

ROAD AND TRANSPORTATION MASTERPLAN

PALESTINE

TA 2012013 PS 00 F10
VII –Transport ModelOutputs

SEPTEMBER 30,2016



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1 Introduction

This introductory chapter is aimed at providing a technical and detailed outline of the comprehensive Transport Model exercise (here after: PTM), which was developed specifically to assess the effectiveness of the future proposed infrastructural scenarios, supporting, with a solid and evidence-based analytical approach, the formulation of the NTMP of West Bank and Gaza Strip, providing relevant and accurate information into planning and decision-making and thus playing an essential role as a decision-support tool.

This chapter includes the following parts:

- Part 2: Modelling Framework, describing model's structure, and;
- Parts 3 - 9: Model outputs for each modelled scenario (Base Year, No Restrictions on Base Year, Phase 1, Phase 2, Phase 3, Phase 4).

The detailed description of the software package used for the implementation of the model, each modelling step, the calibration process and the forecasting assumptions are reported in the *Annex 16 - Transport Model Features and Calibration*

In general, a Transport Model can be defined as a computer-based representation of the movement of people and goods (trips) across a transport network within a certain Study Area, which has specific socio-economic and land-use characteristics, with the primary aim of providing an indication of how trips will respond, over time, to changes in transport supply and demand.

To this end, the outputs from a Transport Model provide essential insight into the understanding of existing or future transport issues, supporting infrastructure design and operational planning as well as identifying the likely impacts that will result from a proposed project or strategy.

As thoroughly described here, NTMP represents the final result of a robust and in-depth analysis of the Palestinian context, aimed at replicating, with great accuracy, the current status of affair at territorial scale from a multi-dimensional perspective, including all transportation sectors (from both demand and supply standpoints), the political and administrative framework, urban development demography and social aspects, economy and environment.

To this end, a large amount of available data and background information were sourced, carefully analysed and integrated with an extensive and articulated traffic survey campaign, specifically designed to gather from the ground all necessary information to build and calibrate a robust baseline model (to replicate existing conditions) and ensure full reliability for the results of future scenario testing.

In detail, the Transport Model was used for:

- Understanding the specific role and function of any existing infrastructure and transport service in response to freight and passengers' mobility;
- Exploring and identifying potential issues and criticalities across the multi-modal network and understanding the need for additional capacity and/or improved efficiency;
- Providing demand data for appropriate scenario testing, dimensioning and design of new infrastructure and operational service able to effectively respond to traffic forecasts as well as functional requirements;
- Understanding and evaluating the impact of a new transport scheme on transport demand and how transport conditions will change in the future in response to changes in population, employment, economic activity, land-use distribution, car ownership, etc.; and,
- Providing quantitative information to inform Feasibility, Cost Benefit Analysis, Financial Analysis, and Environmental Assessment.



As indicated in the following paragraph, among different approaches and transport model's architectures, an enhanced macroscopic four-step transportation model is chosen as the most suitable analytical platform to assess the effectiveness of Master Plan's proposals. Four-step models are the standard in transportation modelling since the late 1950s and are effectively used since the 1960s; although the basic principles behind such models have largely remained unchanged, modelling software has on the other hand drastically with advances computer technology and years of experimentation and development have resulted in a general structure which is called the classic transport model commonly referred to as a Four-Stage Model.

2 Modelling Framework

While there are other methods used to estimate travel demand in urban areas, travel demand forecasting and modelling remain decisive tools in the analysis of transportation plans, projects, and policies. Modelling results are useful to those making transportation decisions (and analysts assisting in the decision-making process) in system and facility design and operations and to those developing transportation policy.

In general, transport models belong to a relevant segment of abstract models, namely mathematical models, characterized by the attempt to efficiently replicate a particular system of interest and its behavior by means of mathematical equations, based on specific theoretical statements.

Years of experimentation and development have resulted in a general structure that is called the classic transport model commonly referred to as a **Four-Stage Model**. Four Stage models are built on a sequential process of four distinct steps for estimating transportation demand; namely: trip generation, distribution, modal split and assignment. Four stage models are effectively used since the 1960s and the basic principles behind such models have largely remained unchanged, modelling software has on the other hand drastically with advances computer technology.

In summary the analytical approach used in a four stage model typically starts by considering the extent of the study area and defining the multi-modal network operating within that study area i.e. road network and public transport network. The study area is subsequently divided this into logical and appropriately-sized transport zones and each zone is populated with most recent economic activity data, demographic data and travel demand data. Additional traffic data are collected to assist calibration process that takes place at each step of the modelling process.

These data are then used to estimate a model of the total number of trips generated and attracted by each zone of the study area (trip generation); the next stage is the allocation of these trips to particular destinations, in other words their distribution over space, thus producing a trip matrix (trip distribution).

The following stage involves modelling the choice of mode, resulting in modal split, i.e. the allocation of trips in the matrix to different modes (typically road sector, public transport systems and/or other modes).

Finally, the last stage in the classic model requires the assignment of the trips by each mode to their corresponding networks. Each stage will be explained in detail in subsequent chapters.

The serial nature of the process is not meant to imply that the decisions made by travelers are actually made sequentially rather than simultaneously, nor that the decisions are made in exactly the order implied by the four-stage process. In four-stage travel models, the unit of travel is the "trip," defined as a person or vehicle travelling from an origin to a destination with no intermediate stops. Since people travelling for different reasons behave differently, four-stage models segment trips by trip purpose.

The PTM consists of a specific and tailored multimodal transport platform structured on the basis of the typical four-stage modelling process, covering the geographical area of West Bank and Gaza Strip; key features of the PTM are outlined as follows:

- Typical four-stage modelling process (Trip Generation/Attraction, Trip Distribution, Modal Split, Traffic Assignment);
- Simulation of the 4-hour peak of the PM period;
- Multimodal model | 4 modes: private cars, taxis, collective taxis, public transport (bus and rail). Also light commercial vehicles (LCV) and heavy commercial vehicles (HCV) are included in the model;
- Analysis of both passengers and freight mobility;
- The adopted fare system is 0.2 shekel/km for bus routes and 0.36 shekel/km for rail routes;
- Value of time are derived from the "EU25 Countries" values reported by HEATCO. These values are weighted on the basis of the characteristics of the travel demand in West Bank and Gaza Strip, resulting in 58.99 shekel/h for bus and 73.62 shekel/h for car and train
- Each forecasting scenario is modeled at the end of the last year of the phasing period

The PTM is implemented by using the software package CUBE (Citilabs, Ltd)

3 Transport Model Outputs for Base Year (end 2015)

PTM's outcomes of Base Year 2015 scenario are presented here. Information about the modelled network for both the private traffic and public transport system, along with trip generation/attractions, modal split, public transport fares, vehicle and passenger volumes are reported. Finally, Statistical data of the network's performances are reported. The modelled reference year for the Base Year 2015 is the end of 2015.

3.1 Networks

The following picture shows the modelled road and public transport networks at the Base Year 2015.

Figure 1. Base Year 2015, Road Hierarchy

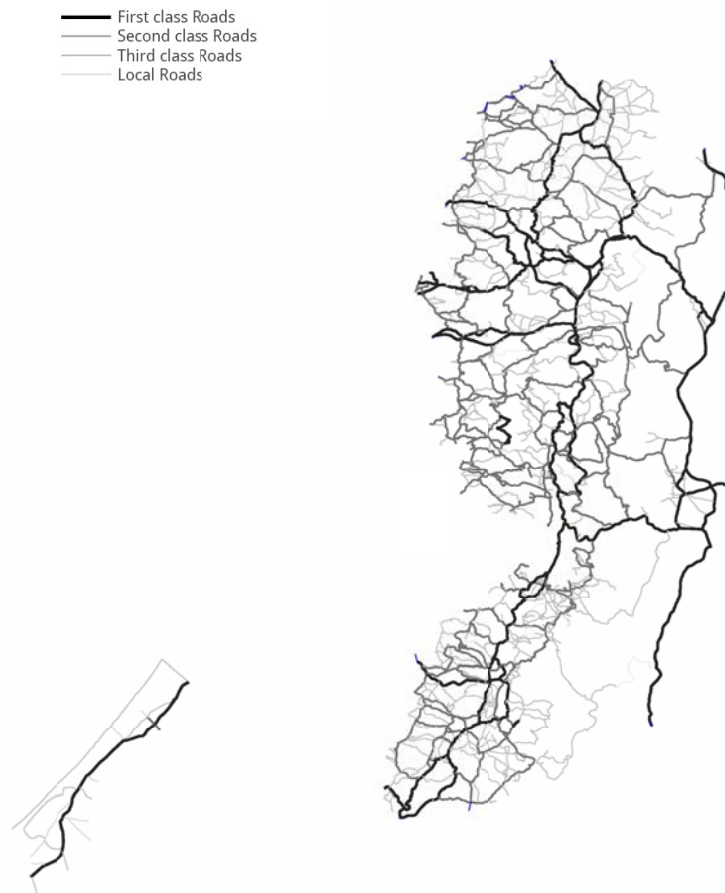
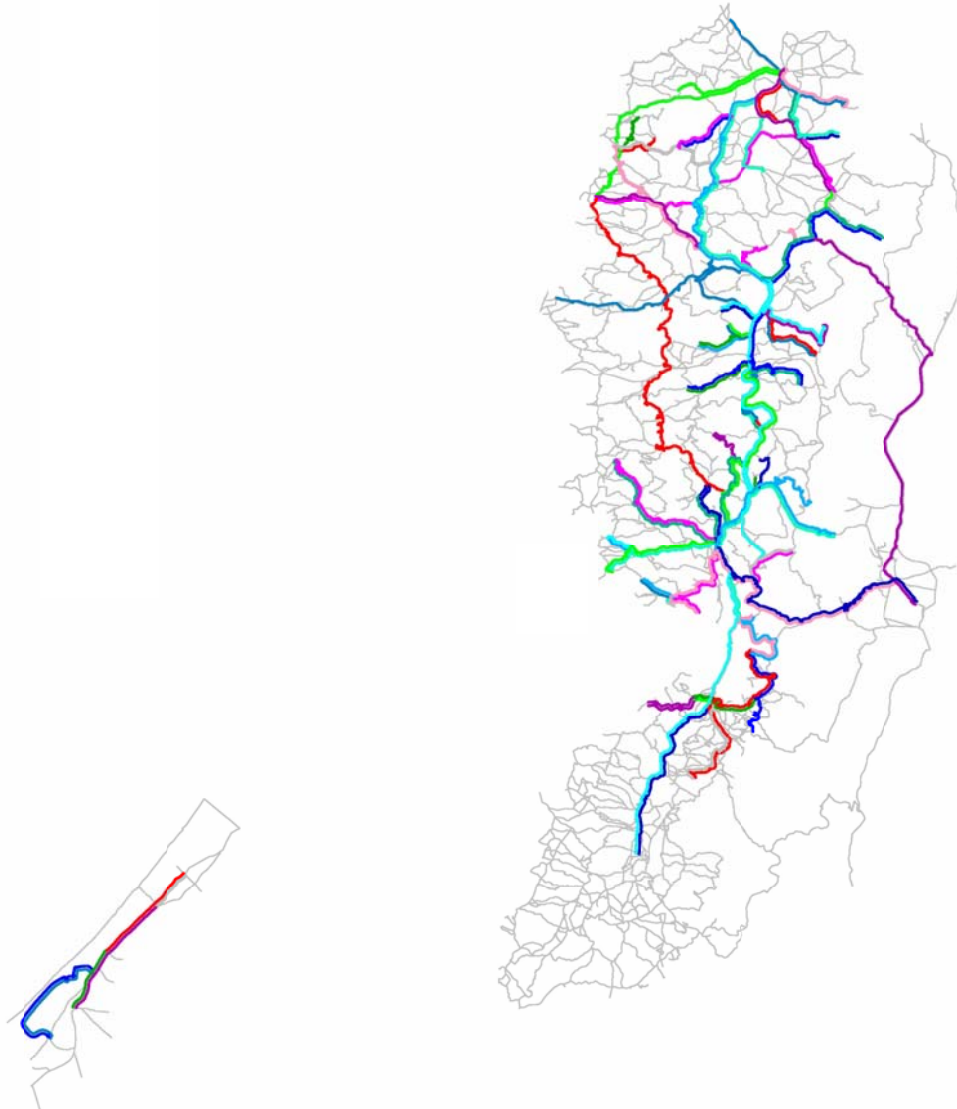




Figure 2. Base Year 2015, Public Transport Network





The origins and destinations of the PT lines are reported in the following table.

Tab 1. Base Year 2015, PT Lines

FROM	TO	FROM	TO
Tulkarm	Zeita	Al-Issawiya	Sur Bahir
Tulkarm	An Nazlat	Anata	Ramallah
Tulkarm	Seida, e'llar, Deir al Ghusun, 'Attil	Anata	Al-Issawiya
Tulkarm	Nablus	Al Mazra'a ash Sharqiya - Sinjil	Ramallah
Tulkarm	Jenin	Al Mazra'a ash Sharqiya	Ramallah
Tulkarm	Raba	Nablus	Qalqiliya
Beit 'Ur	Ramallah	Al-Issawiya	Shufat
Beit Liqya	Ramallah	Al-Issawiya	Anata
Zeita	Nablus	Al-Issawiya	Beit Safafa
Deir Abu Mash'al	Ramallah	Al-Issawiya	Sur Bahir
Hebron	Bethlehem	Anata	Ramallah
Beit 'Anan	Ramallah	Anata	Al-Issawiya
Arqoup	Bethlehem	Al Mazra'a ash Sharqiya - Sinjil	Ramallah
Beit Surik	Ramallah	Al Mazra'a ash Sharqiya	Ramallah
Kafr Ra'i	Jenin	Nablus	Qalqiliya
Salfit	Nablus	Nablus	Tulkarm
Beit Fajjar	Bethlehem	Nablus	Zeita
Al Walaja	Bethlehem	Nablus	Salfit
Al Walaja	Al-Issawiya	Nablus	Jamma'in
Beit Iksa	Ramallah	Nablus	Ramallah
Jamma'in	Nablus	Nablus	Asira Alqableh
Burqa	Ramallah	Nablus	'Urif
Bir Zayt University	Bir Zayt	Nablus	Aseera al-shamalia
Bir Zayt University	Ramallah	Nablus	Beita
Bir Zayt	Bir Zayt University	Nablus	Jenin
Bethlehem	Hebron	Nablus	Al Badhan
Bethlehem	Arqoup	Nablus	Qusra
Bethlehem	Beit Fajjar	Nablus	El Far'a Camp
Bethlehem	Al Walaja	Nablus	Agraba
Bethlehem	Al-Issawiya	Nablus	Beit Furik
Ramallah	Tulkarm	Nablus	Tubas
Ramallah	Beit 'Ur	Nablus	Tammun
Ramallah	Beit Liqya	Beita	Nablus
Ramallah	Deir Abu Mash'al	Qabatiya	Jenin
Ramallah	Beit 'Anan	Jenin	Hebron
Ramallah	Beit Surik	Jenin	Ya'bad
Ramallah	Beit Iksa	Jenin	Kafr Ra'i
Ramallah	Burqa	Jenin	Nablus
Ramallah	Bir Zayt University	Jenin	Meithalun
Ramallah	At Tayba	Jenin	Qabatiya
Ramallah	'Abwein	Jenin	Tubas
Ramallah	Al-Issawiya	Jenin	Raba
Ramallah	Anata	Jenin	Jalqamus
Ramallah	Silwad	Jenin	Jericho
Ramallah	Al Mazra'a ash Sharqiya - Sinjil	Al Jalazun Camp	Ramallah
Ramallah	Nablus	Qusra	Nablus
Ramallah	Jenin	El Far'a Camp	Nablus
Ramallah	Al Jalazun Camp	Agraba	Nablus
Ramallah	At Tayba-Deir Jarir	Beit Furik	Nablus
Ramallah	Rammun	Tubas	Nablus
Ramallah	Jericho	Tubas	Jenin
Al Bireh	Ramallah	Rammun	Ramallah
Asira Alqableh	Nablus	Raba	Jenin
'Urif	Nablus	Jalqamus	Jenin
Beit Hanina al Balad	Al-Issawiya	Tammun	Nablus
Shufat Camp	Al-Issawiya	Jericho	Ramallah
Za'tara	Ramallah	Rafah	Gaza
Al-Issawiya	Al Walaja	Khan Younis	Gaza
Al-Issawiya	Bethlehem	Al Nouseirat	Gaza
Al-Issawiya	Ramallah	Gaza	Rafah
Al-Issawiya	Beit Hanina al Balad	Gaza	Khan Younis
Al-Issawiya	Shufat	Gaza	Deir al Balah
Al-Issawiya	Anata	Beit Safafa	Al-Issawiya
Al-Issawiya	Beit Safafa	Sur Bahir	Al-Issawiya

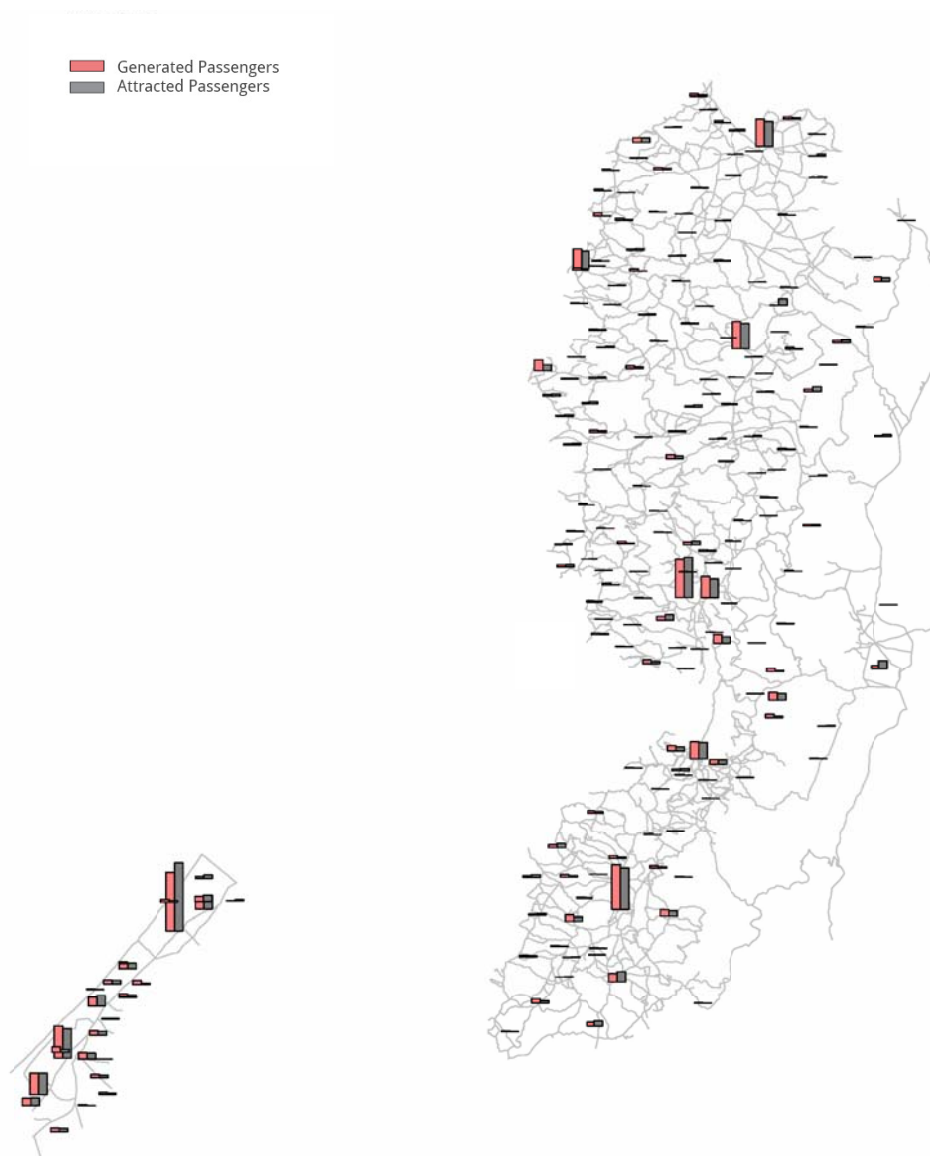
3.2 Trip Generation

In the Base Year 2015 the trip generation/attractions figures are:

- 317,388 generated passengers trips
- 292,756 attracted passengers trips
- 9,124 LCVs
- 24,179 HCVs
- 1,180 International passengers

The following picture shows the origin and destination trips by histograms.

