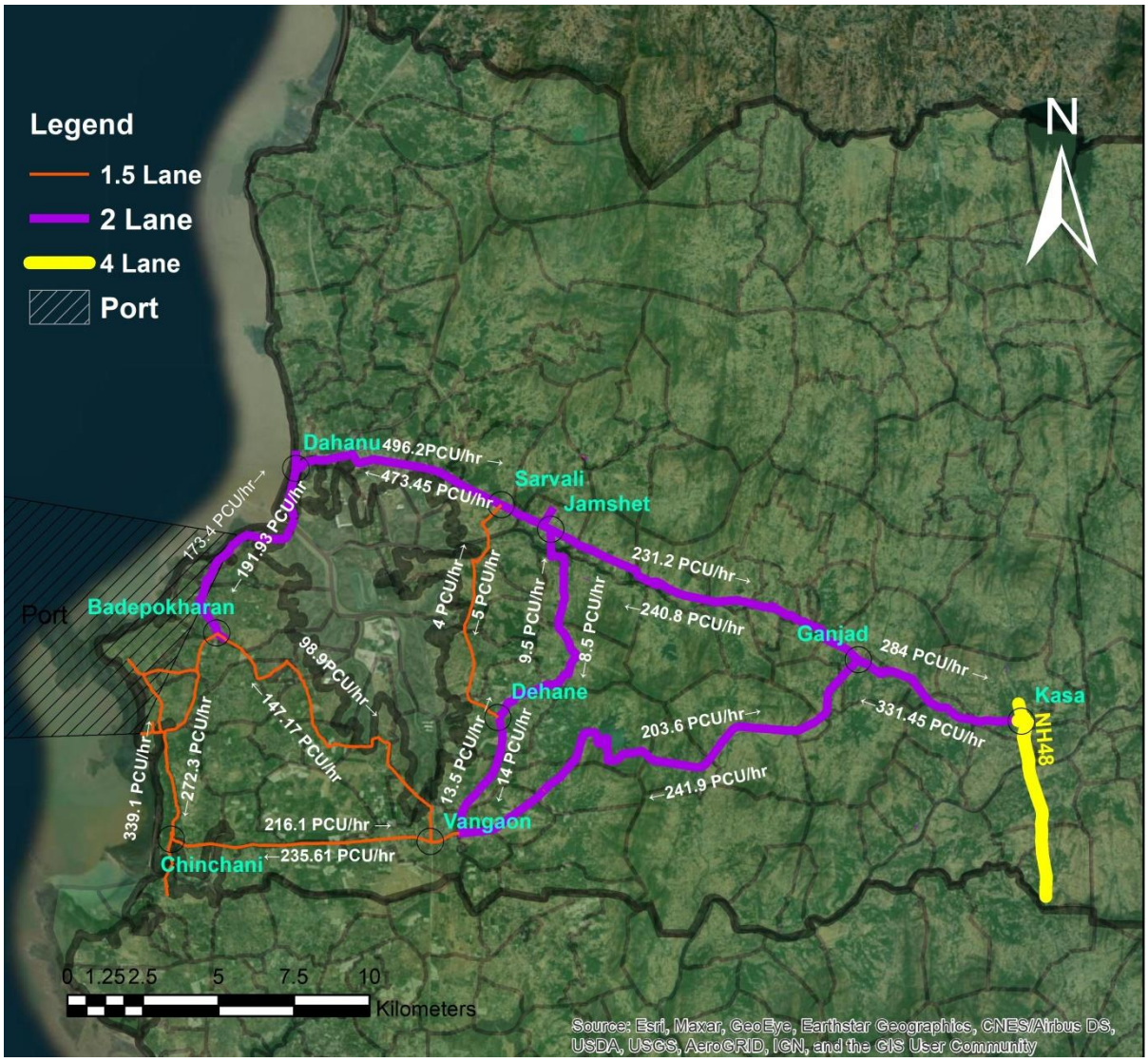


Figure 4.5 Morning peak hour link flows in PCU/hr

4.2 Volume to capacity ratio (v/c)

Volume to capacity ratio (v/c) is a popular performance measure to assess the level on a roadway link. The capacity of the roadway is defined as the maximum hourly traffic volume expected to traverse a point or a uniform section of a roadway under the prevailing roadway, traffic, and control conditions. A higher value of v/c ratio suggests that the traffic flow in the roadway is close to the theoretical maximum possible flow. Thus the road requires improvement and better traffic management plans. IRC 106 (1990) gives capacity values in

PCU/hr for urban roads. Accordingly, the capacity of a 2-lane road is 1500 PCU/hr. Urban roads are characterized by intersections at regular intervals resulting in a lesser capacity. The study network is in a rural area. IRC 64 (1990) deals with the theoretical capacity of roads in a rural area, but capacity per hour is not given. Indian Highway Capacity Manual (2017) suggests a formula to estimate the base capacity of the road by using the operating speed on the road. Based on the speed data collected using V-Box, we estimated the capacity using the suggested formula by Indian Highway Capacity Manual (2017) and the capacity varied from 1500 PCU/hr to 2000 PCU/hr for the 2-lane roads. We assume the capacity of 1700 PCU/hr for 2-lane road for our v/c ratio calculations. Similarly, for 1.5 lane or intermediate lane, the capacity of 1400 PCU/hr is assumed. The assumed capacity values and the volume on different links in Figure 4.5 are used for v/c analysis, and results are presented in Figure 4.6. The highest v/c ratio value of 0.57 is observed on the 2- lane road link between Dahanu and Ashagad (see Figure 4.6). This link mainly passes through the Dahanu town, and relatively higher traffic is observed in the link as compared to the other links in the study area. The average speed based on V-box data on this link is 28.45 kmph (see Figure 3.15), which is the lowest observed speed as compared to the other links in the road network, which also backs the finding for the highest v/c ratio value on the link.

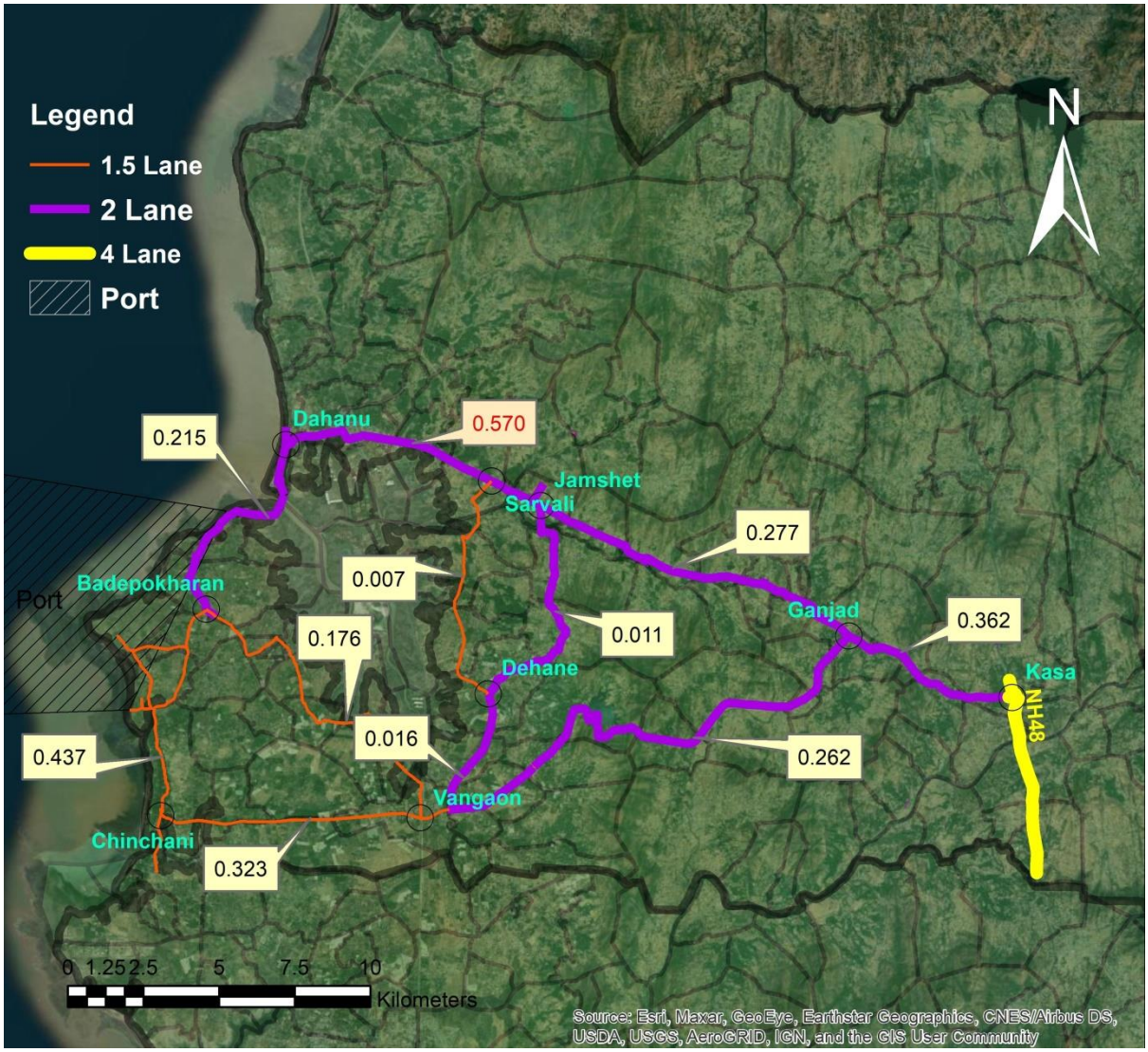


Figure 4.6 Volume to capacity ratios (v/c) of road sections

4.2.1 Forecasted traffic and future v/c ratios for do-nothing scenario

At present, the study network is mostly uncongested, but it important to assess the situation in the future. The past traffic data in the study network are not available. Thus, the traffic volume growth needs to be estimated based on some external factors. The increase in decadal population from 2001-2011 is 18.1% in Dahanu taluka as per 2011 census. The recent data available for Palghar district about the vehicle ownership per 1000 population was 85 in 2016. As per the recommendation of IRC 37 (2018), in the absence of data for estimation of the annual growth rate of vehicles a minimum annual growth rate of 5 per cent should be used for vehicles for estimating the future design traffic volume. IRC 37 recommendation is for pavement design traffic volume. Considering all these observations, we assume traffic volume

growth rate of 5% in the study network for traffic analysis. Figure 4.7 presents the future projected peak hour link flow for the year 2028.