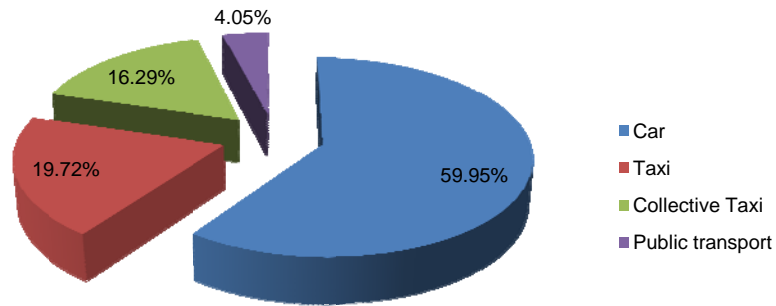
Figure 3. Base Year 2015, Trip Generations and Attractions



3.3 Modal Split

The following graph shows the modal split in the Base Year 2015:

Figure 4. Base Year 2015, Modal Split



The following table shows the trips by mode for the main cities.

Tab 2. Base Year 2015, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	9,942	10,071	3,043	3,112	2,584	2,632	884	513
Deir Al Balah	10,923	9,089	4,218	3,512	3,315	2,759	477	396
Gaza	17,414	19,839	6,766	7,539	5,350	6,028	1,271	1,391
Hebron	29,564	29,931	10,284	10,354	8,191	8,262	1,879	2,105
Jenin	14,959	14,943	4,846	4,919	3,993	4,043	1,065	1,101
East Jerusalem	9,316	7,148	2,867	2,171	2,435	1,855	1,244	836
Jericho	1,307	3,713	336	840	314	840	81	393
Khan Younis	16,231	13,331	5,735	4,828	4,745	3,942	829	665
Nablus	14,390	18,872	4,272	5,509	3,568	4,651	902	1,220
North Gaza	4,851	7,231	1,745	2,535	1,417	2,091	246	376
Qalqilya	6,809	6,054	1,913	1,732	1,646	1,484	246	259
Ramallah/Al Bireh	28,040	27,675	8,398	8,427	7,166	7,114	2,289	2,427
Rafah	9,522	9,450	3,196	3,245	2,707	2,715	473	469
Salfit	3,207	3,112	897	879	792	770	142	157
Tubas	11,907	8,496	3,487	2,575	2,989	2,174	721	475
Tulkarm	1,879	1,306	571	395	475	330	106	73

3.4 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 5. Base Year 2015, Traffic Volumes

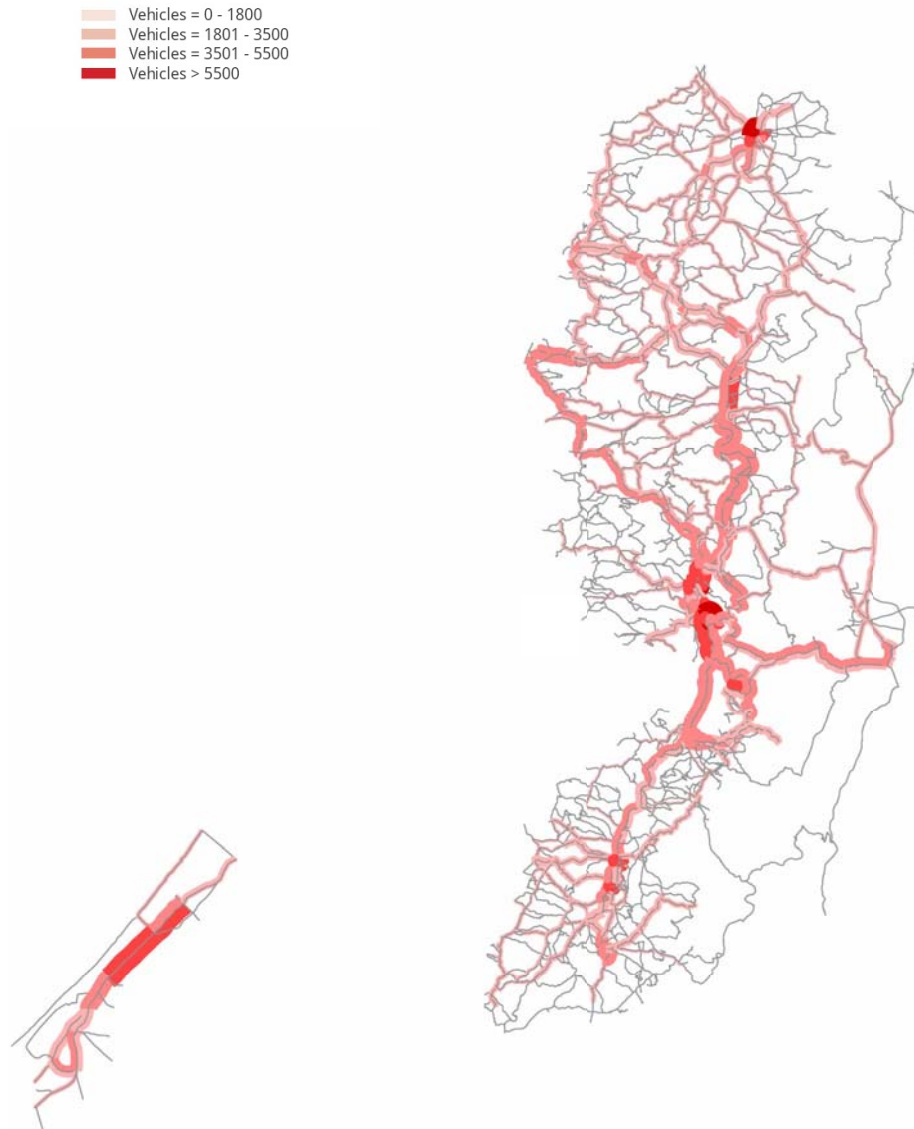


Figure 6. Base Year 2015, Volume/Capacity Ratio

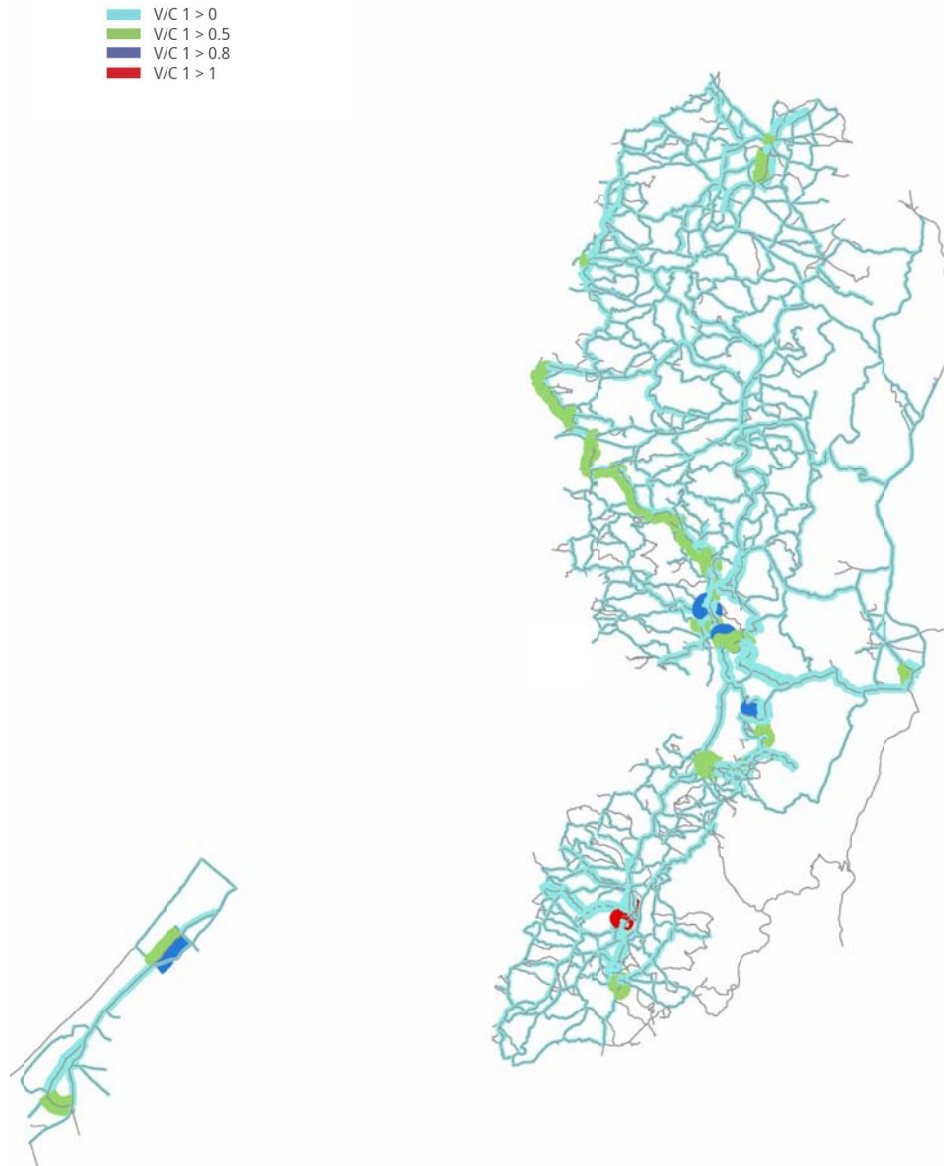
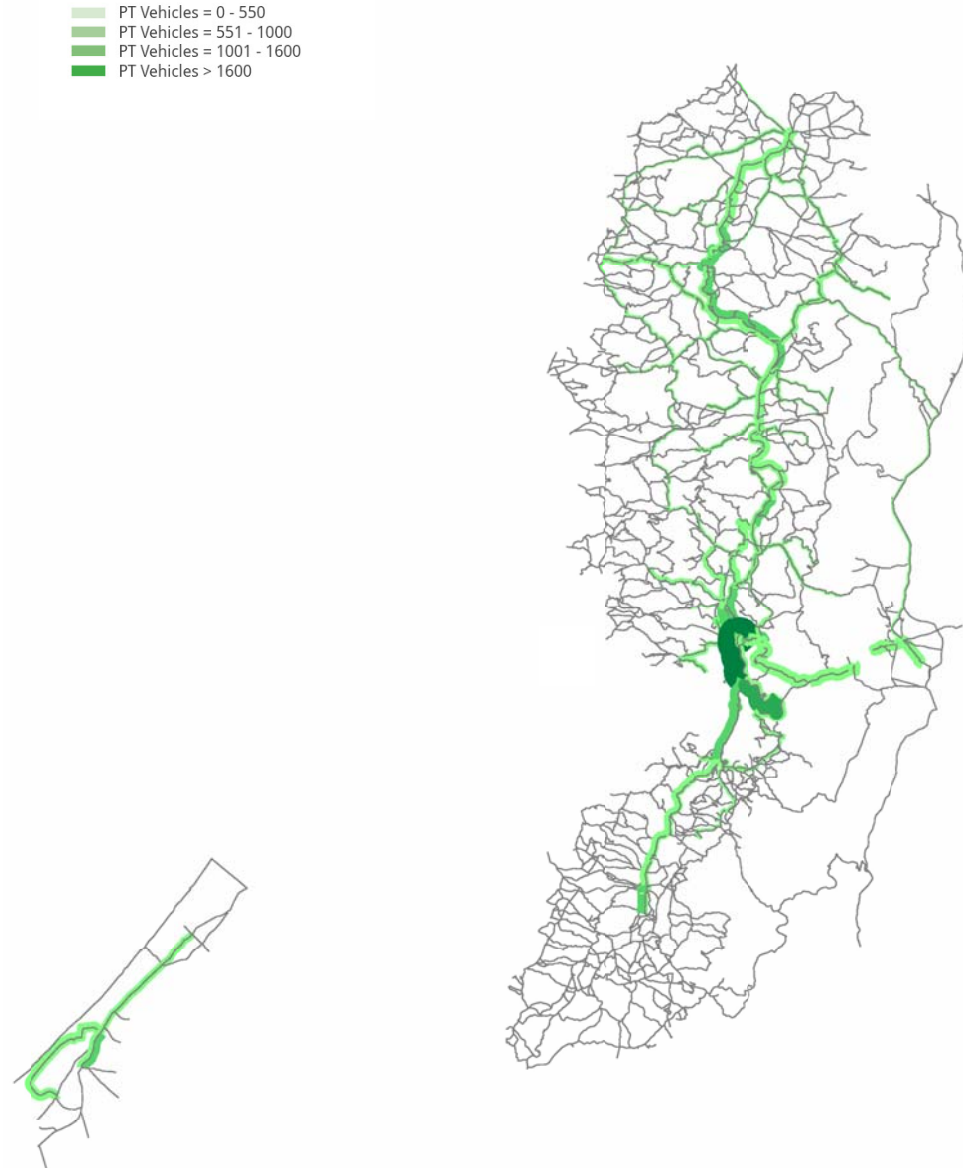


Figure 7. Base Year 2015, PT Ridership





3.5 Main Results

The network output are reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network;
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network;
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network.

Tab 3. Base Year 2015, Road Network Main Results

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,070.99	2,765,396.95	43,235.95	63.96
Other a	275.00	115,357.32	2,307.15	50.00
Other b	30.00	1,244.65	24.89	50.00
Local a	214.19	10,699.68	360.71	29.66
Local b	17.39	0.00	0.00	0.00
Third Class Road	117.47	38,895.33	792.79	49.06
Second Class Road	3,443.85	440,521.61	9,112.58	48.34
Primary Class Road a	2,487.48	781,222.94	12,831.92	60.88
Primary Class Road b	268.77	101,482.43	1,060.01	95.74
Other c	1,212.64	1,275,875.54	16,736.14	76.23

Regarding the Public Transport System, in the **Base Year 2015** there are **251,635 passengers*km** for an average of **8,256passengers*hour**.

4 Traffic Restrictions Removal

The Base Year 2015 vehicle circulation is affected by several traffic restrictions. In this paragraph are reported the main outcomes and comparisons of a test conducted by removing the traffic restrictions. The road network, PT lines and trip generation data are the same of the Base Year 2015 with restrictions.

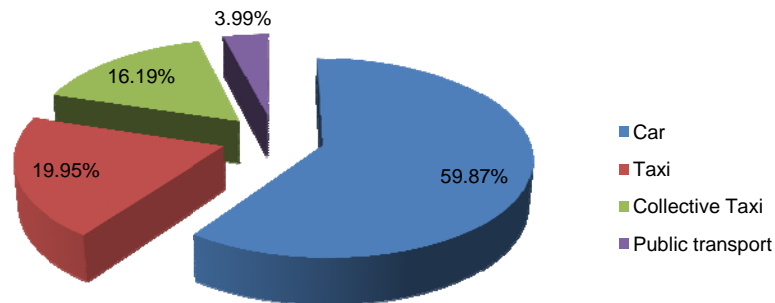
The results show that without restrictions there is a potential increase of traffic of 1%. Focusing on the time lost in the network, the comparison of the results shows that without restrictions there is a reduction of 11%. By applying the VOT to these values, there would be savings of 335,772 shekels, referring to the 4-hour peak. Extending this value on a daily basis it becomes 1,199,187 shekels per day, hence around 420m shekels (around €100m annual).

Regarding the Public Transport System, in the Base Year 2015 without restrictions there would be 265,801 passengers*km for an average of 7,100 passengers*hour. There would be, then, an increase of distances travelled by using the public transport system, with a decrease of the time on board of 14.0%.

4.1 Modal Split

The following graph shows the modal split in the Base Year 2015:

Figure 8. Base Year 2015 without restrictions, Modal Split



Without restrictions is registered a higher use of taxis, with an increase of 1.27%. The car users are almost the same, with a variation of -0.08%, while the collective taxis and the public transport show values reduced by -0.55% and -2.67% respectively.

The following table shows the trips by mode for the main cities.



Tab 4. Base Year 2015 without restrictions, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	9,869	10,010	3,141	3,210	2,533	2,580	910	524
Deir Al Balah	10,932	9,089	4,207	3,512	3,316	2,759	478	396
Gaza	17,414	19,832	6,766	7,539	5,350	6,033	1,271	1,394
Hebron	29,475	29,825	10,436	10,501	8,128	8,194	1,880	2,114
Jenin	14,940	14,947	4,876	4,948	3,958	4,007	1,089	1,119
East Jerusalem	9,484	7,104	3,027	2,237	2,447	1,819	904	848
Jericho	1,292	3,680	354	900	305	810	87	397
Khan Younis	16,223	13,331	5,744	4,828	4,742	3,942	831	665
Nablus	14,361	18,835	4,300	5,557	3,547	4,625	923	1,240
North Gaza	4,851	7,232	1,745	2,534	1,417	2,091	246	375
Qalqilya	6,804	6,047	1,924	1,742	1,638	1,476	249	266
Ramallah/Al Bireh	27,902	27,748	8,606	8,689	7,049	7,067	2,335	2,133
Rafah	9,515	9,450	3,196	3,245	2,714	2,714	474	469
Salfit	3,198	3,109	905	885	785	764	150	159
Tubas	11,877	8,470	3,525	2,601	2,966	2,158	735	497
Tulkarm	1,875	1,301	576	401	474	329	107	72

4.2 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 9. Base Year 2015 without restrictions, Traffic Volumes

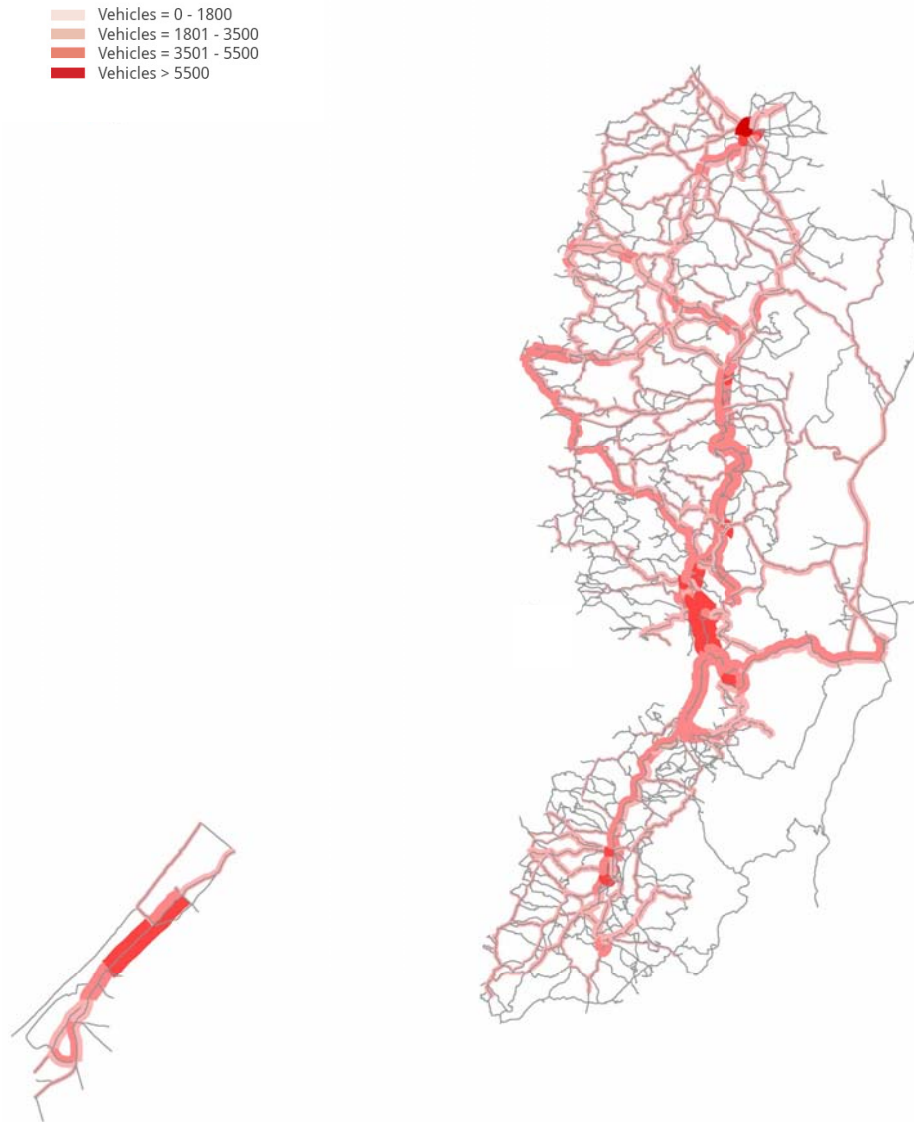


Figure 10. Base Year 2015 without restrictions, Volume/Capacity Ratio

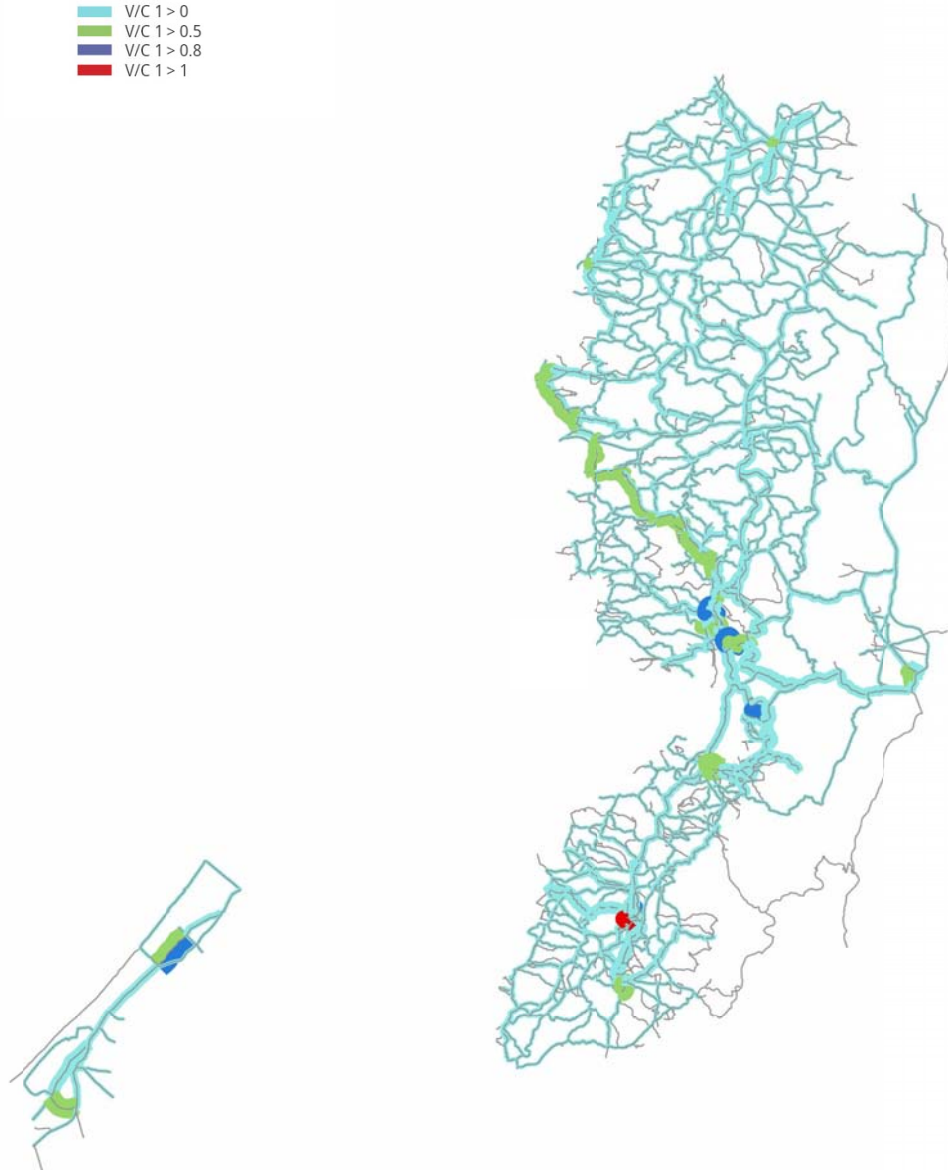


Figure 11. Base Year 2015 without restrictions, PT Ridership





4.3 Main Results

The network output are reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network

Tab 5. Base Year 2015 without restrictions, Road Network Main Results

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,070.99	2,791,405.71	38,677.54	72.17
Other a	275.00	115,969.08	2,319.38	50.00
Other b	30.00	1,244.65	24.89	50.00
Local a	214.19	9,812.90	327.41	29.97
Local b	17.39	0.00	0.00	0.00
Third Class Road	117.47	38,845.27	791.12	49.10
Second Class Road	3,443.85	415,357.98	8,398.62	49.46
Primary Class Road a	2,487.48	747,972.71	10,697.27	69.92
Primary Class Road b	268.77	94,008.60	940.12	100.00
Other c	1,212.64	1,368,093.39	15,168.62	90.19

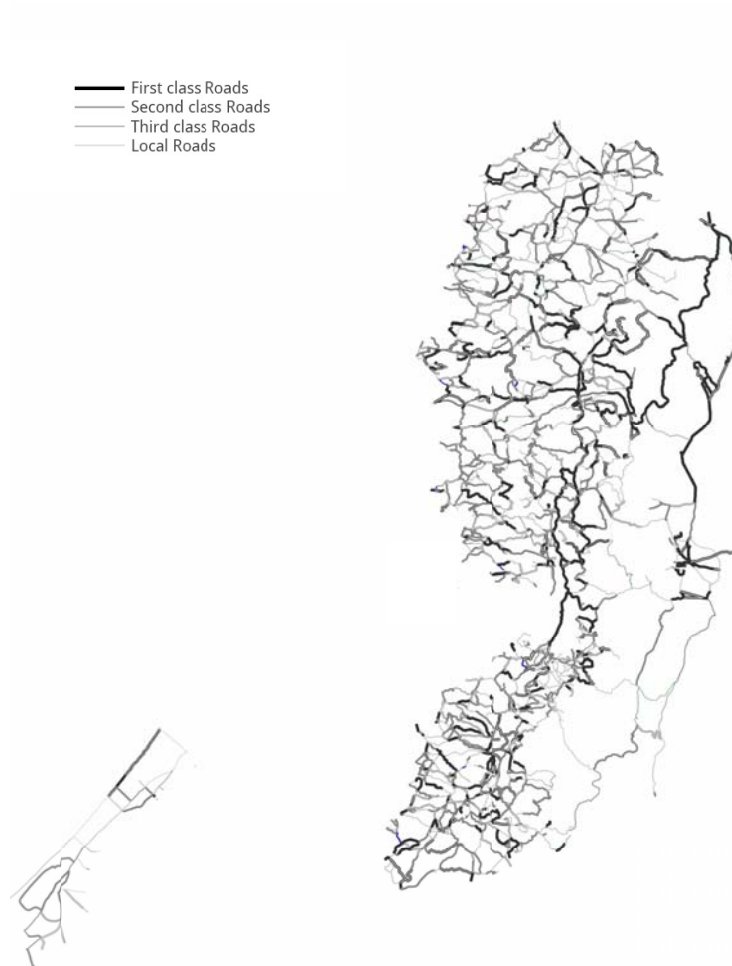
5 Transport Model Outputs for Phase 1A (2-Year Investment Plan: End of 2016 – 2018)

This chapter described the model's outputs of the **Phase 1A** scenario. Information about the modeled network for both the private traffic and public transport system, trip generation/attractions, modal split, public transport fares, vehicle and passenger volumes are reported. Statistical data of the network's performances are reported at the end of the chapter. The modeled reference year for Phase 1A is the end of 2019.

5.1 Networks

The following picture shows the modelled road and PT networks at Phase 1A.

Figure 12. Phase 1A, Road Hierarchy





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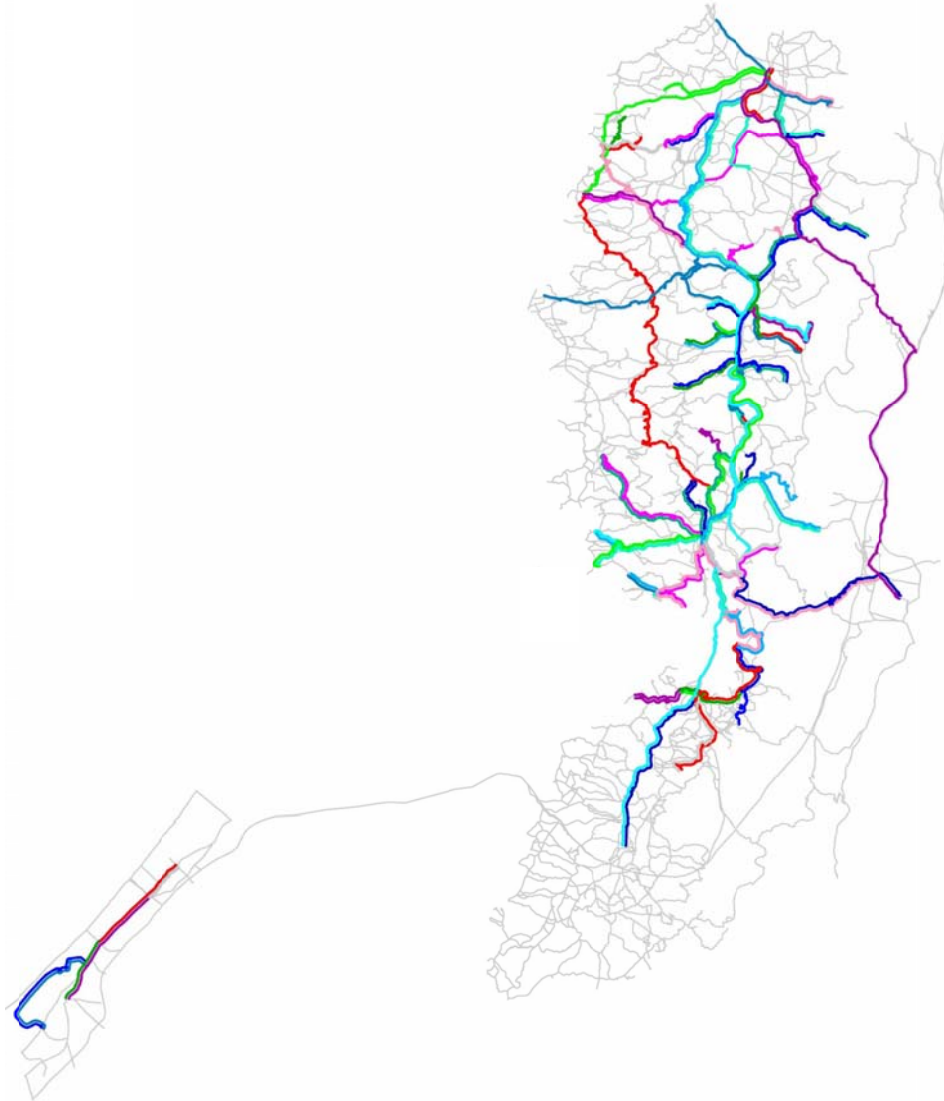
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Figure 13. Phase 1A, PT Lines





The origins and destinations of the PT lines are reported in the following table.

Tab 6. Phase 1A, PT Lines

FROM	TO	FROM	TO
Tulkarm	Zeita	Al-Issawiya	Sur Bahir
Tulkarm	An Nazlat	Anata	Ramallah
Tulkarm	Seida, e'llar, Deir al Ghusun, 'Attil	Anata	Al-Issawiya
Tulkarm	Nablus	Al Mazra'a ash Sharqiya - Sinjil	Ramallah
Tulkarm	Jenin	Al Mazra'a ash Sharqiya	Ramallah
Tulkarm	Raba	Nablus	Qalqiliya
Beit 'Ur	Ramallah	Al-Issawiya	Shufat
Beit Liqya	Ramallah	Al-Issawiya	Anata
Zeita	Nablus	Al-Issawiya	Beit Safafa
Deir Abu Mash'al	Ramallah	Al-Issawiya	Sur Bahir
Hebron	Bethlehem	Anata	Ramallah
Beit 'Anan	Ramallah	Anata	Al-Issawiya
Arqoup	Bethlehem	Al Mazra'a ash Sharqiya - Sinjil	Ramallah
Beit Surik	Ramallah	Al Mazra'a ash Sharqiya	Ramallah
Kafr Ra'i	Jenin	Nablus	Qalqiliya
Salfit	Nablus	Nablus	Tulkarm
Beit Fajjar	Bethlehem	Nablus	Zeita
Al Walaja	Bethlehem	Nablus	Salfit
Al Walaja	Al-Issawiya	Nablus	Jamma'in
Beit Iksa	Ramallah	Nablus	Ramallah
Jamma'in	Nablus	Nablus	Asira Alqableh
Burqa	Ramallah	Nablus	'Urif
Bir Zayt University	Bir Zayt	Nablus	Aseera al-shamalia
Bir Zayt University	Ramallah	Nablus	Beita
Bir Zayt	Bir Zayt University	Nablus	Jenin
Bethlehem	Hebron	Nablus	Al Badhan
Bethlehem	Arqoup	Nablus	Qusra
Bethlehem	Beit Fajjar	Nablus	El Far'a Camp
Bethlehem	Al Walaja	Nablus	Aqraba
Bethlehem	Al-Issawiya	Nablus	Beit Furik
Ramallah	Tulkarm	Nablus	Tubas
Ramallah	Beit 'Ur	Nablus	Tammun
Ramallah	Beit Liqya	Beita	Nablus
Ramallah	Deir Abu Mash'al	Qabatiya	Jenin
Ramallah	Beit 'Anan	Jenin	Hebron
Ramallah	Beit Surik	Jenin	Ya'bad
Ramallah	Beit Iksa	Jenin	Kafr Ra'i
Ramallah	Burqa	Jenin	Nablus
Ramallah	Bir Zayt University	Jenin	Meithalun
Ramallah	At Tayba	Jenin	Qabatiya
Ramallah	'Abwein	Jenin	Tubas
Ramallah	Al-Issawiya	Jenin	Raba
Ramallah	Anata	Jenin	Jalqamus
Ramallah	Silwad	Jenin	Jericho
Ramallah	Al Mazra'a ash Sharqiya - Sinjil	Al Jalazun Camp	Ramallah
Ramallah	Nablus	Qusra	Nablus
Ramallah	Jenin	El Far'a Camp	Nablus
Ramallah	Al Jalazun Camp	Aqraba	Nablus
Ramallah	At Tayba-Deir Jarir	Beit Furik	Nablus
Ramallah	Rammun	Tubas	Nablus
Ramallah	Jericho	Tubas	Jenin
Al Bireh	Ramallah	Rammun	Ramallah
Asira Alqableh	Nablus	Raba	Jenin
'Urif	Nablus	Jalqamus	Jenin
Beit Hanina al Balad	Al-Issawiya	Tammun	Nablus
Shufat Camp	Al-Issawiya	Jericho	Ramallah
Za'tara	Ramallah	Rafah	Gaza
Al-Issawiya	Al Walaja	Khan Younis	Gaza
Al-Issawiya	Bethlehem	An Nuseirat	Gaza
Al-Issawiya	Ramallah	Gaza	Rafah
Al-Issawiya	Beit Hanina al Balad	Gaza	Khan Younis
Al-Issawiya	Shufat	Gaza	Deir al Balah
Al-Issawiya	Anata	Beit Safafa	Al-Issawiya
Al-Issawiya	Beit Safafa	Sur Bahir	Al-Issawiya