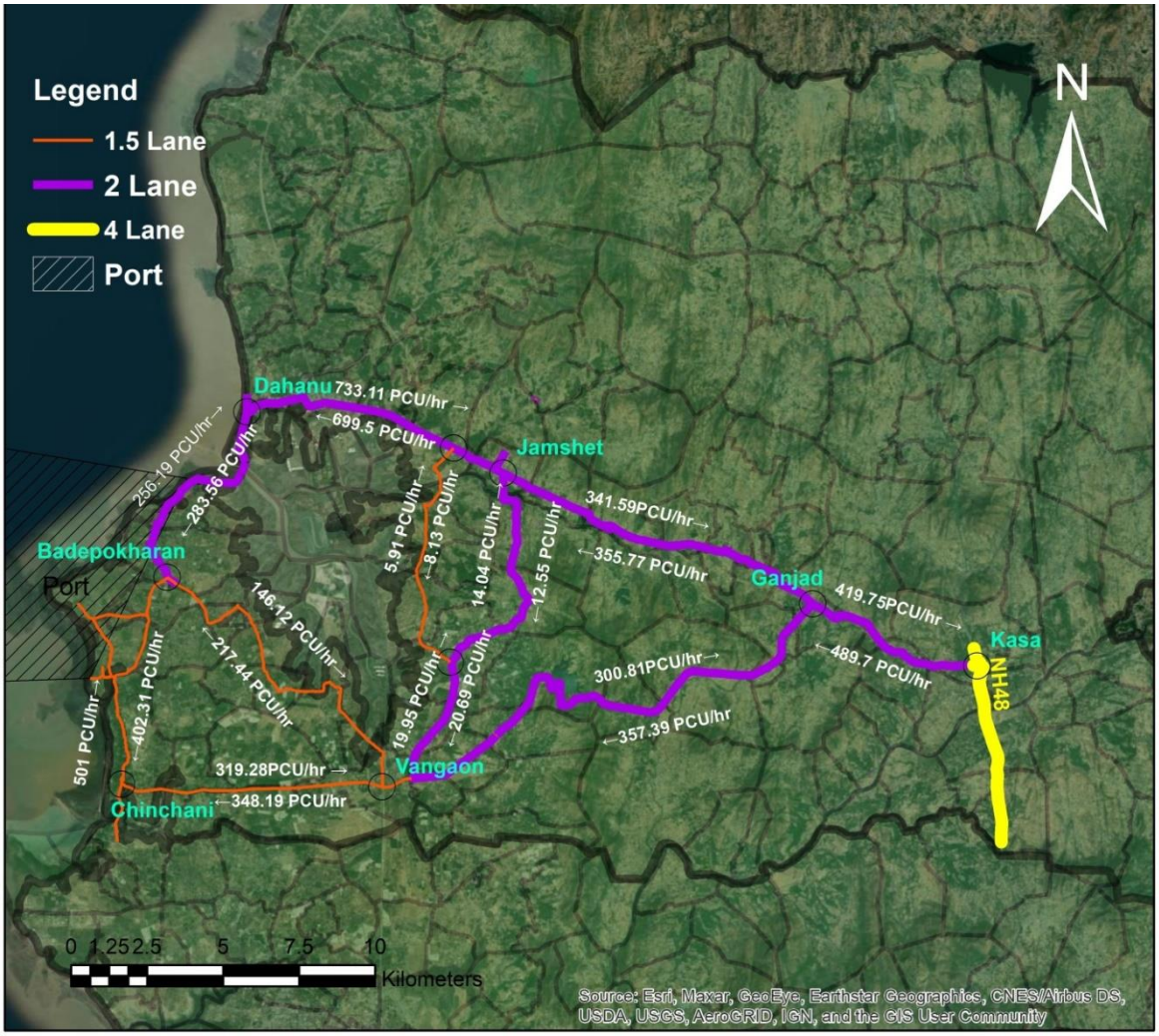


Figure 4.7 Projected peak hour traffic on links in 2028 assuming 5% annual growth rate

Based on the future projected peak hour traffic volume, the v/c ratio will change as the traffic flow will increase if no improvements are made to increase the capacity of the links. Analysis of future traffic is done first for the do-nothing scenario. Table 4.3 presents the future traffic flow and Table 4.4 presents v/c ratio values on different links for different years. The v/c values greater than 0.7 are highlighted. Here it can be seen that as the future projected traffic on the link Dahanu-Ashagad increases the v/c ratio increases. In the year 2028, v/c ratio is expected to be 0.84, which will result in traffic congestion. On urban roads, v/c ratio is okay, but rural roads lesser v/c is desired. Based on the table, it can be observed many roads will need capacity enhancement in the future.

Table 4.3 Peak hour traffic flow in both directions for do-nothing scenario

Link	Section	Both directional traffic flow on the link in PCU/hr						
		2020	2023	2028	2033	2038	2043	2048
Dahanu-Badepokharan	MSH4(S1)	365	423	540	689	879	1122	1432
Chinchani-Badepokharan	MSH4(S2)	611	708	903	1153	1471	1878	2397
Chinchani-Vangaon	SH31(S1)	452	523	667	852	1087	1388	1771
Badepokharan-Vangaon		246	285	364	464	592	756	965
Dehane-Kambhale	SH31(S2)	28	32	41	52	66	84	108
Sarvali-Dehane	SH31(S3)	10	11	14	18	23	29	37
Dehane-Jamshet		18	21	27	34	43	55	71
Dahanu-Ashagad	SH30(S3)	970	1122	1433	1828	2334	2978	3801
Ganjad-Ashagad	SH30(S2)	472	546	697	890	1136	1450	1850
Kasa-Ganjad	SH30(S1)	616	713	909	1161	1481	1891	2413
Vangaon Ganjad		446	516	659	841	1073	1370	1748

Table 4.4 v/c ratios for links in do-nothing scenario

Link	Section	Both directional traffic flow on the link in PCU/hr						
		2020	2023	2028	2033	2038	2043	2048
Dahanu-Badepokharan	MSH4(S1)	0.21	0.25	0.32	0.41	0.52	0.66	0.84
Chinchani-Badepokharan	MSH4(S2)	0.44	0.51	0.65	0.82	1.05	1.34	1.71
Chinchani-Vangaon	SH31(S1)	0.32	0.37	0.48	0.61	0.78	0.99	1.27
Badepokharan-Vangaon		0.18	0.2	0.26	0.33	0.42	0.54	0.69
Dehane-Kambhale	SH31(S2)	0.02	0.02	0.02	0.03	0.04	0.05	0.06
Sarvali-Dehane	SH31(S3)	0.01	0.01	0.01	0.01	0.02	0.02	0.03
Dehane-Jamshet		0.01	0.01	0.02	0.02	0.03	0.03	0.04
Dahanu-Ashagad	SH30(S3)	0.57	0.66	0.84	1.08	1.37	1.75	2.24
Ganjad-Ashagad	SH30(S2)	0.28	0.32	0.41	0.52	0.67	0.85	1.09
Kasa-Ganjad	SH30(S1)	0.36	0.42	0.53	0.68	0.87	1.11	1.42
Vangaon Ganjad		0.26	0.3	0.39	0.49	0.63	0.81	1.03

The traffic projections and subsequent v/c analysis were extended up to 2048 as per the suggestions put forward by JNPT officials in the review meeting. However, trend-based forecasting of traffic for very long time periods has limitations with respect to the assumption of a constant growth rate. There are multiple economic and social factors including the government policies which can alter the growth rates. Thus, accuracy of growth rate-based traffic projections for time horizons beyond 20 to 25 years may be sacrificed. This also highlights the necessity for reconducting traffic surveys and congestion studies at regular intervals.

4.3 Comparisons with existing data

The proposed port at Vadhavan lies in Dahanu taluka in Palghar district which is outside the Mumbai Metropolitan Region (MMR). Hence the region of interest is not included in the Comprehensive Transport Study (CTS) conducted by MMRDA at regular intervals. PWD occasionally performs traffic surveys; however, the latest data on traffic flows in the region are limited. The average traffic flow on each of the main roads constituting the study network in PCU/day from 2011 are presented in Table 4.5. Due to the unavailability of the latest traffic data from PWD in the study network, further analysis is based on data collected at 6 locations as part of this study.

Table 4.5 Link flows in pcu/day as per PWD 2011 traffic survey

Link	Traffic on link in PCU/day
Dahanu Jawahar road (SH 30)	11865
Chinchani Vangaon Ashagad road (SH 31)	7709
Dahanu Tarapur road (MSH 4)	10017
Vangaon Ganjad road	7752
Sarvali Savata road	6318
Vangaon Badepokharean	6713

Further, to understand the traffic flow and traffic characteristics in the study network, a traffic simulation is performed. The traffic simulation is developed for the morning peak period, which is identified from the traffic data collected at 6 different intersections in the study area. This will help in simulating the current field condition and will allow us to simulate future traffic condition. To estimate the future traffic flow, an annual growth rate of 5% is assumed (as recommended by IRC 37 (2018)).