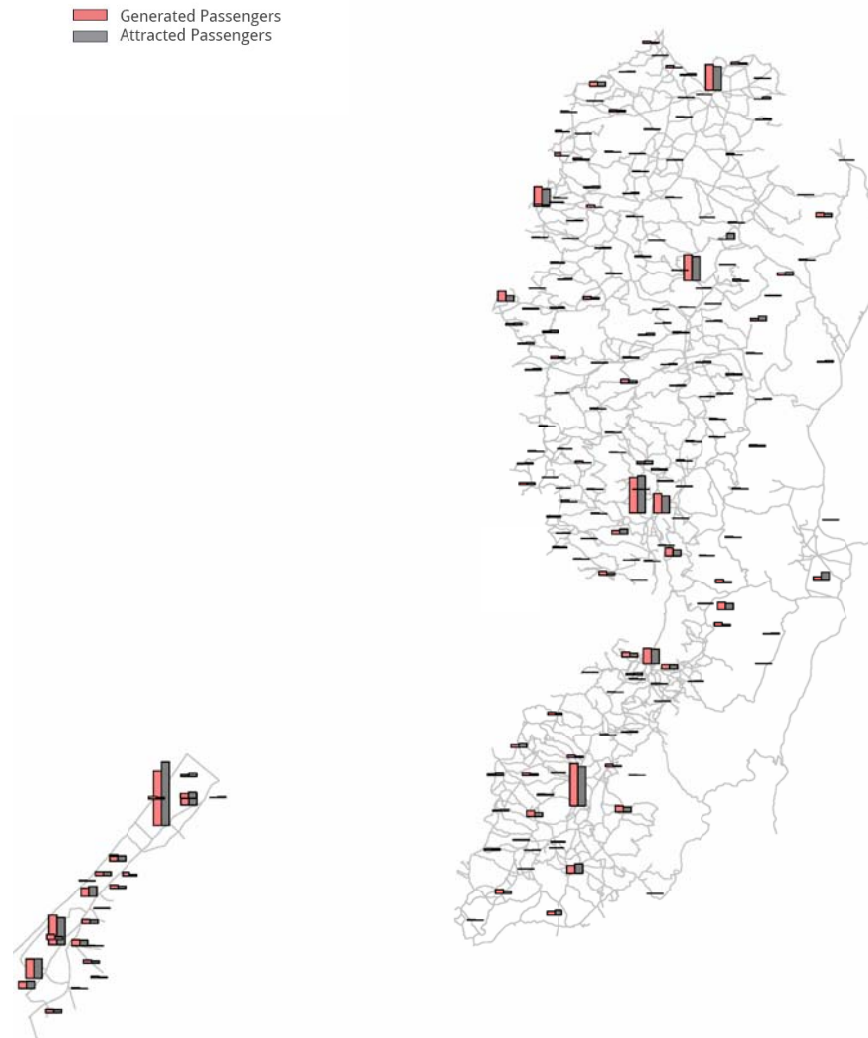
5.2 Trip Generation

In the Phase 0 scenario the trip generation/attractions figures are:

- 385,627 generated passengers trips
- 355,699 attracted passengers trips
- 10,985 LCVs
- 29,666 HCVs
- 3,897 International passengers

The following picture shows the origin and destination trips by histograms.

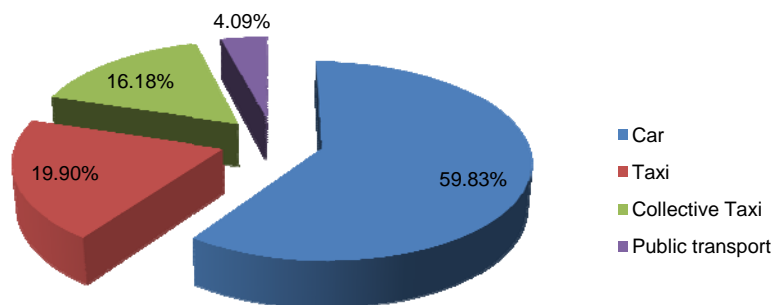
Figure 14. Phase 1A, Trip Generations and Attractions



5.3 Modal Split

The following graph shows the modal split in the Phase 1A scenario:

Figure 15. Phase 1A, Modal Split



The following table shows the trips by mode for the main cities.

Tab 7. Phase 1A, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	12,050	12,185	3,700	3,776	3,134	3,186	1,107	700
Deir Al Balah	13,212	11,010	5,246	4,375	3,954	3,300	591	457
Gaza	20,995	23,950	8,412	9,396	6,384	7,190	1,633	1,743
Hebron	35,901	36,396	12,497	12,592	9,948	10,047	2,305	2,562
Jenin	18,190	18,161	5,833	5,912	4,864	4,916	1,323	1,370
East Jerusalem	11,409	8,693	3,522	2,659	2,976	2,252	1,365	990
Jericho	1,585	4,504	410	1,030	379	1,009	102	486
Khan Younis	19,587	16,077	7,183	6,031	5,652	4,701	1,039	853
Nablus	17,484	22,912	5,185	6,689	4,336	5,653	1,100	1,485
North Gaza	5,870	8,716	2,195	3,191	1,684	2,470	286	486
Qalqilya	8,272	7,353	2,323	2,103	2,001	1,802	302	314
Ramallah/Al Bireh	34,028	33,676	10,190	10,235	8,691	8,656	2,851	2,890
Rafah	11,496	11,407	4,041	4,085	3,220	3,234	558	567
Salfit	3,893	3,779	1,088	1,069	962	936	178	190
Tubas	14,470	10,319	4,223	3,120	3,629	2,640	890	580
Tulkarm	2,281	1,584	693	479	577	401	132	88

5.4 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 16. Phase 1A, Traffic Volumes

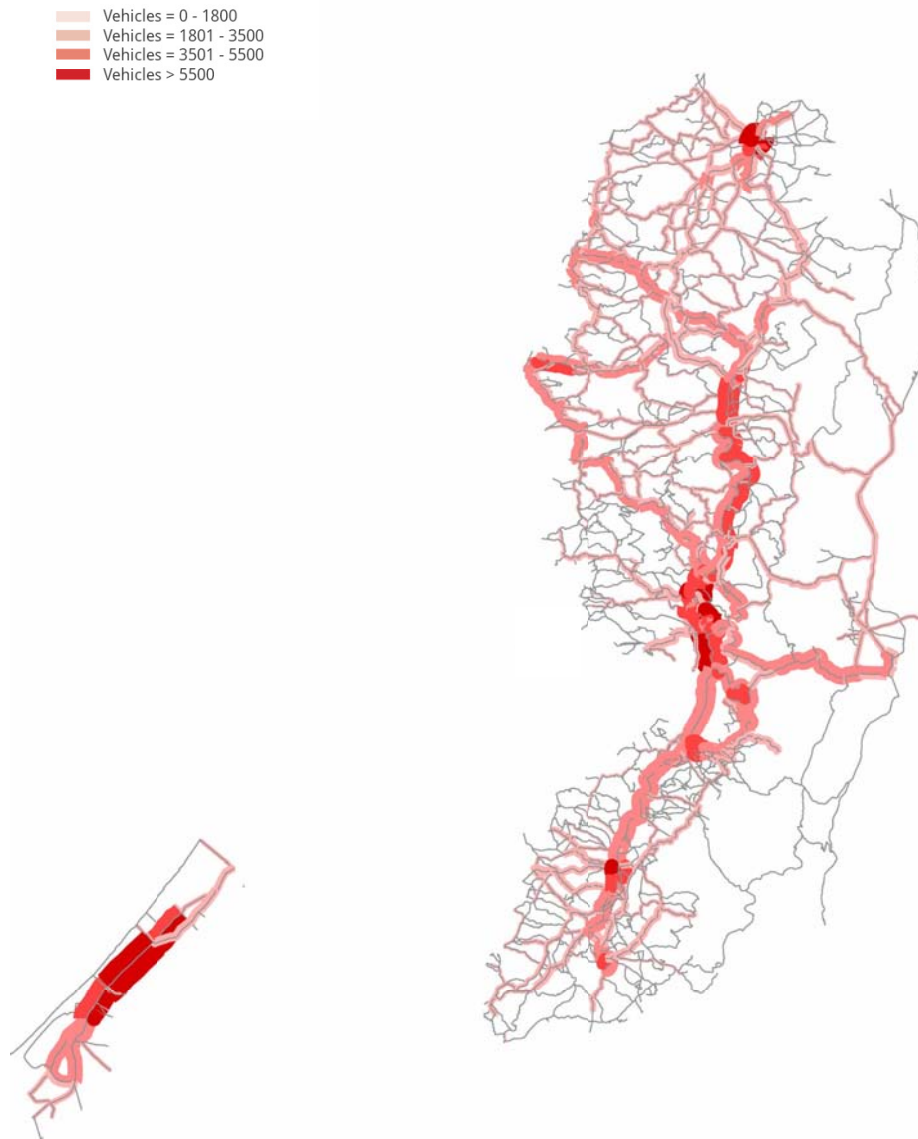




Figure 17.Phase 1A, Volume/Capacity Ratio

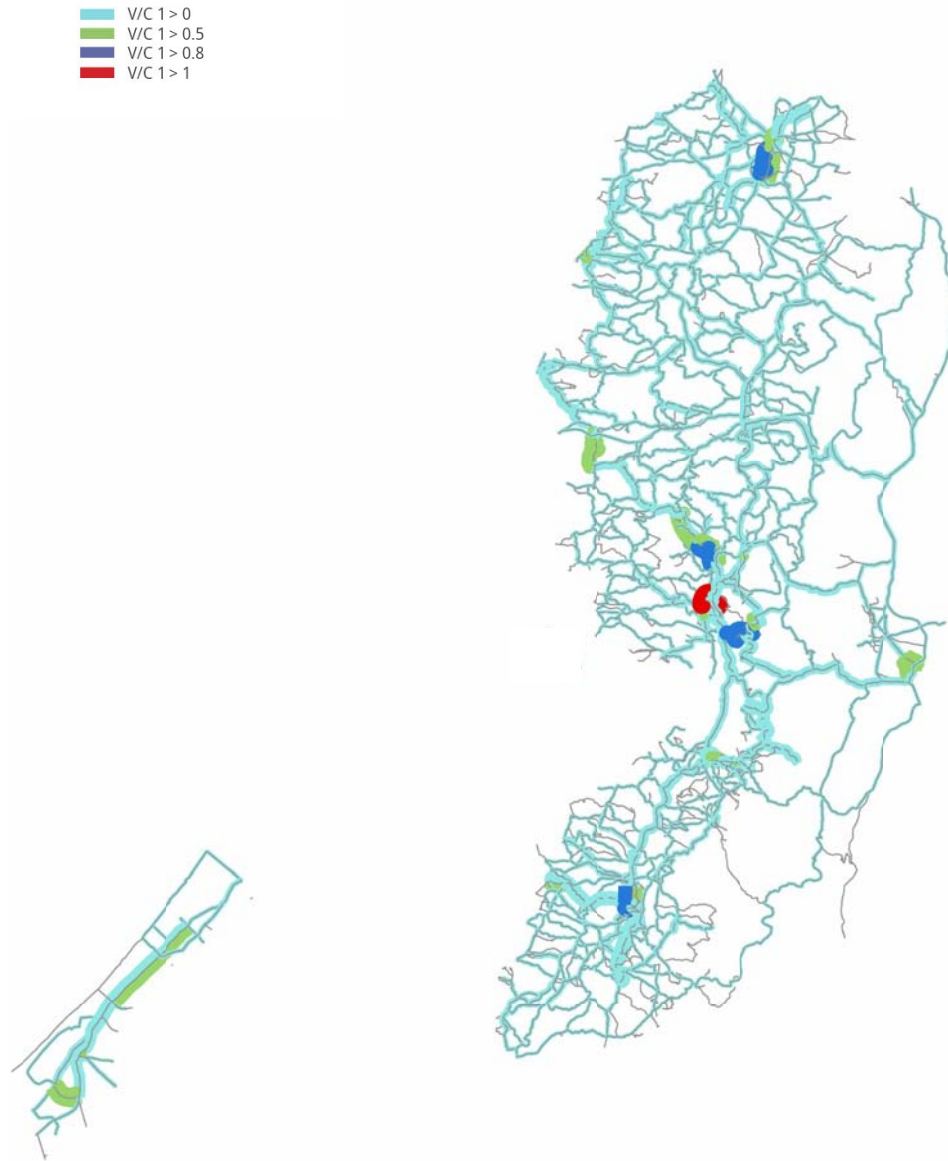
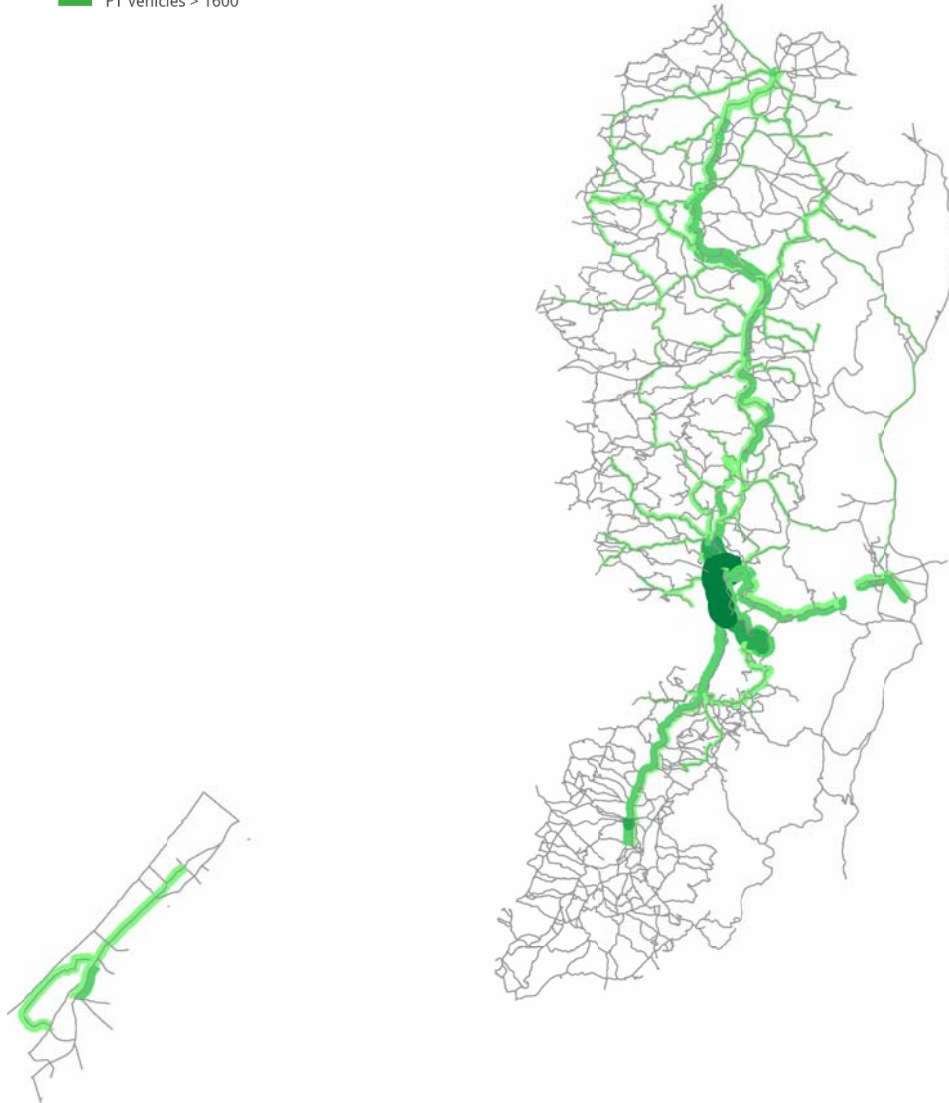




Figure 18. Phase 1A, PT Ridership

- PT Vehicles = 0 - 550
- PT Vehicles = 551 - 1000
- PT Vehicles = 1001 - 1600
- PT Vehicles > 1600



5.5 Main Results

The network outputare reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network;
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network;
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network.

Tab 8. Phase 1A, Road Network Statistics

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,142.71	3,646,324.10	54,166.95	67.32
Other a	281.00	146,841.17	2,936.82	50.00
Other b	24.00	950.53	19.01	50.00
Local a	45.08	418.15	18.50	22.60
Local b	17.38	0.00	0.00	0.00
Third Class Road	78.37	8,356.15	266.73	31.33
Second Class Road	3,451.51	466,978.87	9,667.61	48.30
Primary Class Road a	2,700.18	1,295,999.04	20,007.43	64.78
Primary Class Road b	174.72	94,328.61	988.68	95.41
Other c	1,352.65	1,630,832.89	20,100.05	81.14

Regarding the Public Transport System, in the **Phase 1**Ascenario there are **332,387 passengers*km** for an average of **10,295passengers*hour**.

The following table shows the border crossing data.

Tab 9. Phase 1A, Border Crossing

Border Crossing	Total Vehicles	Car	Taxi	Collective Taxi	Moto	LCV	HCV	PT passengers
Rafah_BCP	329	0	0	0	329	0	0	0
Karem_Abu_Salem_BCP	0	0	0	0	0	0	0	0
Bayt_Hanoun	0	0	0	0	0	0	0	0
Freijat (Al Dahriya)_BCP	94	12	2	0	0	63	17	0
Tarqumiya-ldhna	0	0	0	0	0	0	0	0
Bayt Jala_BCP	1,924	1,251	343	40	38	78	175	0
Tulkarm	85	26	8	2	0	36	13	0



Al_Jalameh_BCP	27	24	2	1	0	0	0	0
Tell_Al_Bayda_BCP	0	0	0	0	0	0	0	0
Damyeh_Bridge_BCP	235	124	63	11	0	0	37	0
Karama_Bridge_BCP	346	231	63	15	0	0	37	0
King_Abdallah_BCP	0	0	0	0	0	0	0	0

During the "Phase" scenarios several projects are implemented. The following table shows the traffic data for each considered section. If the project is not implemented in the current Phase scenario, the table reports the actual data.

Tab 10. Phase 1A, Project Sections Data

7.5	Length [km]	veh*km	veh*h	Ave Speed [km/h]
1	7	0	0	0.00
3	127	359,694	5,141	69.96
4	4	961	14	70.00
5	12	529	8	70.00
6	0	0	0	0.00
8	0	0	0	0.00
9	0	0	0	0.00
10	7	1,253	18	70.00
11	0	0	0	0.00
12	0	0	0	0.00
13	65	203,211	2,032	100.00
14	0	0	0	0.00
16	0	0	0	0.00
19	0	0	0	0.00
20	0	0	0	0.00
21	0	0	0	0.00
22	0	0	0	0.00
24	0	0	0	0.00
26	0	0	0	0.00
27	0	0	0	0.00
28	0	0	0	0.00
29	0	0	0	0.00
30	0	0	0	0.00
31	0	0	0	0.00
32	0	0	0	0.00
33	0	0	0	0.00
34	0	0	0	0.00
35	0	0	0	0.00
36	0	0	0	0.00

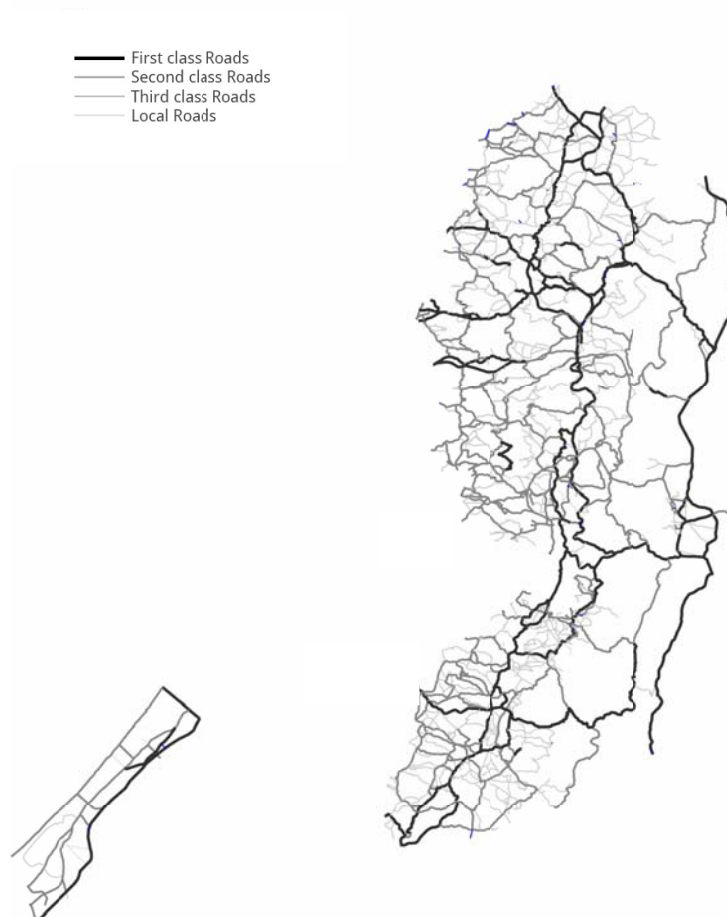
6 Transport Model Outputs for Phase 1 (2019 – 2024)

This chapter described the model's outputs of the **Phase 1** scenario. Information about the modeled network for both the private traffic and public transport system, trip generation/attractions, modal split, public transport fares, vehicle and passenger volumes are reported. Statistical data of the network's performances are reported at the end of the chapter. The modeled reference year for Phase 1 is end of 2024.

6.1 Networks

The following picture shows the modelled road and PT networks at Phase 1.

Figure 19. Phase 1, Road Hierarchy





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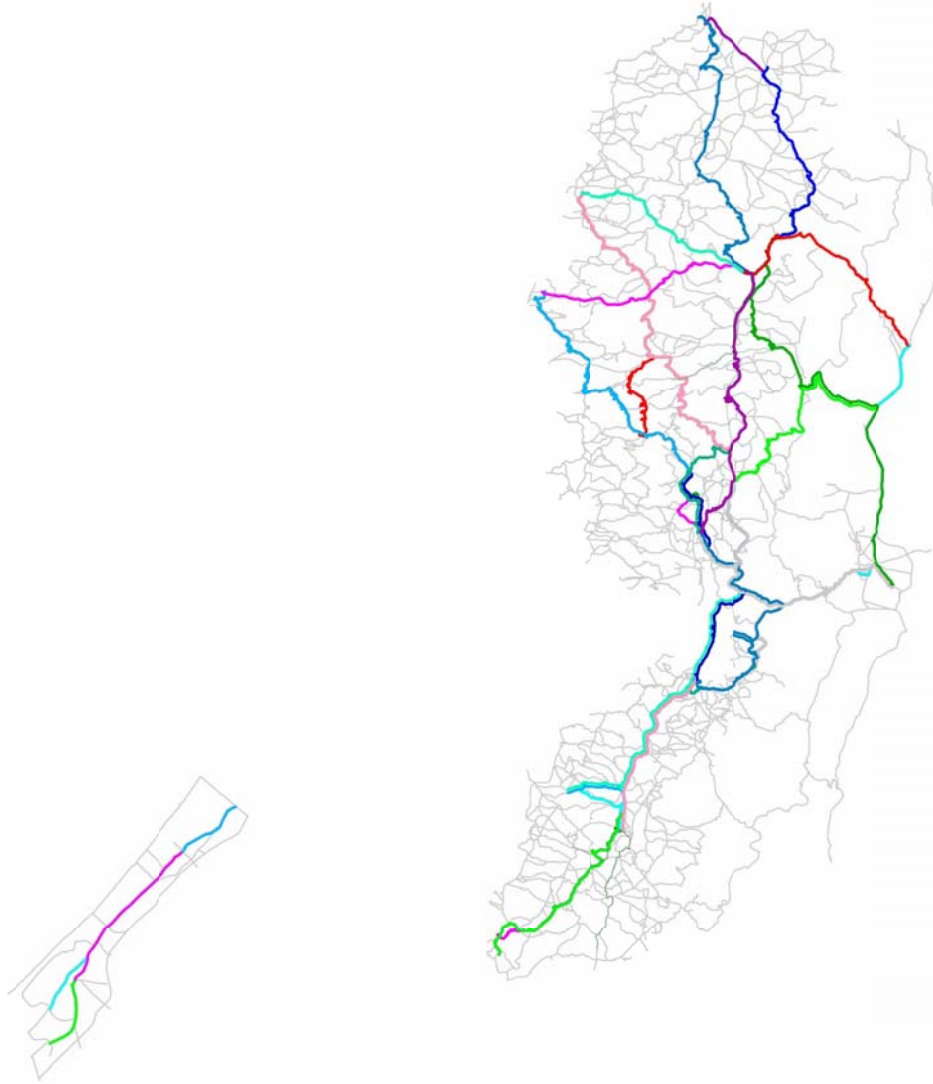
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Figure 20. Phase 1, PT Lines





The origins and destinations of the PT lines are reported in the following table.

Tab 11. Phase 1, PT Lines

FROM	TO
Ramallah	Tarqumiya
Ramallah	Hebron
Ramallah	Bethlehem
Ramallah	East Jerusalem
Ramallah	Bir Zayt
Ramallah	Jericho
Ramallah	Nablus
Ramallah	Qalqilya
Ramallah	Tulkarm
Ramallah	Jenin
Ramallah	Freijat (Al Dahriya) BCP
Ramallah	Jalameh BCP
Ramallah	Al Karama Bridge BCP
Nablus	Tarqumiya
Nablus	Hebron
Nablus	Bethlehem
Nablus	Ramallah
Nablus	East Jerusalem
Nablus	Bir Zayt
Nablus	Jericho
Nablus	Qalqilya
Nablus	Tulkarm
Nablus	Jenin
Nablus	Freijat (Al Dahriya) BCP
Nablus	Jalameh BCP
Nablus	Al Karama Bridge BCP
Hebron	Tarqumiya
Hebron	Bethlehem
Hebron	Ramallah
Hebron	East Jerusalem
Hebron	Bir Zayt
Hebron	Jericho
Hebron	Nablus
Hebron	Qalqilya
Hebron	Tulkarm
Hebron	Jenin
Hebron	Freijat (Al Dahriya) BCP
Hebron	Jalameh BCP
Hebron	Al Karama Bridge BCP
East Jerusalem	Tarqumiya
East Jerusalem	Hebron
East Jerusalem	Bethlehem
East Jerusalem	Ramallah
East Jerusalem	Bir Zayt
East Jerusalem	Jericho
East Jerusalem	Nablus
East Jerusalem	Qalqilya
East Jerusalem	Tulkarm
East Jerusalem	Jenin
East Jerusalem	Freijat (Al Dahriya) BCP
East Jerusalem	Jalameh BCP
East Jerusalem	Al Karama Bridge BCP
Gaza	Khan Younis
Gaza	Rafah
Gaza	Bayt Hanoun
Gaza	Rafah BCP
Nablus	Salfit
Nablus	Tubas
Hebron	Dura
Hebron	Dahriya



Hebron	Samu'a
Hebron	Yatta
Rail Ramallah	Rail Nablus

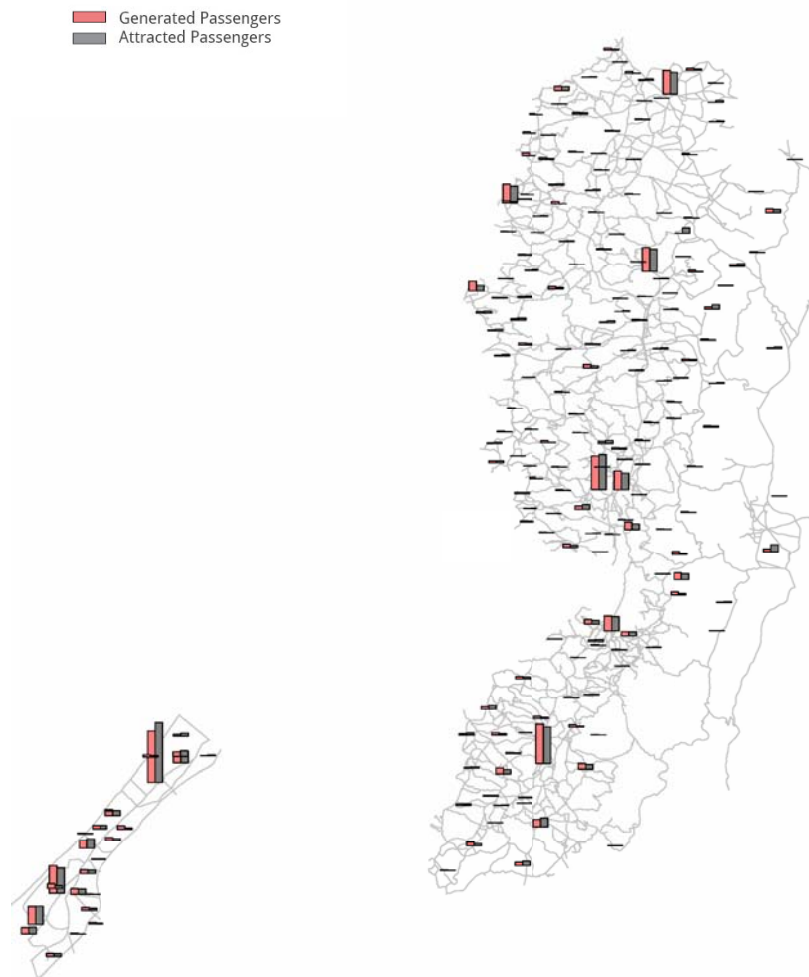
6.2 Trip Generation

In the Phase 1 scenario the trip generation/attractions figures are:

- 473,226 generated passengers trips
- 436,450 attracted passengers trips
- 13,374 LCVs
- 37,318 HCVs
- 6,969 International passengers

The following picture shows the origin and destination trips by histograms.

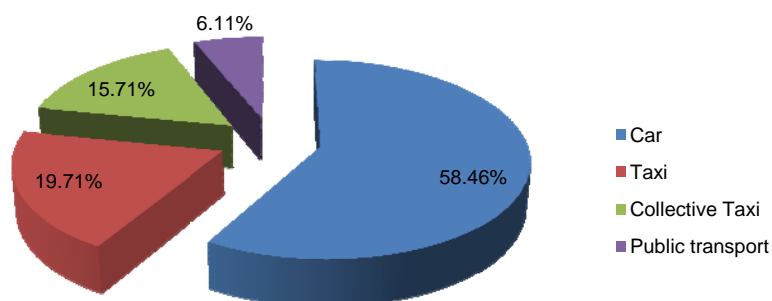
Figure 21. Phase 1, Trip Generations and Attractions



6.3 Modal Split

The following graph shows the modal split in the Phase 1 scenario:

Figure 22. Phase 1, Modal Split



The following table shows the trips by mode for the main cities.

Tab 12. Phase 1, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	14,592	14,217	4,652	4,572	3,744	3,668	1,544	1,899
Deir Al Balah	16,136	13,438	6,457	5,365	4,833	4,026	801	662
Gaza	25,633	29,181	10,310	11,524	7,791	8,762	2,192	2,416
Hebron	41,335	42,311	14,424	14,634	11,311	11,510	7,360	7,103
Jenin	22,072	22,180	7,121	7,242	5,846	5,940	2,035	1,934
East Jerusalem	13,866	10,583	4,456	3,374	3,583	2,720	1,746	1,232
Jericho	1,868	5,467	515	1,351	441	1,206	215	605
Khan Younis	23,870	19,607	8,826	7,399	6,883	5,728	1,484	1,211
Nablus	20,573	27,093	6,123	7,985	5,065	6,645	2,729	3,369
North Gaza	7,143	10,640	2,692	3,931	2,049	3,016	431	652
Qalqilya	9,831	8,749	2,778	2,513	2,365	2,132	852	805
Ramallah/Al Bireh	40,886	40,501	12,652	12,726	10,338	10,328	4,551	4,479
Rafah	13,951	13,867	4,923	4,989	3,911	3,933	919	887
Salfit	4,665	4,494	1,316	1,277	1,143	1,103	388	454
Tubas	17,511	12,414	5,205	3,819	4,376	3,165	1,393	1,054
Tulkarm	2,712	1,903	834	583	687	481	286	167

6.4 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 23. Phase 1, Traffic Volumes

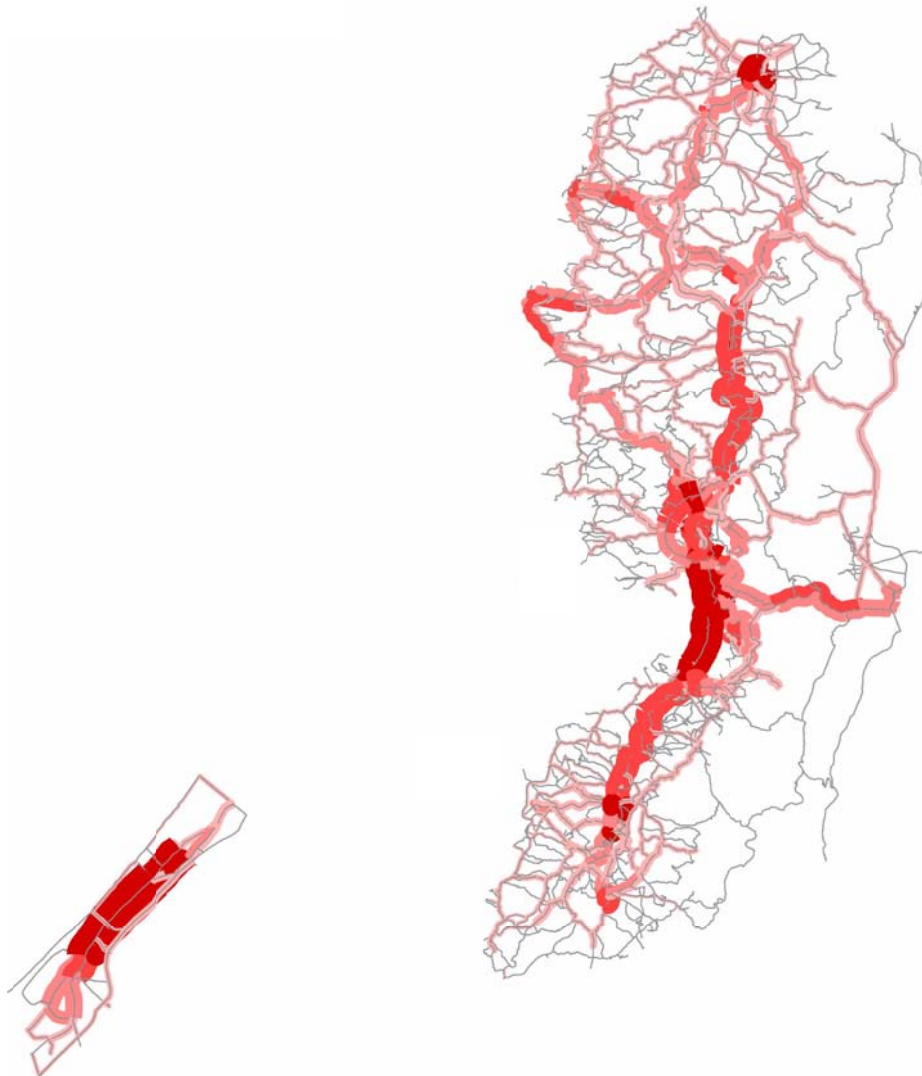
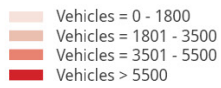