5. Traffic simulation

The simulation of traffic movements in the existing road network surrounding was developed for 2020 based on the field data collected using PTV VISSIM, a microscopic multi-modal traffic flow simulation software package. Projected traffic volumes are used to develop future scenarios. In future scenarios, the proposed 8-lane road between NH 48 and the port is included.

5.1 Vehicle specifications

. The various types of vehicles used in the simulation on the existing road network are:

- Bike (2-wheeler)
- Auto (3-wheeler)
- Car
- Tempo (LCV)
- Truck (HCV)
- Bus

The specifications for each vehicle are given in Table 5.1. PTV VISSIM requires desired speeds of different vehicles as an input. The desired speed is the speed at which drivers desire to drive in the absence of hindrance from other vehicles. The maximum and minimum values of speeds and distribution between these values were defined in the model (See Table 5.1). The desired speed distribution curve for any vehicle category is generally an 'S' shaped curve. The speed distribution defined in VISSIM represents the observed values in the field.

Table 5.1 Vehicle dimensions and desired speed distribution used in the simulation

Vehicle type	Dimensions used in the simulation (mm)		Desired speed distribution (km/h) (lower limit-upper limit)	
	Length	**Width**	**1.5-lane**	**2-lane**
Bike	2000	850	30	70
Auto	9200	2550	25	60
Car	4200	2000	30	70
Tempo (LCV)	6671	2600	25	60
Truck (HCV)	8800	2500	20	55
Bus	10486	3170	20	55

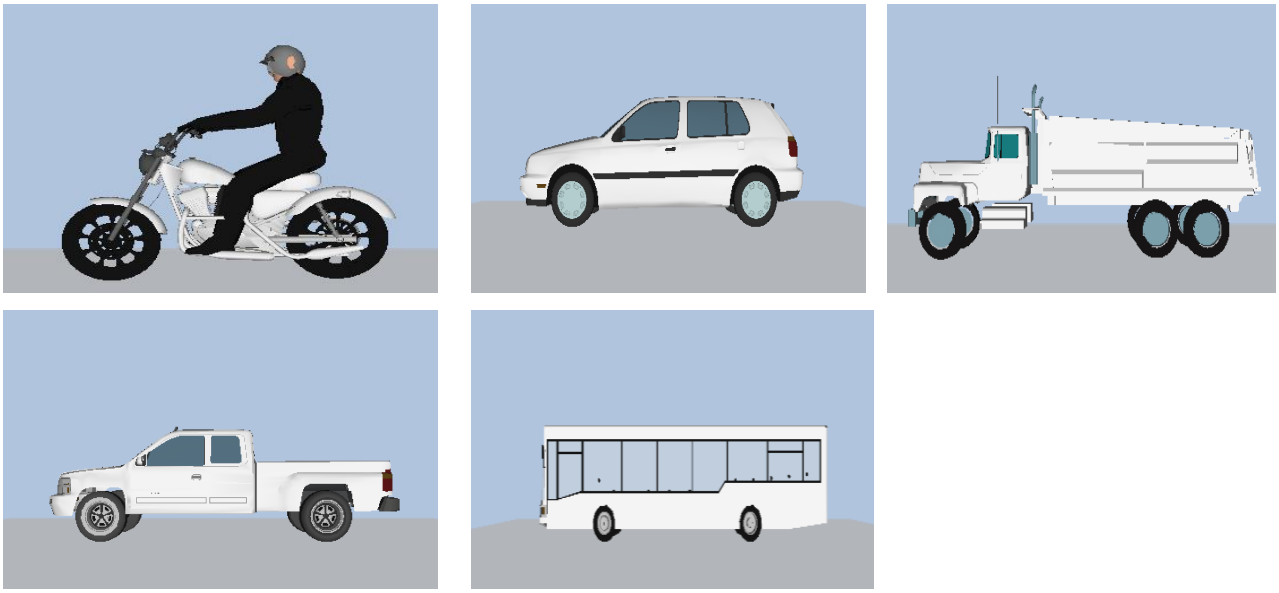


Figure 5.1 Types of vehicles used in the simulation

5.2 Proposed port connector corridor

An 8-lane divided corridor is proposed for connecting the port to the national highway (NH 48). This alignment is shown in Figure 5.2. This corridor is assumed to be constructed before the operationalization of the port. Thus, the bound port traffic will not use any existing road network.

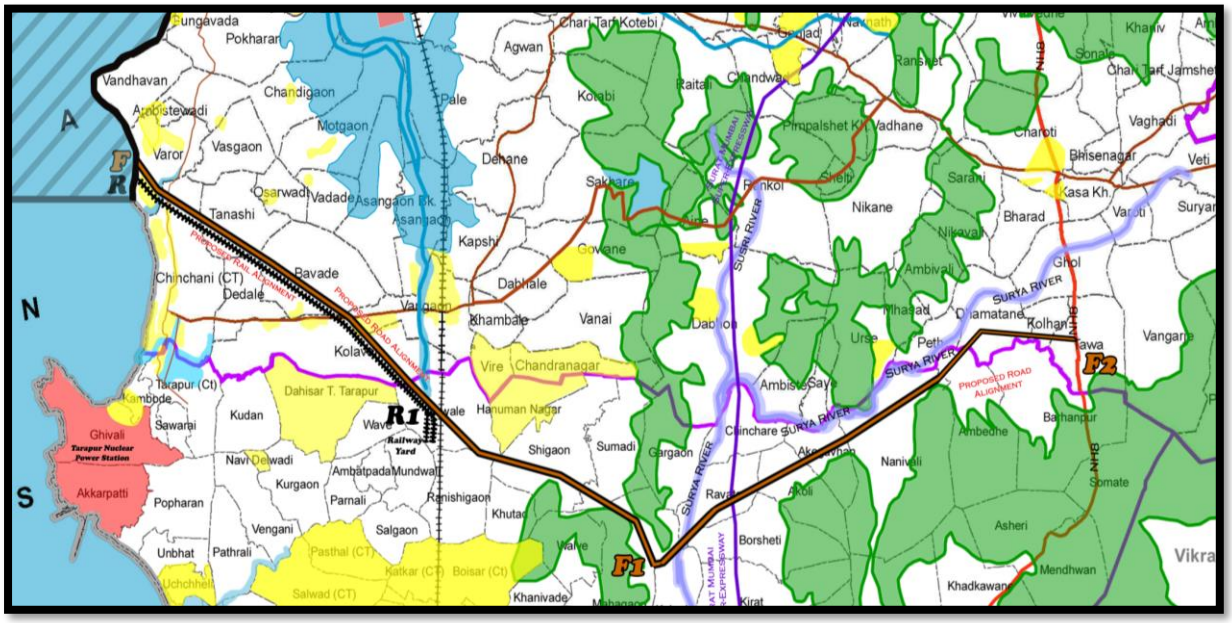
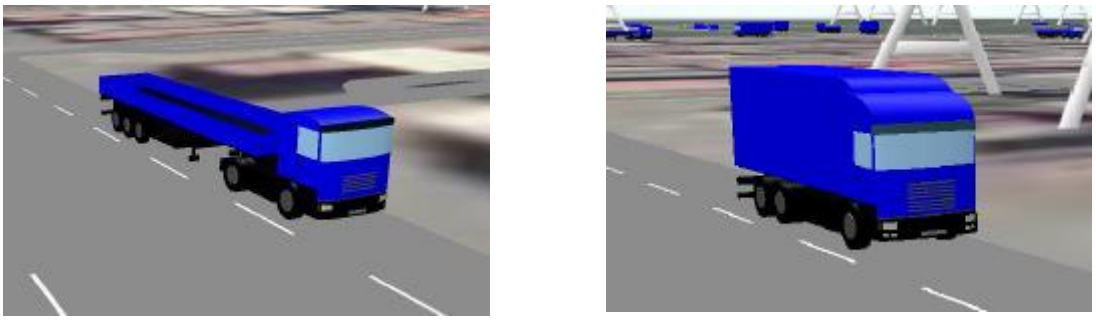


Figure 5.2 Road network with new proposed alignment

It is assumed that the connector will be exclusively used by port-bound traffic and the entry to other vehicles will be restricted. A past survey conducted at JNPT by IIT Bombay team found the following vehicle types used container transportation.

- 3 and 4 axles Single unit
- 3 or 4 axle Truck trailer
- 5+ axle Truck trailer

Images of a 3-axle single unit and 5-axle truck trailer from PTV VISSIM library are shown in Figure 5.3. The specifications of these vehicles are given in Table 5.2. Since the proposed 8-lane corridor is expected to be high geometric and construction standards, higher desired speeds than that for the existing road networks are assumed (Table 5.2).



a. 5 axle truck trailer **b. 3 axle single unit**

Figure 5.3 Types of vehicles used for the simulation of proposed alignment

Table 5.2 Vehicle dimension used in simulation

Vehicle type	Dimensions used in simulation (mm)		Desired Speed distribution in kmph (lower limit-Upper limit)
	Length	Width	
3 and 4 axle Single unit	9200	2550	70 (68-78)
3 or 4 axle Truck trailer	9200	2550	60 (58-68)
5+ axle Truck trailer	15200	2550	50 (48-58)

5.3 Port bound traffic on proposed 8-lane connector traffic projection

Table 5.3 shows the projection of the port traffic as per the HaskoningDHV report from FY 21-25 to FY 46-50.

Table 5.3 Port traffic projection

Sr. no.	Commodities	Units	FY 21-25	FY 26-30	FY 31-35	FY 36-40	FY 41-45	FY 46-50
1	Containers	Mn T	10.8	77.8	169.2	278.4	375.6	472.8
		Mn TEUs	0.9	6.5	14.1	23.2	31.3	39.4
2	Chemicals	Mn T	0.6	0.9	1.0	1.1	1.2	1.3
3	Edible oil	Mn T	0.4	1.0	1.1	1.2	1.3	1.4
4	LPG	Mn T	2.7	3.1	3.8	4.2	4.7	5.2
5	Fertilizers	Mn T	0.9	1.0	1.2	1.2	1.3	1.4
6	General cargo	Mn T	1.5	2.4	3.5	4.6	5.9	7.2
7	Coastal cargo	Mn T	1.0	1.7	2.4	3.2	4.1	5.0
8	Ro Ro	‘000 veh	20.9	49.5	76.8	169.0	195.9	227.1
9	**Total**	**Mn T**	**17.9**	**90.2**	**186.7**	**298.4**	**398.6**	**498.8**

5.3.2 Truck load capacity

Table 5.4 shows the tuck capacity to be assumed as provided by HaskoningDHV for the calculation of the number of trucks to be handled by the 8-lane dedicated corridor connecting part and NH48. It also specifies the type of cargo in terms of import (outgoing) or export (incoming).

Table 5.4 Truck load capacity for cargo

Sr. no	Commodity	Truck capacity	Unit
Outgoing			
1	Chemicals	10	tonnes
2	Edible oil	18	tonnes
3	LPG	18	tonnes
4	Fertilizers	12	tonnes
Incoming/Outgoing (50% incoming and 50% outgoing)			
1	General cargo	10	tonnes
2	Coastal cargo	10	tonnes
3	Containers	1.5	TEUs
Incoming			
1	Ro Ro	5	000’ vehicles

5.3.3 Container traffic calculation

It is believed that not all loaded trucks going to the port would return loaded as this would not be practical. So, we referred to the JNPCT data of total trucks visiting the port for the calendar year 2020 and followed some thumb rules therein for forecasting traffic calculations for Vadhavan port. As per the record, 100% of the empty trucks entering the port for collecting imports would return laden. Further, they have considered that number of laden trucks leaving the port is 29% of the total laden trucks entering the port. Thus, we have carried out the sensitivity analysis with respect to port traffic calculations considering the laden out by laden in ratios as 30%, 40% and 50%. Taking the reference from the HaskoningDHV report and later confirming from JNPT, the road share was considered to be 65%.

We have considered three types of trucks that would carry cargo to and fro the port, namely, 3 or 4 axle single unit (capacity: 1 TEU), 3 or 4 axle truck trailer (capacity: 1 TEU) and 5+ axle truck trailer (capacity: 2 TEUs). The proportion of these vehicles is given in Table 5.5 (Source: *Report on Feasibility analysis of fourth container terminal at JNPT*). The values in the table are based on the field traffic survey conducted by IIT Bombay research team outside JN Port as a part of some other project.

Table 5.5 Proportion of vehicles considered

Vehicle type	Proportion (%)
3 or 4-axle Single unit	19
3 or 4 axle Truck trailer	29
5+ axle Truck trailer	52

Table 5.6, Table 5.7 and Table 5.8 shows the container traffic calculations carried out by IIT Bombay by considering the laden out by laden in ratio to be 30%, 40% and 50%, respectively. Note that for simulating four different scenarios, we have considered traffic given for the FY 21-25 as the traffic for the year 2023, for FY 26-30 as the traffic for the year 2028.

Table 5.6 Container traffic calculations (laden out/laden in =30%)

Commodity-containers	**Trucks handled per day by proposed 8 lane connector**											
	2023		**2028**		**2033**		**2038**		**2043**		**2048**	
	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*
3/4 axle SU (19%)	179	179	1299	1299	2819	2819	4639	4639	6258	6258	7878	7878
3/4 axle TT (29%)	275	275	1984	1984	4303	4303	7080	7080	9553	9553	12024	12024
5+ axles TT (52%)	493	493	3557	3557	7717	7717	12696	12696	17129	17129	21562	21562
Total trucks (all types)	**947**	**947**	**6,840**	**6,840**	**14,839**	**14,839**	**24,415**	**24,415**	**32,940**	**32,940**	**41,464**	**41,464**
Total trucks handled (both direction)	**1,894**		**13,680**		**29,678**		**48,830**		**65,880**		**82,928**	

*IN- from NH to port; *OUT- from port to NH

Table 5.7 Container traffic calculations (laden out/laden in =40%)

Commodity-containers	**Trucks handled per day by proposed 8 lane connector**											
	2023		**2028**		**2033**		**2038**		**2043**		**2048**	
	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*
3/4 axle SU (19%)	169	169	1223	1223	2653	2653	4365	4365	5890	5890	7415	7415
3/4 axle TT (29%)	258	258	1867	1867	4050	4050	6664	6664	8991	8991	11317	11317
5+ axles TT (52%)	464	464	3348	3348	7263	7263	11950	11950	16122	16122	20293	20293
Total trucks (all types)	**891**	**891**	**6,438**	**6,438**	**13,966**	**13,966**	**22,979**	**22,979**	**31,003**	**31,003**	**39,025**	**39,025**
Total trucks handled (both direction)	**1,782**		**12,876**		**27,932**		**45,958**		**62,006**		**78,050**	

*IN- from NH to port, *OUT- from port to NH

Table 5.8 Container traffic calculations (laden out/laden in =50%)

Commodity-containers	**Trucks handled per day by proposed 8 lane connector**											
	2023		**2028**		**2033**		**2038**		**2043**		**2048**	
	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*
3/4 axle SU (19%)	159	159	1147	1147	2488	2488	4094	4094	5522	5522	6951	6951
3/4 axle TT (29%)	242	242	1750	1750	3797	3797	6247	6247	8429	8429	10610	10610
5+ axles TT (52%)	435	435	3139	3139	6809	6809	11202	11202	15114	15114	19025	19025
Total trucks (all types)	**836**	**836**	**6,036**	**6,036**	**13,094**	**13,094**	**21,543**	**21,543**	**29,065**	**29,065**	**36,586**	**36,586**
Total trucks handled (both direction)	**1,672**		**12,072**		**26,188**		**43,086**		**58,130**		**73,172**	

*IN- from NH to port; *OUT- from port to NH

5.3.4 Bulk cargo traffic calculations

Table 5.9 shows the traffic calculation for bulk cargo as calculated by IIT Bombay. We have assumed the road share for cargo related to chemicals, edible oil, Ro-Ro and general cargo and coastal cargo to be 100% (as given in HaskoningDHV report). Whereas, the road share for LPG and fertilizers was found out to be 15% and 27% after back calculating from the given data related to the truck movements by the consultant. We have assumed that the outgoing cargo (LPG, fertilizers, edible oil and chemicals) as well as the incoming cargo (Ro-Ro) would require the movement of empty trucks from NH to the port and port towards the NH, respectively.

5.3.5 Summary- Traffic handled by 8 lane corridor

Table 5.10 shows the collective truck traffic per day that is to be handled by the 8 lane corridor for all types of cargo after performing all the calculations

Table 5.9 Bulk cargo traffic calculations

Commodity	Trucks handled per day by proposed 8 lane connector											
	2023		2028		2033		2038		2043		2048	
	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*	IN*	OUT*
Chemicals	171	171	257	257	286	286	314	314	343	343	371	371
Edible oil	63	63	159	159	175	175	190	190	206	206	222	222
LPG	64	64	74	74	90	90	100	100	112	112	124	124
Fertilizers	58	58	64	64	77	77	77	77	84	84	90	90
Ro Ro	4	4	10	10	15	15	34	34	39	39	45	45
General cargo	364	364	583	583	850	850	1117	1117	1433	1433	1749	1749
Coastal cargo	243	243	413	413	583	583	777	777	996	996	1214	1214

*IN- from NH to port; *OUT- from port to NH

Table 5.10 Traffic handled per day (laden out to laden in ratio taken as 30%)

Sr. no	Commodities	Trucks handled per day by proposed 8 lane connector											
		2023		2028		2033		2038		2043		2048	
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
1	Chemicals	171	171	257	257	286	286	314	314	343	343	371	371
2	Edible oil	63	63	159	159	175	175	190	190	206	206	222	222
3	LPG	64	64	74	74	90	90	100	100	112	112	124	124
4	Fertilizers	58	58	64	64	77	77	77	77	84	84	90	90
5	General cargo	364	364	583	583	850	850	1117	1117	1433	1433	1749	1749
6	Coastal cargo	243	243	413	413	583	583	777	777	996	996	1214	1214
7	Ro Ro	4	4	10	10	15	15	34	34	39	39	45	45
8	Containers:												
	3/4 axle SU	179	179	1299	1299	2819	2819	4639	4639	6258	6258	7878	7878
	3/4 axle TT	275	275	1984	1984	4303	4303	7080	7080	9553	9553	12024	12024
	5+ axle TT	493	493	3557	3557	7717	7717	12696	12696	17129	17129	21562	21562
	Total (all truck types)	**947**	**947**	**6,840**	**6,840**	**14,839**	**14,839**	**24,415**	**24,415**	**32,940**	**32,940**	**41,464**	**41,464**

	Total trucks (both directions)	**1,894**		**13,680**		**29,678**		**48,830**		**65,880**		**82,928**	
Total truck movements per day		1,914	1,914	8,400	8,400	16,915	16,915	27,024	27,024	36,153	36,153	45,279	45,279
Total truck movements per day (both directions)		**3,828**		**16,800**		**33,830**		**54,048**		**72,306**		**90,558**	
Total truck movements (incoming and outgoing) **per day** including **peak hour factor of 25%**		**4,785**		**21,000**		**42,288**		**67,560**		**90,383**		**113,198**	

5.3.6 V/C calculation on the proposed link

Based on the projected peak hour traffic volume on the proposed link (Table 5.10), the v/c ratio analysis is performed. The peak hour traffic flow in terms of vehicle/hr on the proposed link is converted to PCU/hr based on the PCU given in Table 5.11.Table 5.12 presents the v/c ratio value on the proposed link for different years. The capacity value for the proposed link is assumed to be 2200 PCU/hr per lane i.e., 8800 PCU/hr for one direction for 4 lane road in a direction. Here it can be seen that as the future projected traffic on the proposed link increases the v/c ratio increases and reaches to 1.16 in 2048. It is to be noted that this analysis has been performed for the worst-case scenario i.e. by considering the laden out to laden in ratio as 30%. (see Table 5.12).