Figure 24. Phase 1, Volume/Capacity Ratio

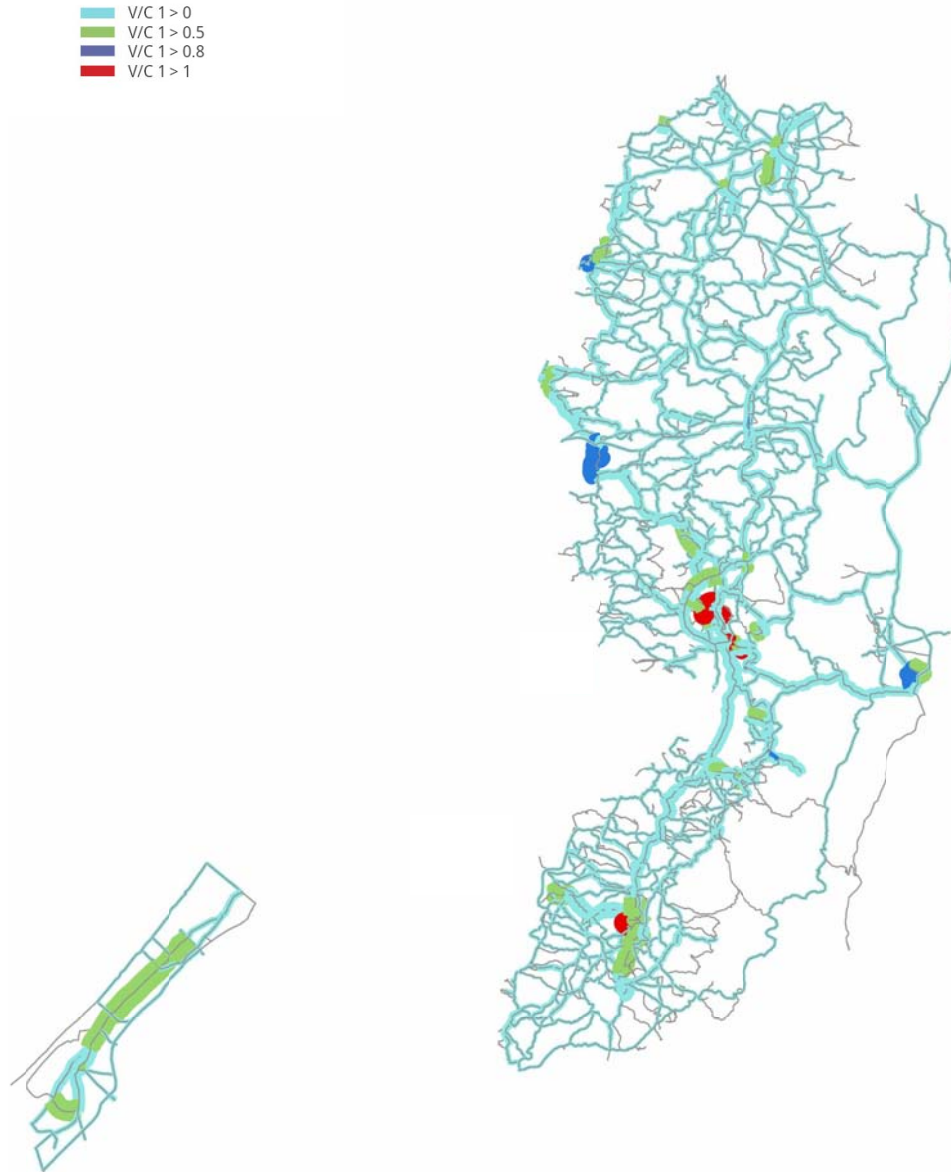
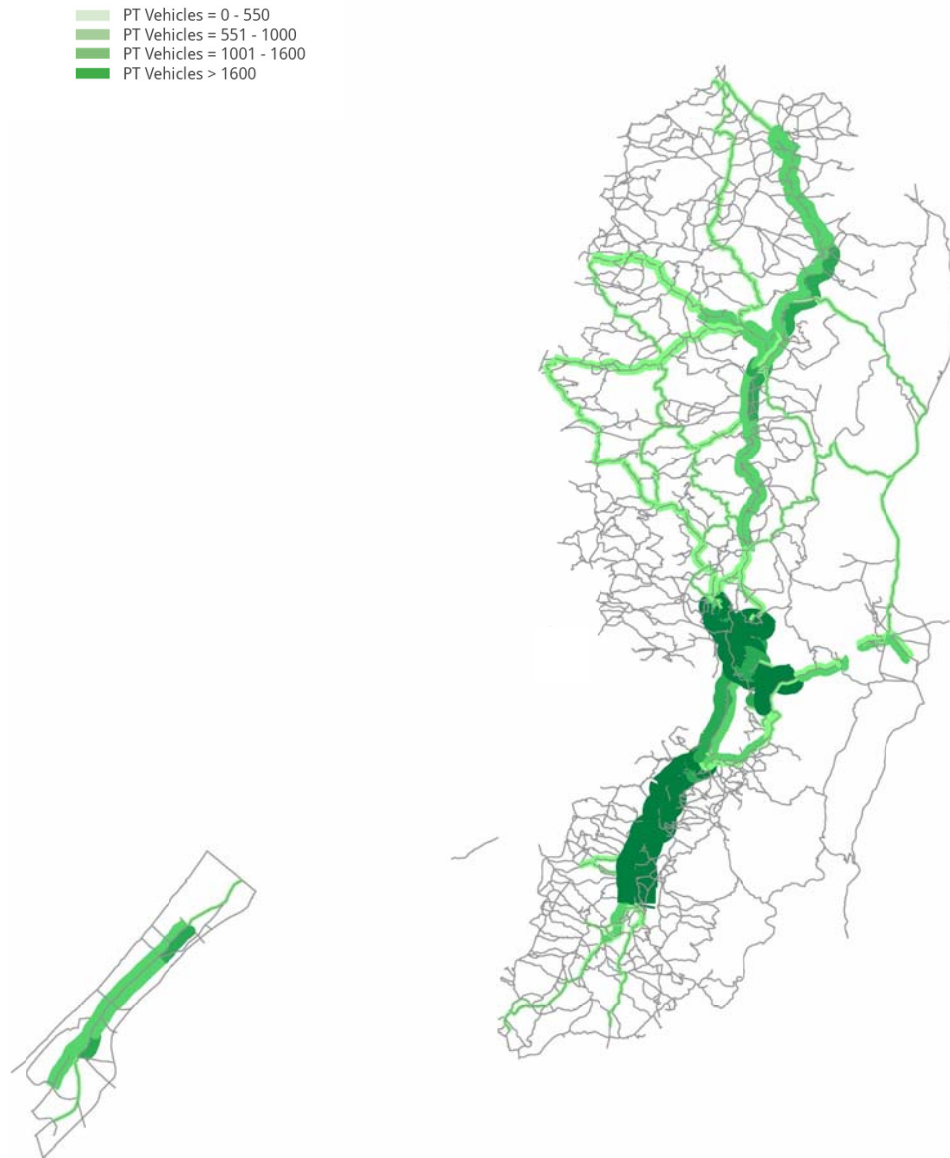


Figure 25. Phase 1, PT Ridership



6.5 Main Results

The network Outputare reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network;
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network;
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network.

Tab 13. Phase 1, Road Network Main Results

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,421.63	4,731,811.88	62,180.65	76.10
Other a	281.00	183,544.45	3,670.89	50.00
Other b	24.00	1,687.86	33.76	50.00
Local a	25.51	563.90	18.80	30.00
Local b	17.38	0.00	0.00	0.00
Third Class Road	78.37	7,326.31	242.23	30.24
Second Class Road	3,255.57	473,673.38	10,056.27	47.10
Primary Class Road a	2,969.51	1,694,449.77	24,224.30	69.95
Primary Class Road b	98.15	61,887.66	618.96	99.99
Other c	1,654.32	2,306,157.31	23,062.57	100.00

Regarding the Public Transport System, in the **Phase 1** scenario there are **645,387 passengers*km** for an average of **7,949 passengers*hour**.

The following table shows the border crossing data.

Tab 14. Phase 1, Border Crossing

Border Crossing	Total Vehicles	Car	Taxi	Collective Taxi	Moto	LCV	HCV	PT passengers
Rafah_BCP	329	0	0	0	329	0	0	0
Karem_Abu_Salem_BCP	0	0	0	0	0	0	0	0
Bayt_Hanoun	0	0	0	0	0	0	0	0
Freijat (Al Dahriya)_BCP	42	15	3	1	0	0	22	0
Tarqumiya-Idhna	0	0	0	0	0	0	0	0
Bayt Jala_BCP	2,309	1,465	405	63	57	95	223	0
Tulkarm	116	38	13	3	0	44	18	0



Al_Jalameh_BCP	53	45	6	2	0	0	0	0
Tell_Al_Bayda_BCP	96	37	23	5	0	0	31	0
Damyeh_Bridge_BCP	226	100	53	8	0	0	65	0
Karama_Bridge_BCP	10	4	3	0	0	0	3	0
King_Abdallah_BCP	464	271	92	18	0	0	83	0

During the "Phase" scenarios several projects are implemented. The following table shows the traffic data for each considered section. If the project is not implemented in the current Phase scenario, the table reports the actual data.

Tab 15. Phase 1, Project Sections Data

Sn	Length [km]	veh*km	veh*h	Ave Speed [km/h]
1	7	777	11	70.00
3	127	493,946	7,066	69.91
4	4	1,749	25	70.00
5	12	645	9	70.00
6	109	18,522	265	69.95
8	70	2,310	33	69.99
9	20	20,086	201	100.00
10	7	37	1	70.00
11	20	8,290	118	69.99
12	10	6,302	63	99.59
13	65	210,024	2,100	100.00
14	49	35,373	505	69.99
16	0	0	0	0.00
19	75	5,578	80	70.00
20	25	5,854	84	69.65
21	96	40,842	408	100.00
22	322	430,476	4,316	99.74
24	110	1,025	12	84.24
26	115	131,506	1,707	77.02
27	37	24,300	243	100.00
28	0	0	0	0.00
29	0	0	0	0.00
30	0	0	0	0.00
31	0	0	0	0.00
32	0	0	0	0.00
33	0	0	0	0.00
34	0	0	0	0.00
35	0	0	0	0.00
36	17	3,467	35	100.00

7 Model Outputs for Phase 2 (2025 – 2031)

This chapter described the model's outputs of the **Phase 2** scenario. Information about the modeled network for both the private traffic and public transport system, trip generation/attractions, modal split, public transport fares, vehicle and passenger volumes are reported. Statistical data of the network's performances are reported at the end of the chapter. The modeled reference year for Phase 2 is the end of 2031.

7.1 Networks

The following picture shows the modelled road and PT networks at Phase 2.

Figure 26. Phase 2, Road Hierarchy

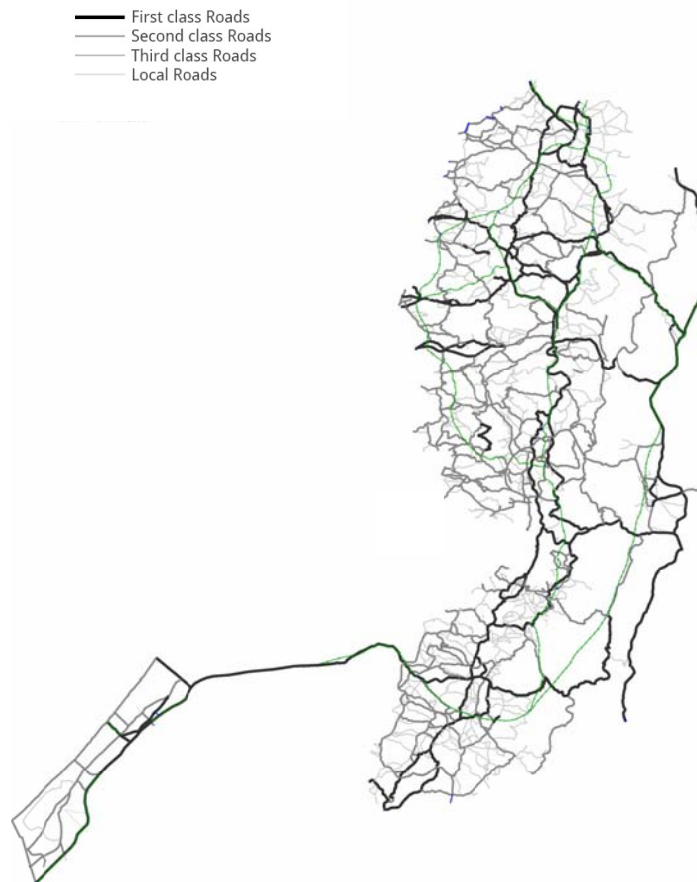


Figure 27. Phase 2, PT Lines



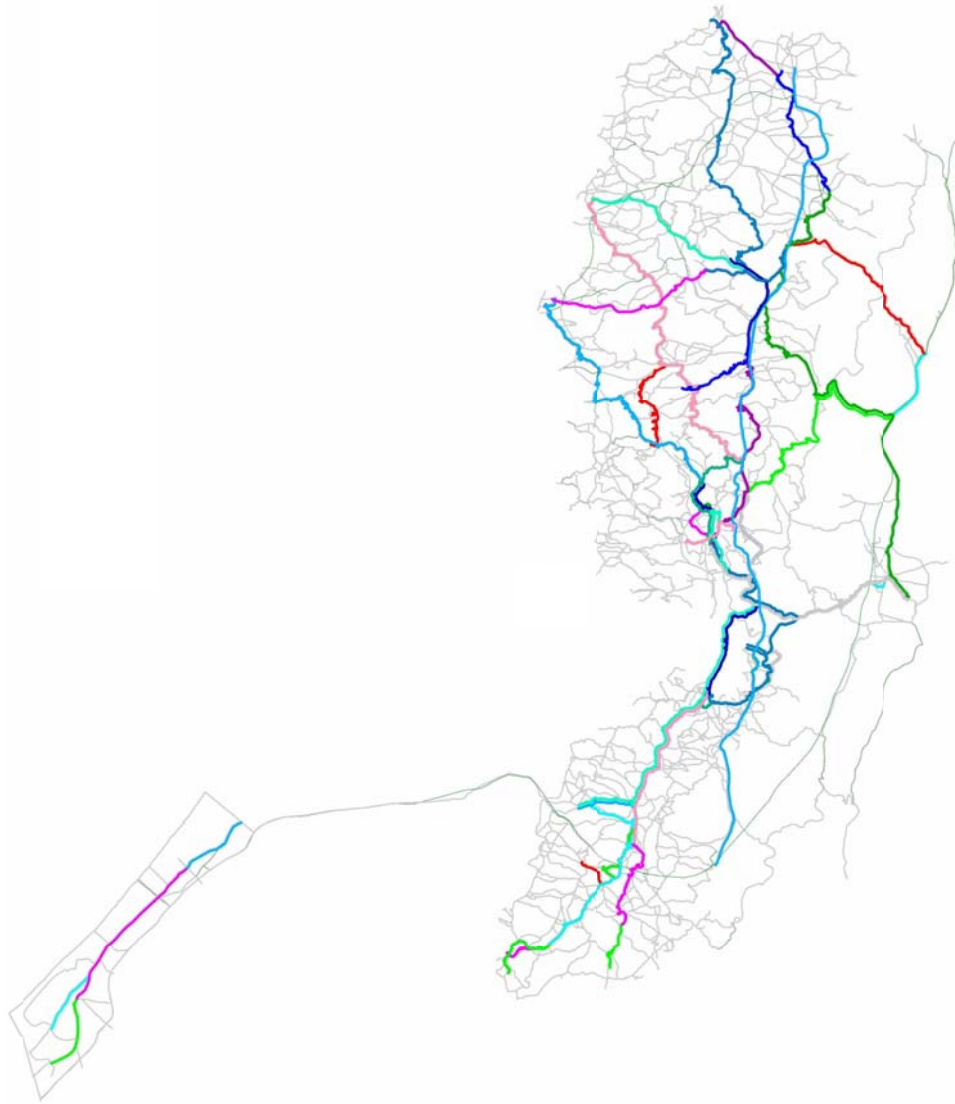
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The origins and destinations of the PT lines are reported in the following table.



Tab 16. Phase 2, PT Lines

FROM	TO
Ramallah	Tarqumiya
Ramallah	Hebron
Ramallah	Bethlehem
Ramallah	East Jerusalem
Ramallah	Bir Zayt
Ramallah	Jericho
Ramallah	Nablus
Ramallah	Qalqilya
Ramallah	Tulkarm
Ramallah	Jenin
Ramallah	Freijat (Al Dahriya)BCP
Ramallah	Jalameh BCP
Ramallah	Al Karama Bridge BCP
Nablus	Tarqumiya
Nablus	Hebron
Nablus	Bethlehem
Nablus	Ramallah
Nablus	East Jerusalem
Nablus	Bir Zayt
Nablus	Jericho
Nablus	Qalqilya
Nablus	Tulkarm
Nablus	Jenin
Nablus	Freijat (Al Dahriya)BCP
Nablus	Jalameh BCP
Nablus	Al Karama Bridge BCP
Hebron	Tarqumiya
Hebron	Bethlehem
Hebron	Ramallah
Hebron	East Jerusalem
Hebron	Bir Zayt
Hebron	Jericho
Hebron	Nablus
Hebron	Qalqilya
Hebron	Tulkarm
Hebron	Jenin
Hebron	Freijat (Al Dahriya)BCP
Hebron	Jalameh BCP
Hebron	Al Karama Bridge BCP
East Jerusalem	Tarqumiya
East Jerusalem	Hebron
East Jerusalem	Bethlehem
East Jerusalem	Ramallah
East Jerusalem	Bir Zayt
East Jerusalem	Jericho
East Jerusalem	Nablus
East Jerusalem	Qalqilya
East Jerusalem	Tulkarm
East Jerusalem	Jenin
East Jerusalem	Freijat (Al Dahriya)BCP
East Jerusalem	Jalameh BCP
East Jerusalem	Al Karama Bridge BCP
Gaza	Khan Younis
Gaza	Rafah
Gaza	Bayt Hanoun
Gaza	Rafah BCP
Nablus	Salfit
Nablus	Tubas
Hebron	Dura
Hebron	Dahriya
Hebron	Samu'a
Hebron	Yatta

BRT Ramallah	BRT Al Bireh/Beitunia/Qalandiya
BRT Nablus	BRT Station South/Station North/Rafidia
Rail Bani Na'im	Rail Jenin

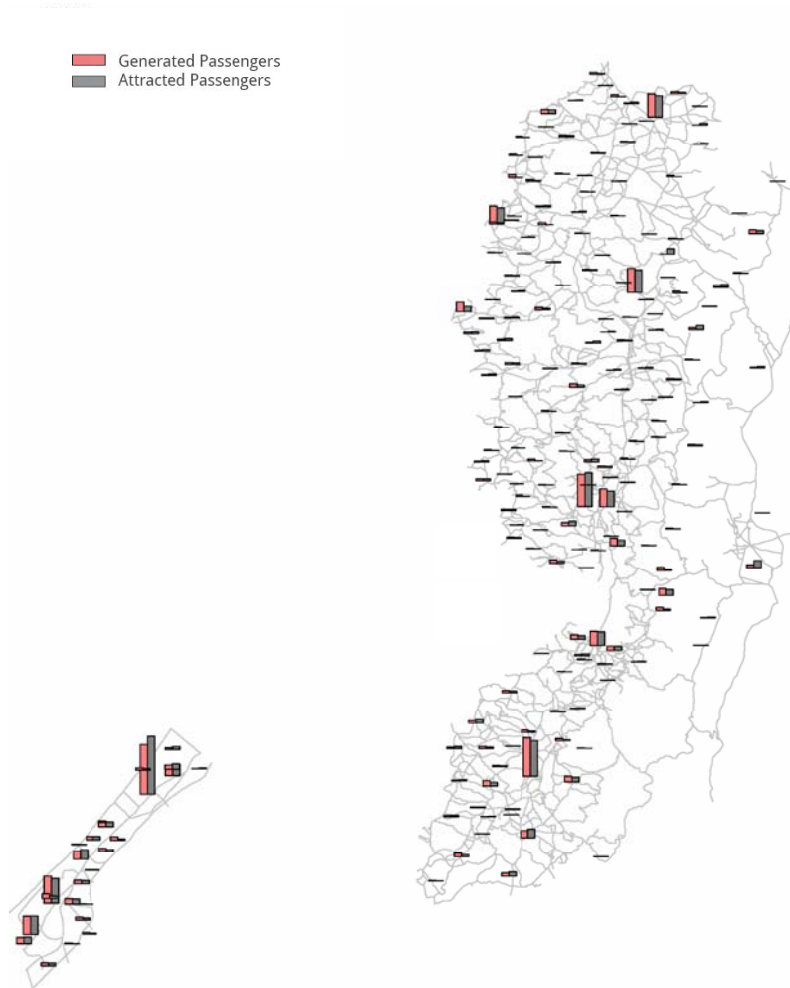
7.2 Trip Generation

In the Phase 2 scenario the trip generation/attractions figures are:

- 567,808 generated passengers trips
- 523,741 attracted passengers trips
- 15,954 LCVs
- 45,655 HCVs
- 10,016 International passengers

The following picture shows the origin and destination trips by histograms.