Table 5.11 PCU for truck types

Vehicle type	**PCU value**
Non container trucks	3.5
Containers:	
3/4 axle single unit	3.5
3/4 axle truck trailer	4
5+ axle truck trailer	5

Table 5.12 V/C ratio on the proposed link after projected traffic flow

Link	Lanes	Directional capacity in PCU/hr	V/C ratio					
			2023	**2028**	**2033**	**2038**	**2043**	**2048**
Proposed Link	8	8800	0.05	0.21	0.43	0.69	0.93	1.16

5.4 Simulation results for current and future traffic condition

The simulation of the existing road network for the base year (2020) and future years 2023, 2028, 2033, 2038, 2043 and 2048 are performed. This can be assumed as a do-nothing scenario in which the traffic will grow for the future year, and the study network capacity will be as per the base year. This will help to evaluate how congestion levels would increase on the roads in the future and their impact on the performance indicators.

Performance indicator of the road network based on simulation is average travel speeds on the links and average queue length at critical intersections. The simulation results for the do-nothing scenario are presented in Table 5.13 and Figure 5.4.

Table 5.13 Average link speeds from do-nothing scenario simulation

Link	Average speeds from simulation results						
	2020	2023	2028	2033	2038	2043	2048
Badepokhran Chinchani	43.43	40.50	39.90	33.87	25.70	20.69	15.83
Dahanu Badepokhran	37.93	35.07	34.74	33.85	30.10	26.65	22.10
Chinchani Vangaon	34.70	31.05	28.56	27.93	24.07	17.56	12.12
Dahanu Ashagad	45.08	36.33	30.04	25.40	19.14	12.03	8.36
Sarvali Dehane	41.77	40.63	41.43	41.02	40.72	41.03	40.72
Dehane Khambale	45.67	45.46	42.51	41.94	40.98	40.85	40.30
Ganjad Jamshet	39.2	33.83	30.87	29.26	27.15	23.50	17.62
Khambale Ganjad	35.89	33.67	32.41	29.34	28.12	23.22	16.36
Jamshet Dehane	47.05	45.15	44.03	45.62	44.53	43.23	44.96
Proposed alignment	-	50.3	45.9	39.2	32.8	25.6	18.7

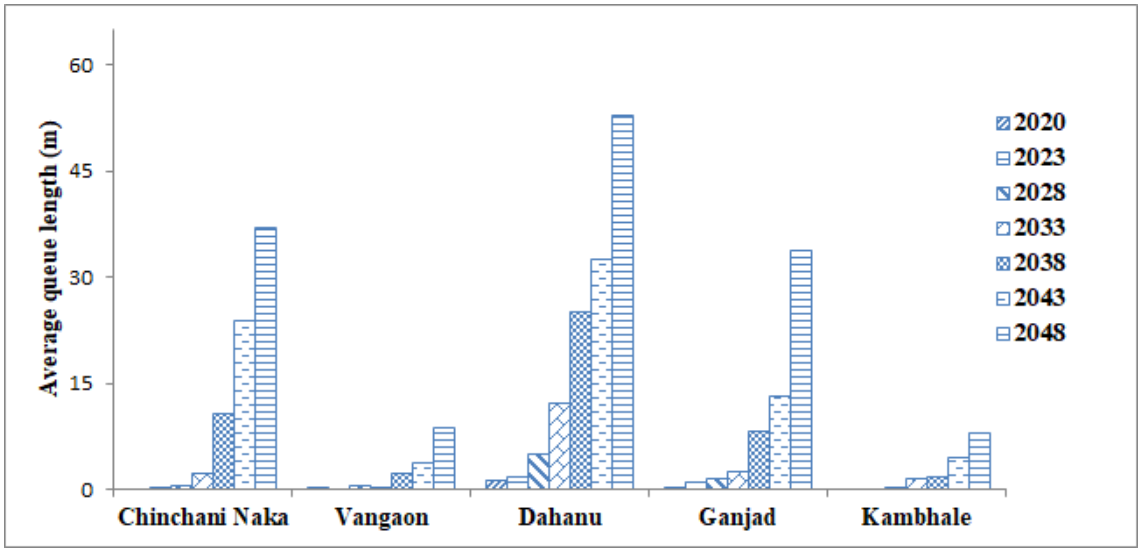


Figure 5.4 Average maximum queue length at major intersections for do-nothing scenerio

Average maximum queue length from the simulation in PTV VISSIM suggests queuing is observed in Dahanu in all the do-nothing scenarios and increasing to a maximum value of 52.87m in 2048 (See Figure 5.4). Average maximum queues at Vangaon and Kambhale Naka are less than 2 car length. The simulation was performed for a period of one hour, and the queue length was averaged over an interval of 300 secs in that period.

Average speeds calculated in links based on simulation is presented in Table 5.13 represents a consistent decrease in average link travel speeds in future, which explains the increase in traffic. Dahanu- Ashagad section most crucial link in the network and findings from simulation back the v/c analysis also suggesting the same (Figure 5.4). v/c ratio analysis in this link also gave critical results with V/C ratio of 0.84 in 2028, which advances to beyond 1 in 2033, assuming no improvements. A simulation screenshot in the base year is given in Figure 5.5 at Dahanu intersection. Similarly, a screenshot of a simulation the base year at Chinchani intersection is seen in Figure 5.6.

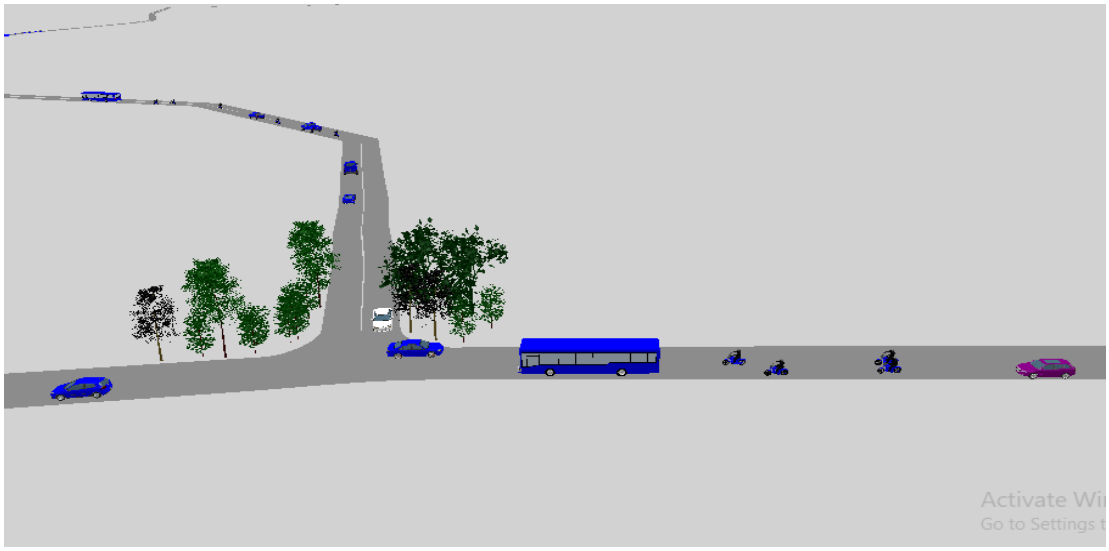


Figure 5.5 Simulation screenshot at Dahanu intersection for 2020

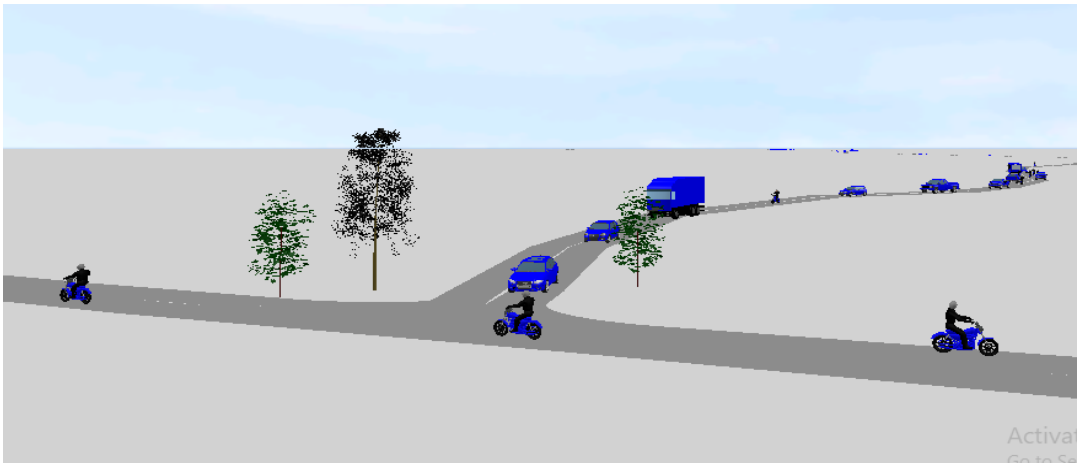
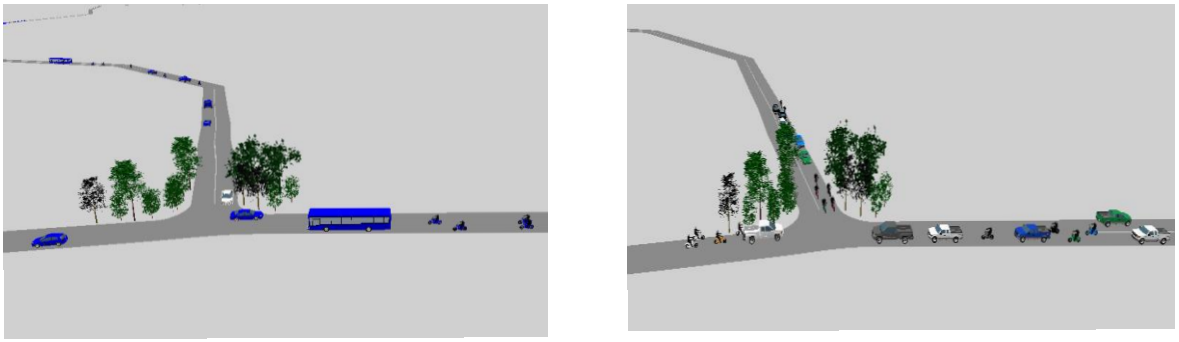


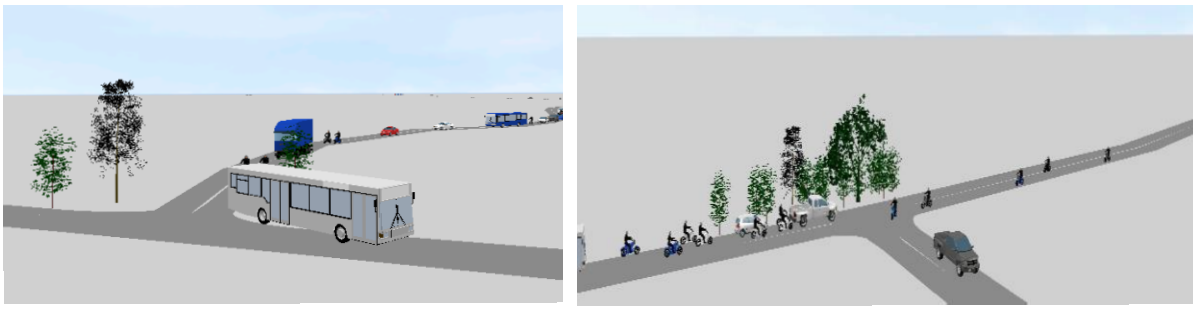
Figure 5.6 A simulation screenshot at Chinchani intersection for 2020

The general findings from simulation results are comparable with v/c ratio analysis, suggesting that the SH30 and MSH 4 sections are the crucial links in the network studied (see Table 4.4). At Ganjad SH 30 also witnesses vehicular queue build up in future years in 2048. Simulation screenshots Dahanu intersection in the base year 2020 and year 2048 are shown in Figure 5.7. Similar screenshots for Ganjad intersection are shown in Figure 5.8.



a. 2020 b. 2048

Figure 5.7 Traffic condition comparsion at Dahanu intersection for 2020 and 2048



a. 2020 b. 2048

Figure 5.8 Traffic condition comparison at Ganjad intersection for 2020 and 2048

6. Proposed network improvements

Video recordings from V-box survey, volume by capacity (v/c) ratio analysis and traffic simulation of the current situation and future traffic scenarios can help in providing a comprehensive view of the entire road network. Based on this understanding, various improvements are proposed at different stages in the future.

6.1 Resurfacing of distressed road stretches

Resurfacing of the deteriorated stretches, as shown in Figure 6.1 is suggested to ensure comfortable and faster travel.

Figure 6.1 Deteriorated road conditions

6.2 Provision of paved or unpaved shoulders

At a few locations on the road sections passing through built-up areas, it was found that road was encroached by street vendors, auto, taxi, etc. (see Figure 6.2). On-street parking at narrow sections also hinders free traffic flow and is observed at intersections. It is recommended that proper paved shoulder or footpaths are at such locations. At a few places in rural areas, roads do not have shoulders. Shoulders help in smoothening flow on roads increasing the average speed. It is recommended to provide shoulders along with the road network in the study area.

Figure 6.2 Encroachment on the road by vendors and parked vehicle hindering flow

6.3 The road overbridge (ROB) at Vangaon railway crossing

The at-grade railway crossing in Vangaon, where the SH 31 crosses the western railway mainline is a bottleneck which causes 10-15 minutes stoppage at very frequent intervals, resulting in significant queue length. Narrow roads, poor surface conditions, encroachment by street vendors and parked vehicles near the crossing adds to the woes of the road users and is an important section demanding attention in the future (see Figure 6.3). The average travel speeds estimated from V-box in the section is on the lower side, although v/c ratio computed for the base year is only 0.323 (Figure 4.6). A possible reason for lower travel speed irrespective of low v/c ratio could be the delay at the railway crossing. Recommendation to alleviate the congestion is constructing a road over-bridge. It was informed that the work as already started. We recommend it to be completed at the earliest.

Figure 6.3 Congestion, queue, bad road pavement condition and encroachment near the railway crossing

6.4 Widening of Dahanu-Ashagad section(SH 30(S3))

The road stretch between Dahanu and Ashagad ,SH 30(S3) (See Figure 6.5) includes municipal areas of Dahanu with the increased build-up and high human activities, resulting in lower travel speeds, frequent obstruction to flow due to stopped vehicles and other encroachments. In the current situation, the observed peak hour traffic flow on the link Dahanu-Ashagad is highest as compared to the other links in the study network (see Figure 4.5). In the year 2028, the v/c ratio

will reach to 0.84 (see Table 4.4), which suggests further congestion and delay. Based on the traffic simulation results, the highest level of queuing is observed on Dahanu intersection in the base year (see Figure 5.4), and the lowest speed is observed for Dahanu to Ashagad link (see Table 5.13).

The road connecting Dahahu and Ashagad is mostly an undivided 2 lane road, which is recommended to be widened to a 4-lane road in 2023. Further by 2043, the road that was already expanded to 4 lanes also shows higher congestion in the v/c analysis and simulations. Proper signal coordination and other advanced ITS related capacity improvement measures are suggested for the smooth flow of traffic in this stretch beyond 2043 if land is not available for further widening.

Figure 6.4 Busy Dahanu-Ashagad road section

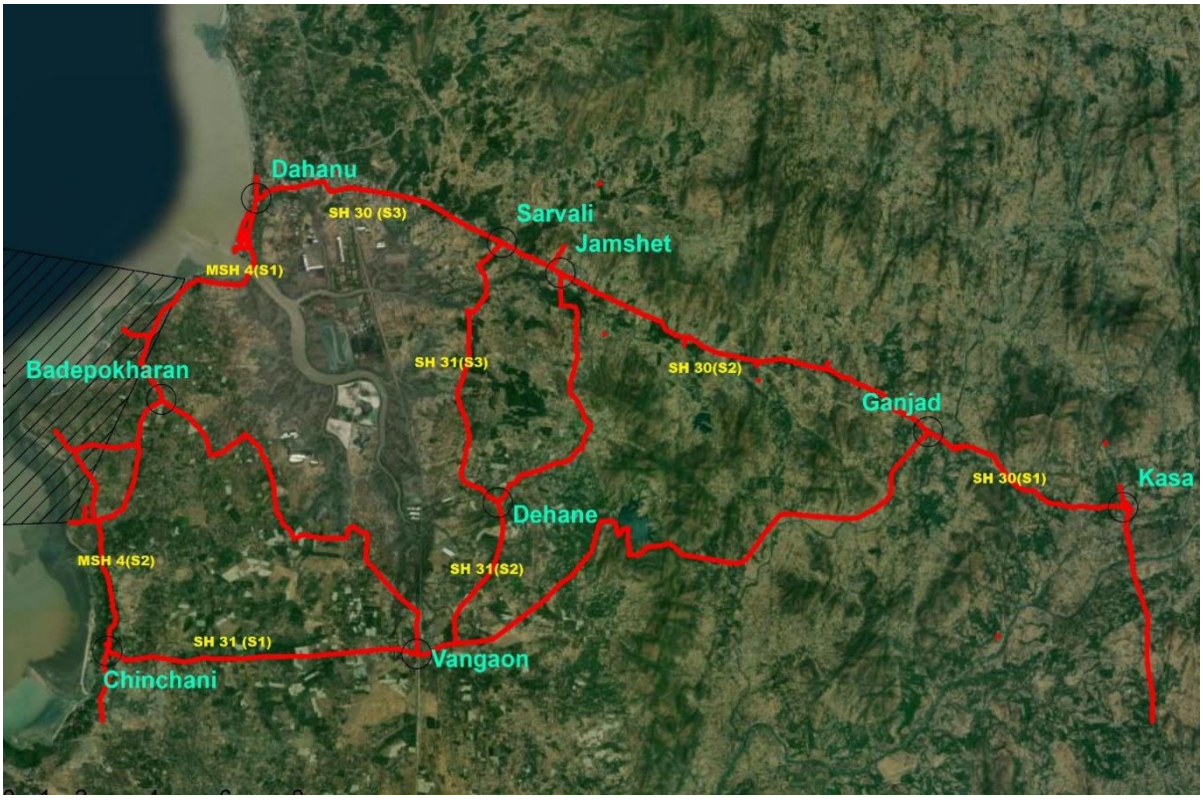


Figure 6.5 Road network

6.5 Bhoisar-Dahanu Coastal Road (MSH 4)

Bhoisar is an industrial area and northbound traffic from Bhoisar uses Bhoisar-Dahanu road that passes through Chinchani and Badepokharan. Currently, the width of this road varies from one to two lanes. The portion from Badepokharan to Dahanu is two lanes. We recommend that the entire road from Bhoisaar to Dahanu is widening to two-lane before 2023. A provision of proper shoulders should be provided on both sides of the road for the entire length. This coastal road needs to widen to four-lane before 2033.