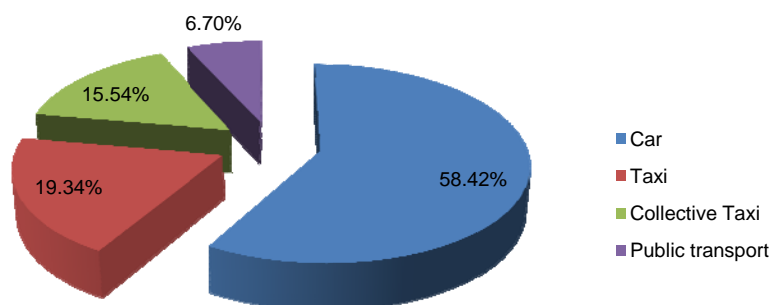
Figure 28. Phase 2, Trip Generations and Attractions



7.3 Modal Split

The following graph shows the modal split in the Phase 2 scenario:

Figure 29. Phase 2, Modal Split



The following table shows the trips by mode for the main cities.

Tab 17. Phase 2, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	17,541	16,717	5,497	5,340	4,450	4,297	1,947	2,434
Deir Al Balah	19,419	16,580	7,632	6,450	5,749	4,869	1,069	911
Gaza	31,284	36,905	12,066	13,603	9,238	10,572	2,516	2,762
Hebron	51,212	50,663	16,728	16,852	13,451	13,465	7,915	7,722
Jenin	26,330	26,341	8,533	8,645	6,979	7,062	2,640	2,554
East Jerusalem	16,556	12,361	5,284	3,946	4,262	3,183	2,275	1,746
Jericho	2,238	6,412	617	1,595	529	1,417	262	832
Khan Younis	28,664	24,116	10,582	9,006	8,255	6,990	1,769	1,462
Nablus	23,703	31,398	7,055	9,279	5,833	7,706	4,792	5,441
North Gaza	8,727	13,518	3,132	4,614	2,423	3,636	494	731
Qalqilya	11,646	10,249	3,272	2,939	2,802	2,499	1,270	1,263
Ramallah/Al Bireh	48,270	47,403	14,791	14,780	12,202	12,125	6,839	6,496
Rafah	16,754	17,021	5,905	6,081	4,690	4,808	1,092	1,072
Salfit	5,315	5,178	1,514	1,487	1,316	1,281	868	792
Tubas	20,810	14,598	6,184	4,483	5,203	3,726	1,982	1,637
Tulkarm	3,263	2,271	1,014	707	825	573	321	195

7.4 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 30. Phase 2, Traffic Volumes

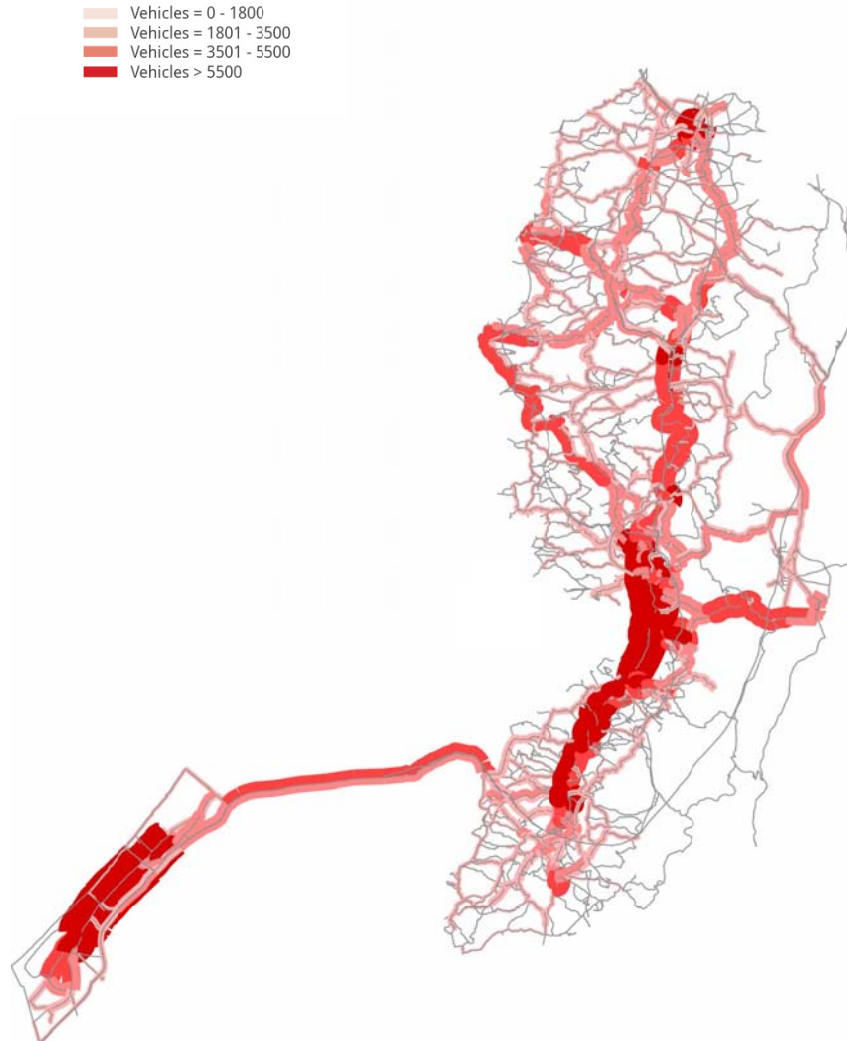


Figure 31. Phase 2, Volume/Capacity Ratio

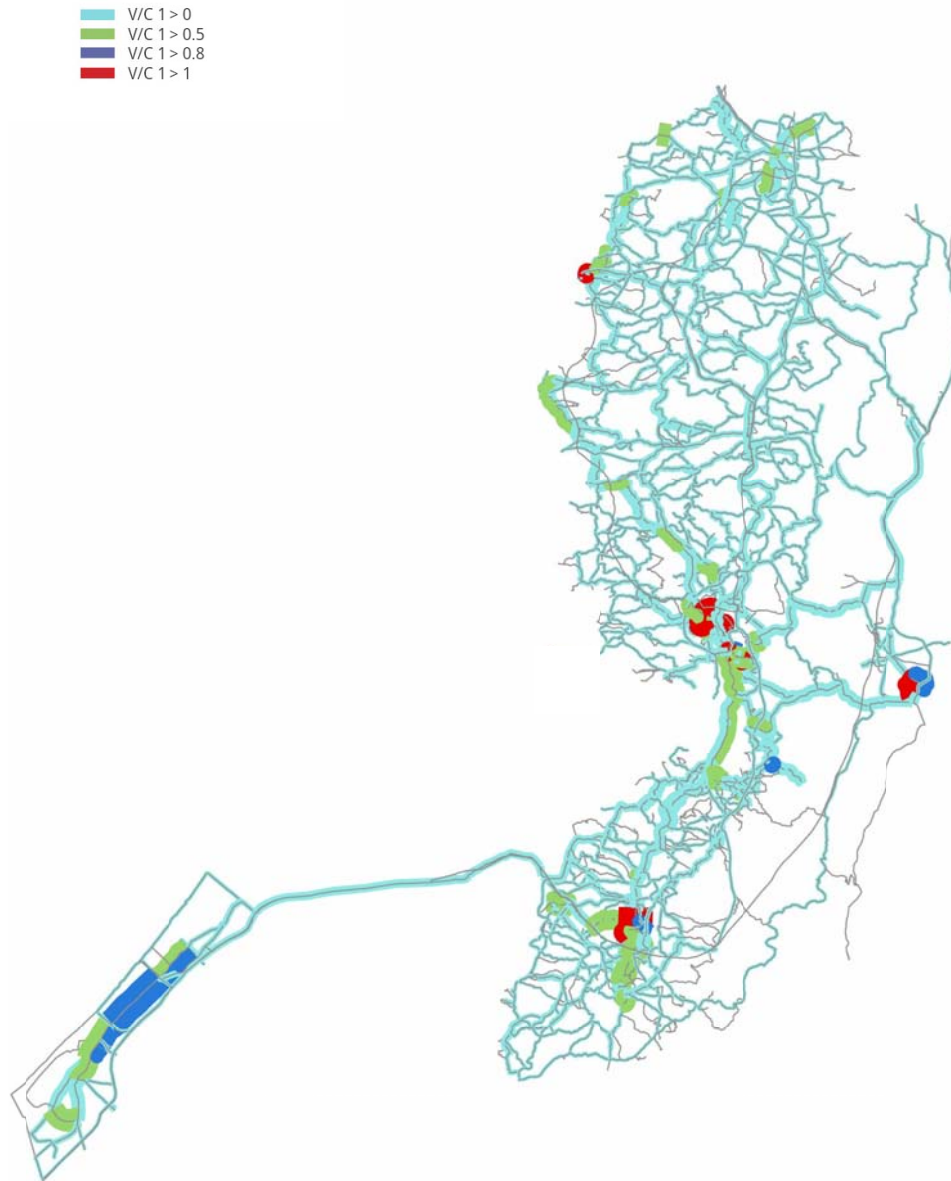
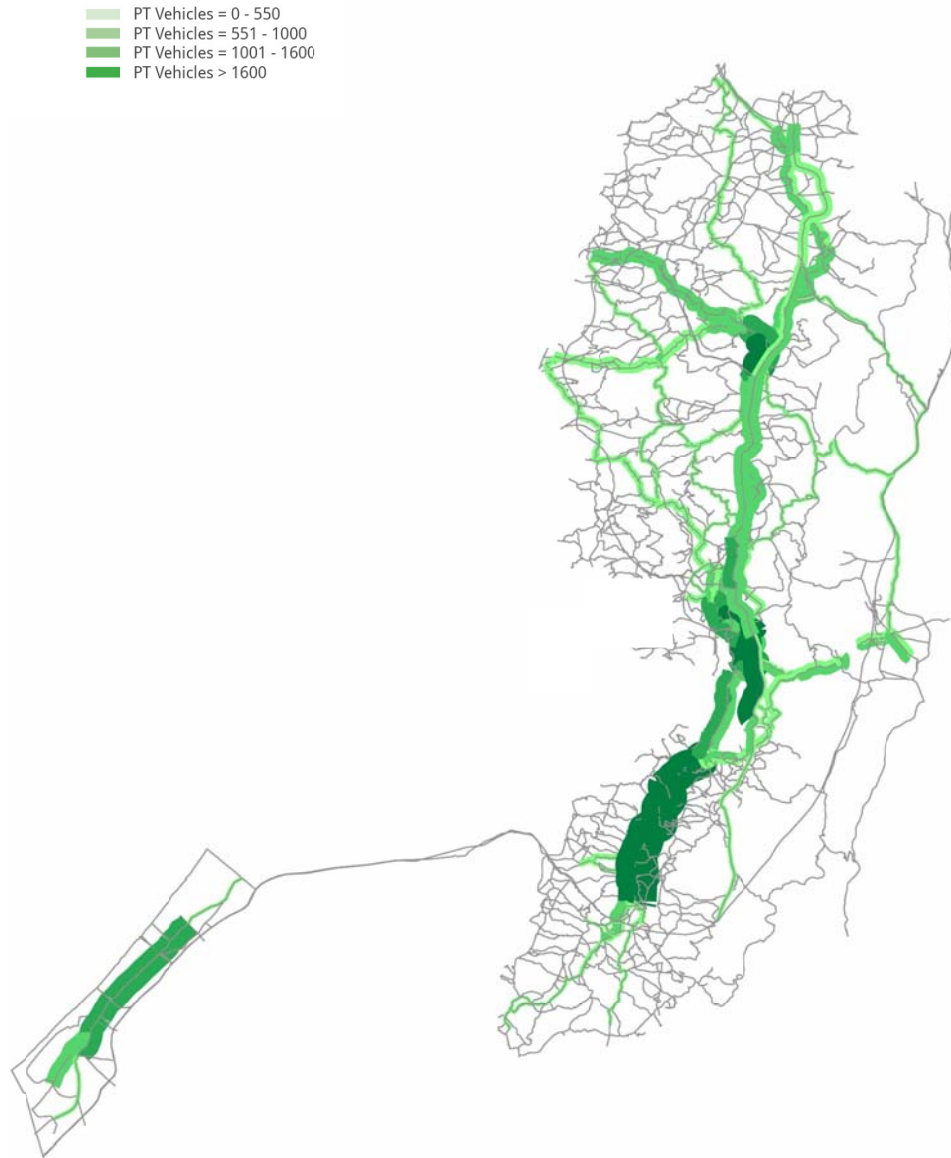




Figure 32. Phase 2, PT Ridership





7.5 Main Results

The network Outputare reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network;
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network;
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network.

Tab 18. Phase 2, Road Network Main Results

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,633.72	6,303,169.07	82,654.98	76.26
Other a	281.00	226,405.95	4,528.12	50.00
Other b	24.00	2,510.01	50.20	50.00
Local a	22.36	654.62	21.82	30.00
Local b	17.38	0.00	0.00	0.00
Third Class Road	71.62	9,676.03	323.16	29.94
Second Class Road	3,236.23	583,718.44	13,183.27	44.28
Primary Class Road a	3,043.27	2,192,135.14	31,372.25	69.87
Primary Class Road b	98.15	88,962.70	889.83	99.98
Other c	1,821.90	3,195,870.58	31,960.39	99.99

Regarding the Public Transport System, in the **Phase 2** scenario there are **740,243passengers*km** for an average of **9,363passengers*hour**.
The following table shows the border crossing data.

Tab 19. Phase 2, Border Crossing

Border Crossing	Total Vehicles	Car	Taxi	Collective Taxi	Moto	LCV	HCV	PT passengers
Rafah_BCP	329	0	0	0	329	0	0	0
Karem_Abu_Salem_BCP	0	0	0	0	0	0	0	0
Bayt_Hanoun	4,941	3,110	278	214	274	94	971	0
Freijat (Al Dahriya)_BCP	17	13	4	1	0	0	0	0
Tarqumiya-Ithna	6,488	4,172	391	288	361	94	1,181	0
Bayt Jala_BCP	2,710	1,702	452	89	80	114	274	0
Tulkarm	129	34	12	3	0	52	29	0
Al_Jalameh_BCP	72	60	9	3	0	0	0	0



Tell_Al_Bayda_BCP	127	43	26	5	0	0	52	0
Damyeh_Bridge_BCP	239	115	62	10	0	0	52	0
Karama_Bridge_BCP	24	9	6	1	0	0	8	0
King_Abdallah_BCP	660	326	105	21	0	0	208	0

During the "Phase" scenarios several projects are implemented. The following table shows the traffic data for each considered section. If the project is not implemented in the current Phase scenario, the table reports the actual data.

Tab 20. Phase 2, Project Sections Data

Sn	Length [km]	veh*km	veh*h	Ave Speed [km/h]
1	7	915	13	70.00
3	127	648,920	9,317	69.65
4	4	2,570	37	70.00
5	12	781	11	70.00
6	109	58,006	829	69.97
8	70	2,762	39	69.99
9	20	25,654	257	100.00
10	7	88	1	70.00
11	20	13,075	187	69.99
12	10	6,759	68	99.56
13	65	230,554	2,306	100.00
14	49	46,049	658	69.97
16	733	89,997	1,921	46.85
19	75	5,790	83	70.00
20	25	18,002	258	69.81
21	96	119,533	1,195	100.00
22	322	520,036	5,213	99.77
24	110	1,638	19	87.63
26	212	173,614	2,170	80.01
27	37	70,671	707	100.00
28	115	148,523	2,109	70.42
29	40	17,478	250	69.96
30	55	49,679	520	95.53
31	213	348,788	3,539	98.57
32	81	257,985	2,580	100.00
33	30	3,077	31	100.00
34	0	0	0	0.00
35	0	0	0	0.00
36	17	8,300	83	100.00

8 Transport Model Outputs for Phase 3 (2032 – 2037)

This chapter described the model's outputs of the **Phase 3** scenario. Information about the modeled network for both the private traffic and public transport system, trip generation/attractions, modal split, public transport fares, vehicle and passenger volumes are reported. Statistical data of the network's performances are reported at the end of the chapter. The modeled reference year for Phase 3 is the end of 2037.

8.1 Networks

The following picture shows the modelled road and PT networks at Phase 3.