6.5.1 Widening of Chinchani to Badepokharan(MSH 4(S2))

The road connecting Chinchani and Badepokharan is mostly a 1.5 intermediate lane road, which needs widening to 2-lane before 2023 and to 4 lane road before 2033. A provision of proper shoulders should be provided on both side of the road along the stretch.

6.5.2 Widening of Dahanu to Badepokharan (MSH 4(S1))

The road connecting Dahahu and Badepokhran, i.e, section MSH 4 (S1) (See Figure 6.5) is mostly an undivided 2 lane road. This section is suggested to be widened to a divided 4 lane road before 2033 with uniform road width, considering the relatively higher queue lengths in

Dahanu as per simulation (see Figure 5.4). This would make the entire road stretch from Dahanu to Chinchani 4 lanes with uniform road width. A provision of proper shoulders should be provided on both side of the road along the stretch.

6.6 Widening of Chinchani to Vangaon(SH 31(S1))

Section SH 31(S1), the road connecting Chinchani and Vangaon (See Figure 6.5) is mostly a 1.5 intermediate lane road, which needs to be widened to undivided 2 lane road before 2023 with uniform road width to increase the effective capacity of the road and to ensure smooth flow of traffic. A provision of proper shoulders should be provided on both side of the road along the stretch. However, the v/c ratios reach 0.78 in 2038 and very close to 1 in 2043(Table 4.4). Based on these calculations and simulation results, it is suggested to widen this stretch to 4 lanes before 2043.

6.7 Widening of Ashagad to Kasa

Ashagad to Kasa includes section SH 30(S1) (Ganjad to Kasa) and section 30(S2) (Ganjad to Ashagad)(See Figure 6.5). The road connecting Ashagad to Kasa is mostly an undivided 2 lane road; it is recommended to be widened to a 4-lane before 2033 (including the link between Ashagad to Ganjad). The simulation results show that at Ganjad intersection, relatively higher queuing after Dahanu is observed (see Figure 5.4). This suggests that improvements are needed so that traffic congestion in future can be avoided. Analysis of v/c ratios in **Error! Reference source not found.** indicates higher values(Ganjad to Kasa 0.87 in 2038; Ashagad to Ganjad 0.67 in 2038) and also confirms the same.

6.8 Widening of Vangaon to Ganjad

Vangaon to Ganjad section which connects SH 31 to SH 30 is mostly an undivided 2 lane road and is suggested to be expanded to 4 lanes by 2043. The v/c ratios in this links exceeds 0.8 beyond 2043 (Table 4.4) and these results are backed by high queue lengths in simulation.

The summary of these recommended improvements is provided in

Table 6.1.

Table 6.1 Proposed measures to improve the capacity of the study network

Link	Section	Existing lanes available	Proposed measure
Dahanu-Badepokharan	MSH4(S1)	2	Expanding to 4 lanes before 2033
Chinchani-Badepokharan	MSH4(S2)	1.5	Widening of road before 2023 and Expanding to 4 lanes before 2033
Chinchani-Vangaon	SH31(S1)	1.5	Widening of road before 2023 and Expanding to 4 lanes before 2043
Dahanu-Ashagad	SH30(S3)	2	Expanding to 4 lanes before 2028
Ganjad-Ashagad	SH30(S2)	2	Expanding to 4 lanes before 2033
Kasa-Ganjad	SH30(S1)	2	Expanding to 4 lanes before 2033
Ganjad-Vangaon		2	Expanding to 4 lanes before 2043
General recommendations			
Resurfaacing of distressed road stretches			
Provision of paved or unpaved shoulders			
Road over bridge (ROB) at Vangaon railway crossing			

6.9 Traffic analysis after improvement

To assess the effectiveness of recommended improvements, traffic analysis is performed incorporating the improvements. These results can be compared with the results of the do-nothing scenario.

6.9.1 v/c ratio after recommended improvements

v/c ratio on network links after introducing the recommended improvements are given in Table 6.2. It can be observed that if the Dahahu and Ashagad section is widened to 4-lane before 2028, then the v/c ratio value will reduce to 0.78 in 2038 (see Table 6.2) as compared to 1.37 in 2038 (see Table 4.4) . For all other sections, the forecasted v/c ratios are in reasonable limits.

Table 6.2 v/c ratio values after incorporating the suggested measures

Link	Section	V/C ratio after incorporating the recommendation						
		2020	2023	2028	2033	2038	2043	2048
Dahanu-Badepokharan	MSH4(S1)	0.21	0.25	0.32	0.23	0.29	0.37	0.48
Chinchani-Badepokharan	MSH4(S2)	0.44	0.42	0.53	0.38	0.49	0.63	0.8
Chinchani-Vangaon	SH31(S1)	0.32	0.31	0.39	0.5	0.64	0.46	0.59
Badepokharan-Vangaon		0.18	0.2	0.26	0.33	0.42	0.54	0.69
Dehane-Kambhale	SH31(S2)	0.02	0.02	0.02	0.03	0.04	0.05	0.06
Sarvali-Dehane	SH31(S3)	0.01	0.01	0.01	0.01	0.02	0.02	0.03
Dehane-Jamshet		0.01	0.01	0.02	0.02	0.03	0.03	0.04
Dahanu-Ashagad	SH30(S3)	0.57	0.66	0.48	0.61	0.78	0.99	1.27
Ganjad-Ashagad	SH30(S2)	0.28	0.32	0.41	0.3	0.38	0.48	0.62
Kasa-Ganjad	SH30(S1)	0.36	0.42	0.53	0.39	0.49	0.63	0.8
Vangaon Ganjad		0.26	0.3	0.39	0.49	0.63	0.46	0.58

6.9.2 Traffic simulation results after incorporating the suggested improvement

Traffic simulation in PTV VISSIM is again performed, incorporating the suggestions for improvement, as mentioned in

Table 6.1. The performance measures for simulation, as discussed before, are average queue length at critical intersections and average link travel speeds.

As seen in Figure 6.6, the maximum length queue length decreased after incorporating the recommended improvements. The queue build-up is observed in Dahanu and is approximately 5.4 m in 2038. These values point to intersections that are less loaded and with more efficient traffic conveyance than do-nothing scenarios. Typical simulation screenshots of at Dahanu intersection after improvements for years 2023, 2028, 2033 and 2038 are shown in Figure 6.7. The simulation was performed for a period of one hour, and the queue length was averaged over an interval of 300 secs in that period.

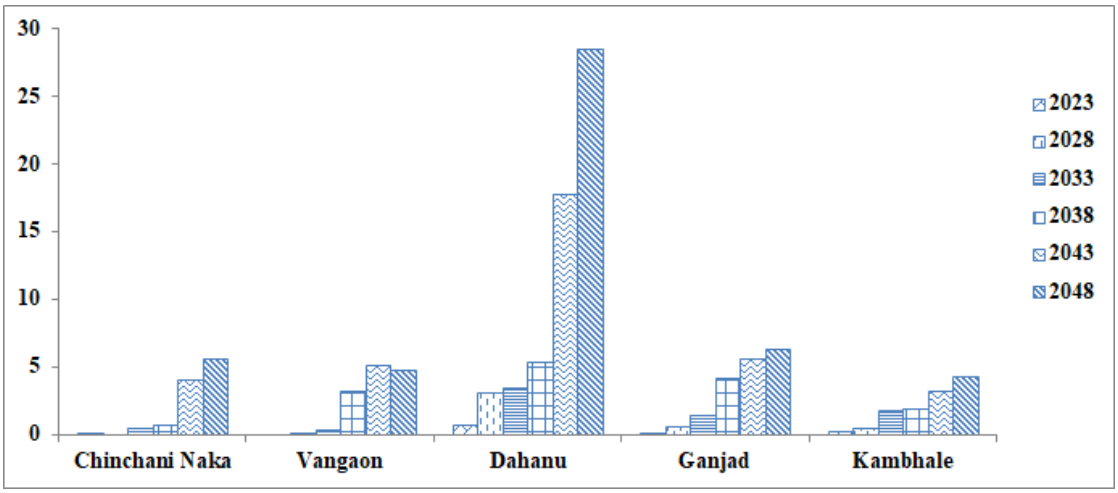
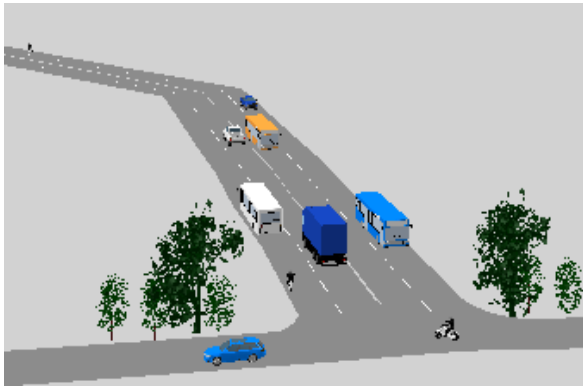
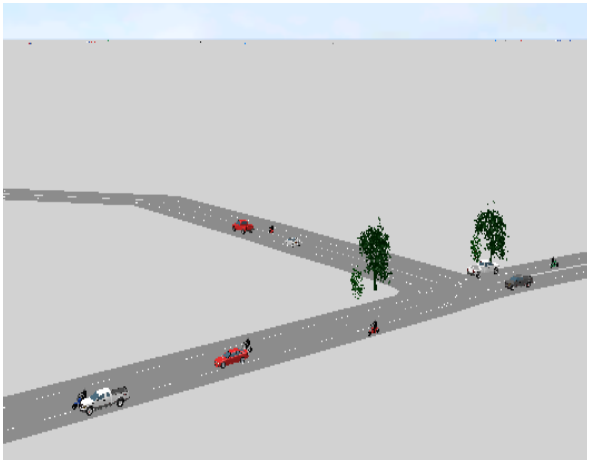


Figure 6.6 Average queue length at critical intersections in improved scenario

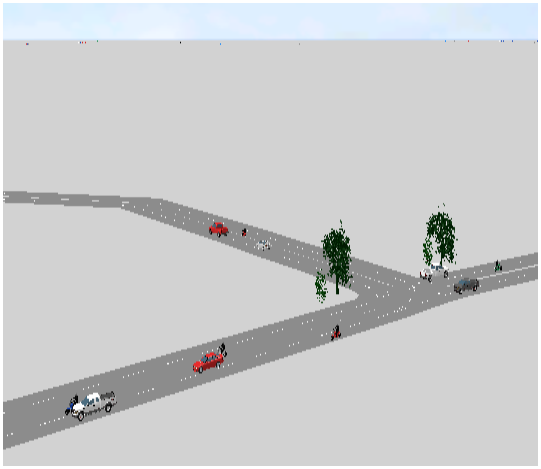
a. 2023



b. 2028



c. 2033



d. 2038

Figure 6.7 Simulation incorporating suggested improvements in Dahanu intersection

The average travel speeds on the links shown in Table 6.3 show the improved road conditions. The Dahanu-Ashagad section, which getting congested in do-nothing analysis shows improved performance if widened to a 4-lane road before 2028. The other roads suggested for 4 laning includes Badepokharan–Chinchani (for a screenshot, see Figure 6.8),Dahanu-Badepokharan, both before 2033 and Ashagad to Ganjad and further on to Kasa in NH 48 by 2033 (for a screenshot, see Figure 6.9). Ganjad to Vangaon section is also proposed to be expanded to 4 lanes before 2043. These road sections also show considerable improvement in speeds compared to the do-nothing scenario.

Table 6.3 Average link speeds incorporating improvements

Link	**Average speeds from simulation results**					
	2023	**2028**	**2033**	**2038**	**2043**	**2048**
Badepokhran chinchani	45.49	43.47	48.02	44.77	38.80	32.90
Dahanu Badepokhran	39.93	37.25	42.37	38.84	34.65	32.85
Chinchani Vangaon	37.65	35.41	32.08	28.72	34.98	30.50
Dahanu Ashagad	38.03	42.59	39.13	30.39	22.23	16.38
Sarvali Dehane	41.63	40.72	41.43	40.70	40.05	40.36
Dehane Khambale	42.46	42.41	40.94	41.98	41.02	39.90
Ganjad Jamshet	36.60	33.18	37.74	34.76	30.85	27.04
Khambale Ganjad	33.67	32.41	28.35	25.12	30.56	26.41
Jamshet Dehane	45.15	44.03	44.62	41.52	40.26	40.63
Proposed alignment	50.3	45.9	39.2	32.8	25.6	18.7

Figure 6.8 Chinchani- Badepokharan road widened to 4-lane in 2033

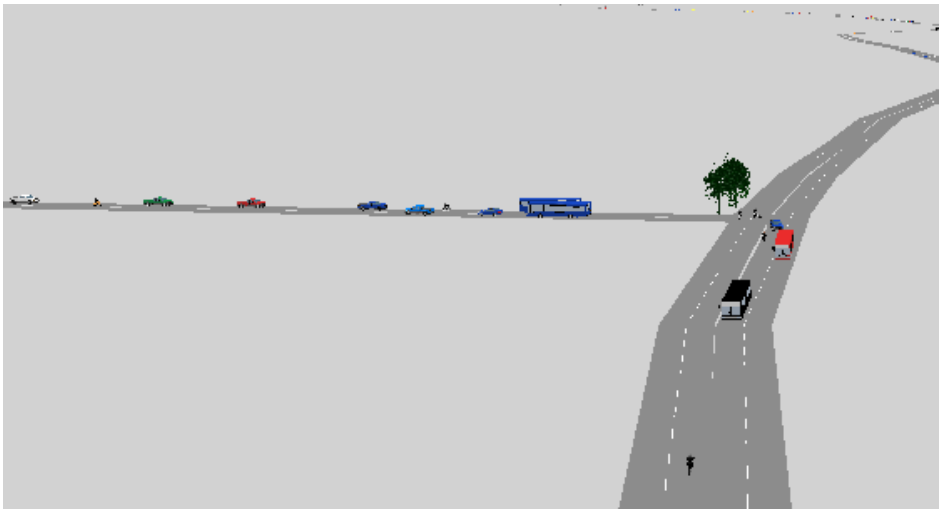


Figure 6.9 Ganjad intersection widened to 4-lane in 2033

7. Conclusions and suggestions

With the increase in the freight demand and containers in India's western and central regions, a new mega port site is proposed by the government, which can cater to future demand. A greenfield port at Vadhavan in Palaghar district is proposed as a satellite port for JNP. The aim of this study is to perform traffic analysis in the vicinity of the proposed road. An 8-lane divided connector is proposed between NH-48 and the proposed port, to cater the port bound traffic. Additionally, no major port-related infrastructure is proposed in the vicinity of the port. Thus, the port bound trucks are expected to use the 8-lane connector thus are not expected to cause congestion on the existing road network. Dahanu taluk, where the port is located, is rural in nature; the taluk headquarter, Dahanu is the biggest town in the vicinity with a population of 50,287 (2011 census). The road network in the study area carries sparse traffic.

As a part of this study, a detailed data collection was undertaken to know road inventory, traffic speed, and classified traffic volumes. The traffic volumes are estimated for 2023, 2028, 2033, 2038, 2043 and 2048. Volume to capacity ratios on network links are estimated for the future years, assuming a do-nothing scenario. A simulation is developed in PTV VISSIM to gain insight into the traffic conditions. The road network is assessed for future scenarios. Based on v/c analysis and simulation outcomes, a series of improvements are proposed in the network.

Some of the broad observations from the study are:

1) The existing road network is sufficient to carry the present level of traffic. However, many parts of the network are under distress condition affecting the speed and capacity.
2) The road widths are not uniform. Narrow road widths for small stretches affecting the travel speed and capacity.
3) In future, the study network will require capacity additions by widening the existing roads. The simulation showed reduced speeds and increased queue lengths at some key locations. Provision must be made for sufficient fund construction and land for widening.
4) The proposed 8-lane connector for port-bound truck traffic is good enough for more than 15 years (until 2038) as per the port TEU handling estimates. The estimated freight demand beyond 2040 may create congestion.

5) With the implementation of the proposed improvements at different stages, the road network can be maintained at a low congestion level for more than 20 years.

The following suggestions are made based on the results obtained through traffic assessment analysis and simulation in the base year 2020 and by analyzing the improvements for future scenarios.

1) **Resurfacing the deteriorated road stretch in the study network**: This ensures safe, comfortable, and faster travel in the study network.
2) **Maintaining the provision of shoulders**: The authorities can ensure the provision of shoulders on both sides of the road throughout the study network
3) **Road-over bridge on a railway crossing in Vangaon**: The at-grade railway crossing (Western railway line) in Vangaon, can be improved with the road-over bridge. This can eliminate a bottleneck which can cause 10-15 minutes stoppage at very frequent intervals, resulting in significant queue length.
4) **Four laning of Dahanu to Ashagad road**: The road connecting Dahanu and Ashagad is mostly an undivided 2 lane road, which is recommended to widened to a divided 4 lane road before 2028 with uniform road width. A provision of proper shoulders should be provided on both side of the road along the stretch
5) **Bhoisar-Dahuan Coastal Road:** This is an important road for Bhoisar industrial area bound traffic. Presently this coastal road is of varying width from one lane to two lanes. The entire road needs to widened to uniform 2-lane before 2023 with shoulders on the both sides. This road need to widened to four-lane before 2033.
    - **Two laning followed with 4 laning of Chinchani to Badepokharan**: The road connecting Chinchani and Badepokharan is mostly a 1.5 intermediate lane road, which recommended to be widened to 2-lane before 2023 and then to a 4-lane road before 2033. A provision of proper shoulders should be provided on both side of the road along the stretch
    - **Four laning of Dahanu to Badepokharan:** The road connecting Dahahu and Badepokhran is mostly an undivided 2 lane road, which is suggested to be widened to a divided 4 lane road before 2033 with uniform road width.
6) **Widening of Chinchani to Vangaon followed by 4 laning in 2043**: The road connecting Chinchani and Vangaon is mostly a 1.5 intermediate lane road, which needs to be widened to undivided 2 lane road before 2023 with uniform road width. A provision of proper

shoulders should be provided on both side of the road along the stretch. Further before 2043 the section is proposed to be widened to 4 lanes to cater for the increasing travel demand.

7) **Four-laning of Ashagad to Ganjad**: The road connecting Ashagad and Ganjad is mostly an undivided 2 lane road, which needs to be expanded to an undivided 4 lane road before 2033 with uniform road width. A provision of proper shoulders should be provided on both side of the road along the stretch.
8) **Four-laning of Ganjad to Vangaon**: The road connecting Vangaon in SH 31 to Ganjad junction in SH 30, which was 2-lane undivided, is recommended to be expanded to 4 lanes before 2043. A provision of proper shoulders should be provided on both side of the road along the stretch.

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