Figure 33. Phase 3, Road Hierarchy

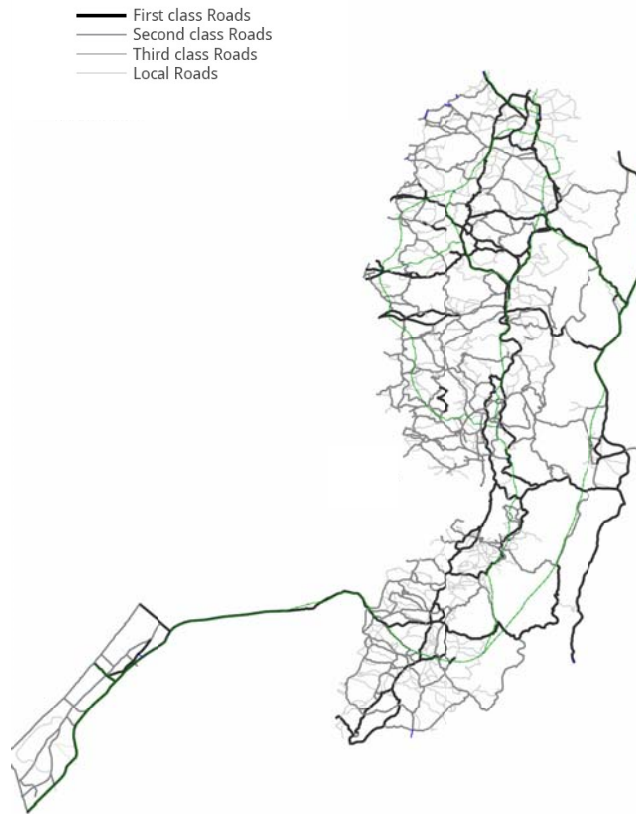
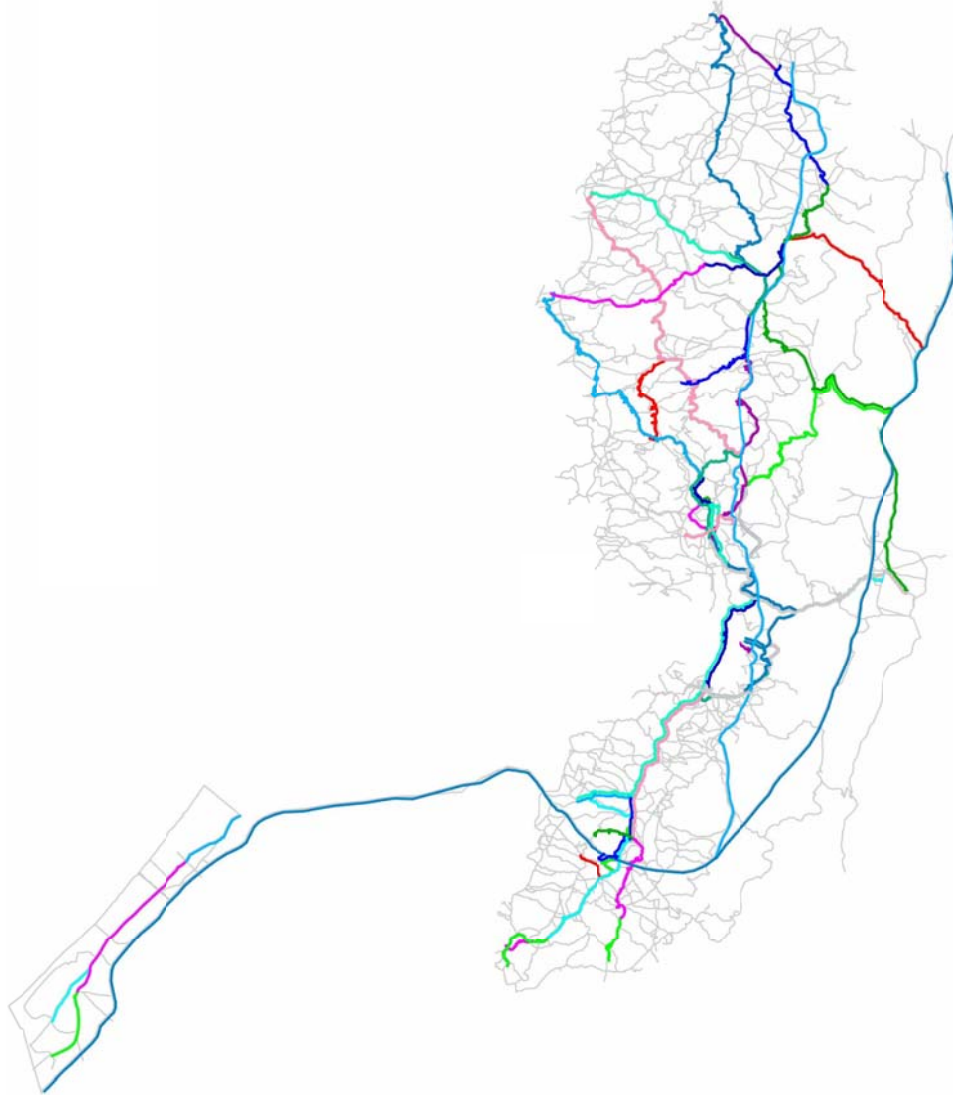




Figure 34. Phase 3, PT Lines



The origins and destinations of the PT lines are reported in the following table.



Tab 21. Phase 3, PT Lines

FROM	TO
Ramallah	Tarqumiya
Ramallah	Hebron
Ramallah	Bethlehem
Ramallah	East Jerusalem
Ramallah	Bir Zayt
Ramallah	Jericho
Ramallah	Nablus
Ramallah	Qalqilya
Ramallah	Tulkarm
Ramallah	Jenin
Ramallah	Freijat (Al Dahriya)BCP
Ramallah	Jalameh BCP
Ramallah	Al Karama Bridge BCP
Nablus	Tarqumiya
Nablus	Hebron
Nablus	Bethlehem
Nablus	Ramallah
Nablus	East Jerusalem
Nablus	Bir Zayt
Nablus	Jericho
Nablus	Qalqilya
Nablus	Tulkarm
Nablus	Jenin
Nablus	Freijat (Al Dahriya)BCP
Nablus	Jalameh BCP
Nablus	Al Karama Bridge BCP
Hebron	Tarqumiya
Hebron	Bethlehem
Hebron	Ramallah
Hebron	East Jerusalem
Hebron	Bir Zayt
Hebron	Jericho
Hebron	Nablus
Hebron	Qalqilya
Hebron	Tulkarm
Hebron	Jenin
Hebron	Freijat (Al Dahriya)BCP
Hebron	Jalameh BCP
Hebron	Al Karama / Bridge BCP
East Jerusalem	Tarqumiya
East Jerusalem	Hebron
East Jerusalem	Bethlehem
East Jerusalem	Ramallah
East Jerusalem	Bir Zayt
East Jerusalem	Jericho
East Jerusalem	Nablus
East Jerusalem	Qalqilya
East Jerusalem	Tulkarm
East Jerusalem	Jenin
East Jerusalem	Freijat (Al Dahriya)BCP
East Jerusalem	Jalameh BCP
East Jerusalem	Al Karama Bridge BCP
Gaza	Khan Younis
Gaza	Rafah
Gaza	Bayt Hanoun
Gaza	Rafah BCP
Nablus	Salfit
Nablus	Tubas
Hebron	Dura
Hebron	Dahriya
Hebron	Samu'a
Hebron	Yatta

BRT Ramallah	BRT Al Bireh/Beitunia/Qalandiya
BRT Nablus	BRT Station South/Station North/Rafidia
BRT East East Jerusalem	BRT Old Citadel/Abu Dis
BRT Bethlehem	BRT Bayt Jalah/Bayt Sahur
BRT Hebron	BRT Dura/Tapuah/Halhul
Rail Bani Na'im	Rail Jenin
Rail Rafah BCP	Rail Tell Al Beyda BCP

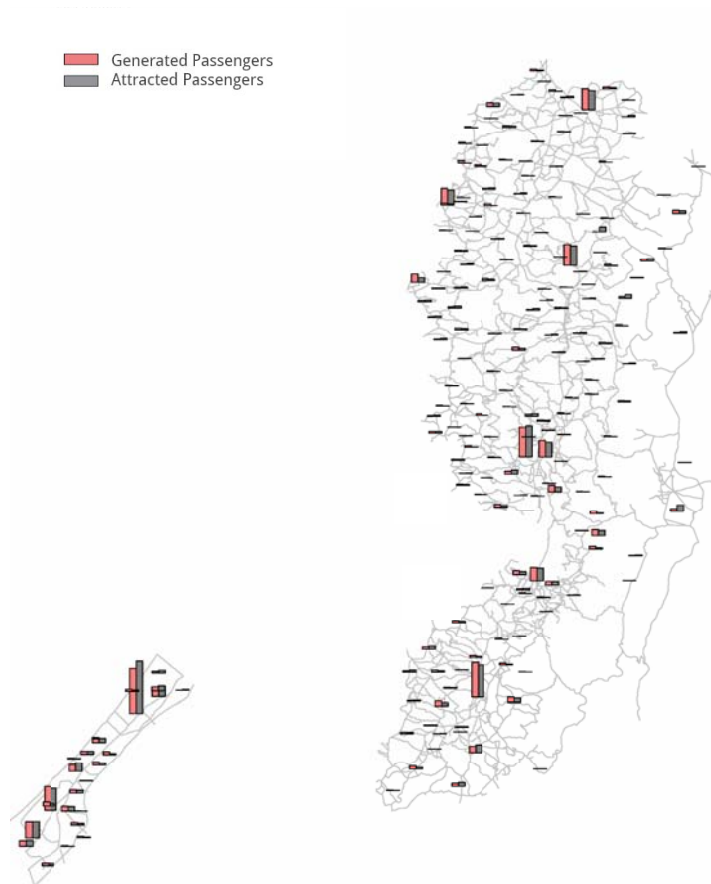
8.2 Trip Generation

In the Phase 3 scenario the trip generation/attractions figures are:

- 655,407 generated passengers trips
- 604,541 attracted passengers trips
- 18,343 LCVs
- 53,118 HCVs
- 11,145 International passengers

The following picture shows the origin and destination trips by histograms.

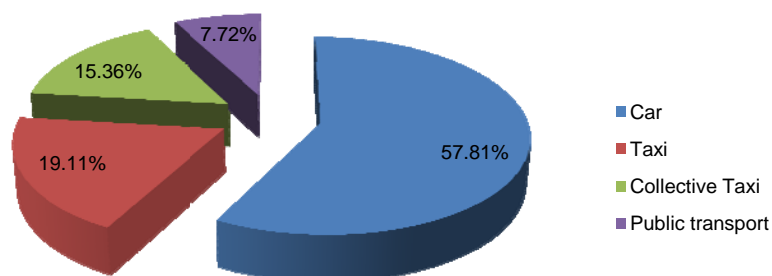
Figure 35. Phase 3, Trip Generations and Attractions



8.3 Modal Split

The following graph shows the modal split in the Phase 3 scenario:

Figure 36. Phase 3, Modal Split



The following table shows the trips by mode for the main cities.

Tab 22. Phase 3, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	19,689	19,293	6,202	6,174	5,020	4,966	3,067	2,801
Deir Al Balah	22,457	19,117	8,735	7,365	6,614	5,591	1,287	1,170
Gaza	35,808	41,947	13,783	15,501	10,555	11,956	3,459	4,271
Hebron	55,767	55,447	18,275	18,392	14,696	14,731	14,348	13,821
Jenin	30,417	30,407	9,851	9,979	8,059	8,147	3,019	2,961
East Jerusalem	19,106	14,279	6,118	4,561	4,932	3,688	2,599	1,988
Jericho	2,579	7,407	705	1,835	612	1,635	313	962
Khan Younis	33,093	27,739	12,103	10,291	9,424	8,021	2,250	1,922
Nablus	27,268	36,304	8,090	10,714	6,706	8,910	5,703	6,211
North Gaza	9,974	15,303	3,598	5,273	2,774	4,135	710	1,252
Qalqilya	13,435	11,802	3,773	3,384	3,232	2,879	1,480	1,505
Ramallah/AI Bireh	56,007	54,807	17,122	17,061	14,175	14,035	7,463	7,380
Rafah	19,340	19,615	6,804	7,005	5,378	5,530	1,307	1,292
Salfit	6,106	5,994	1,739	1,720	1,515	1,484	1,044	889
Tubas	24,096	16,822	7,157	5,154	6,020	4,292	2,179	1,954
Tulkarm	3,763	2,621	1,171	816	951	661	375	228

8.4 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 37. Phase 3, Traffic Volumes

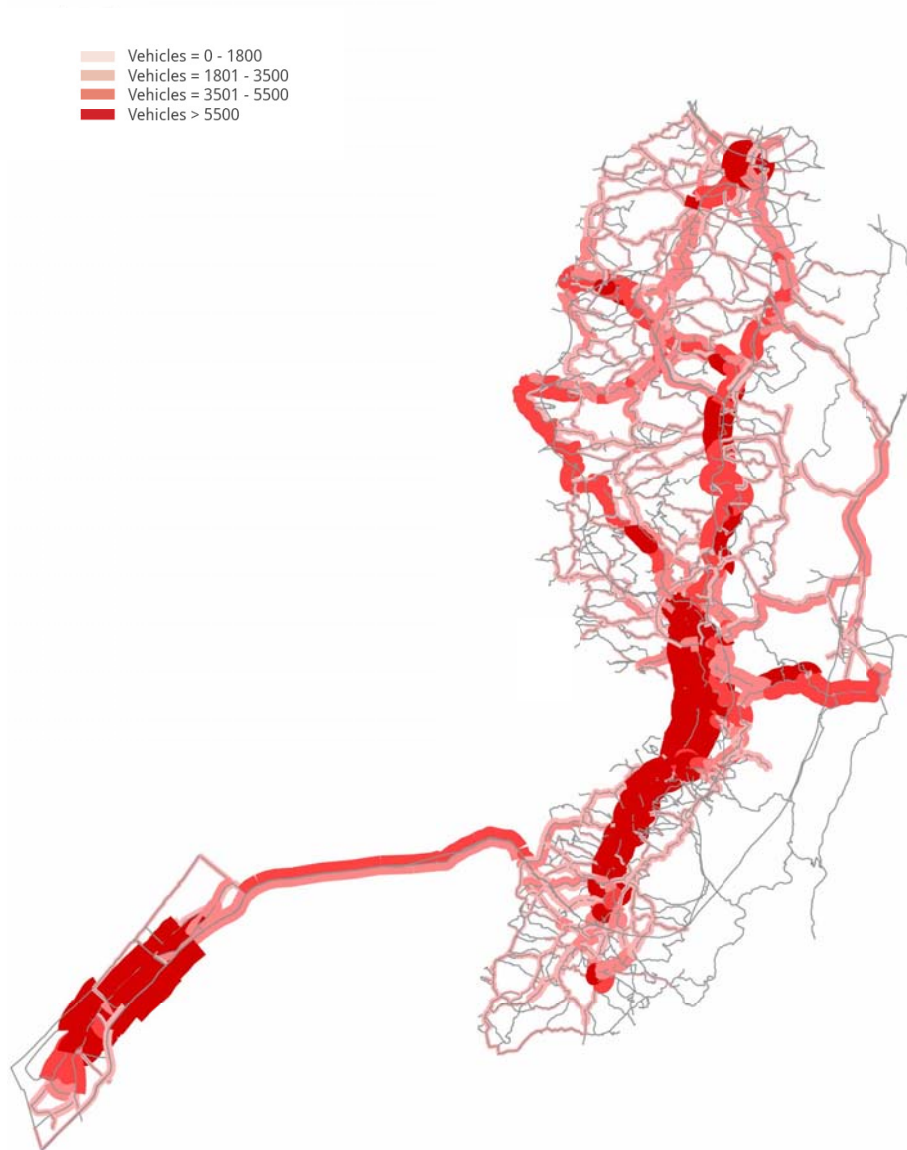




Figure 38. Phase 3, Volume/Capacity Ratio

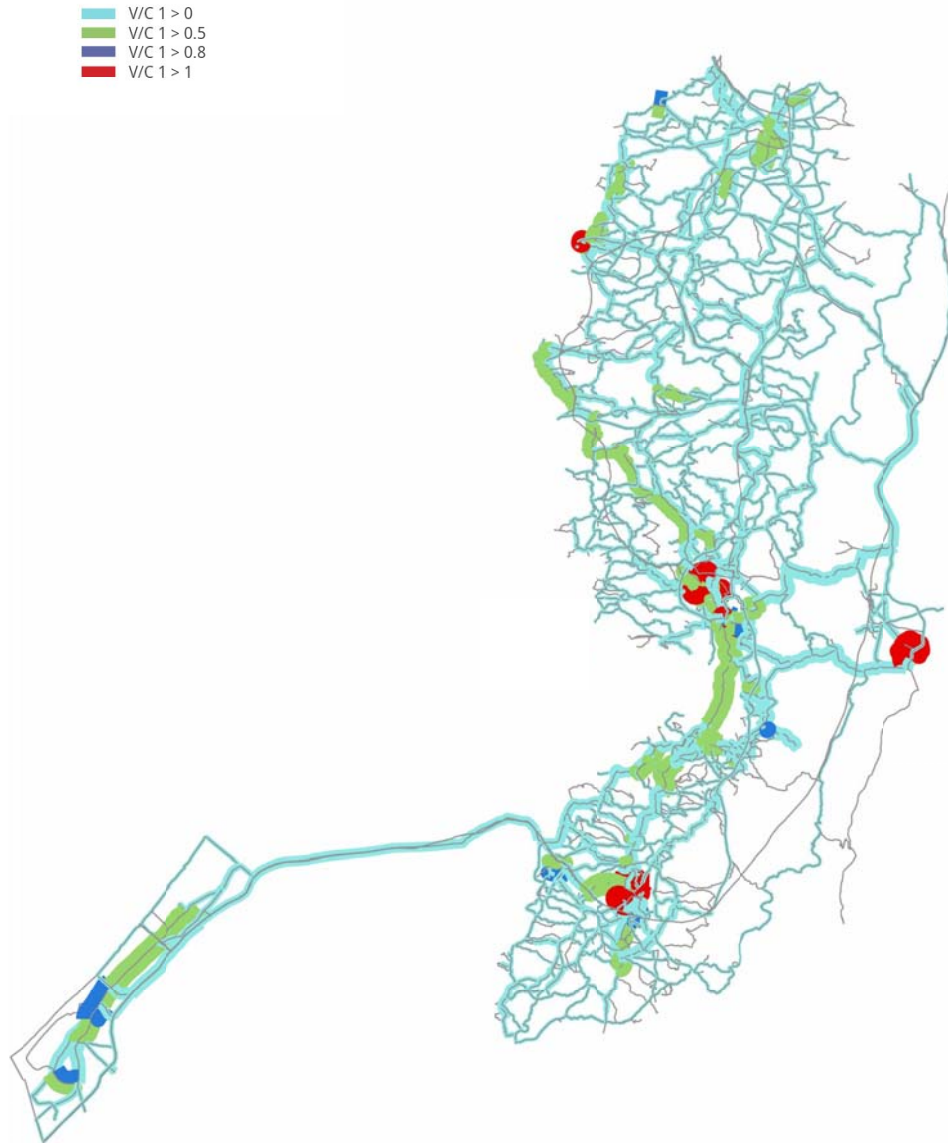
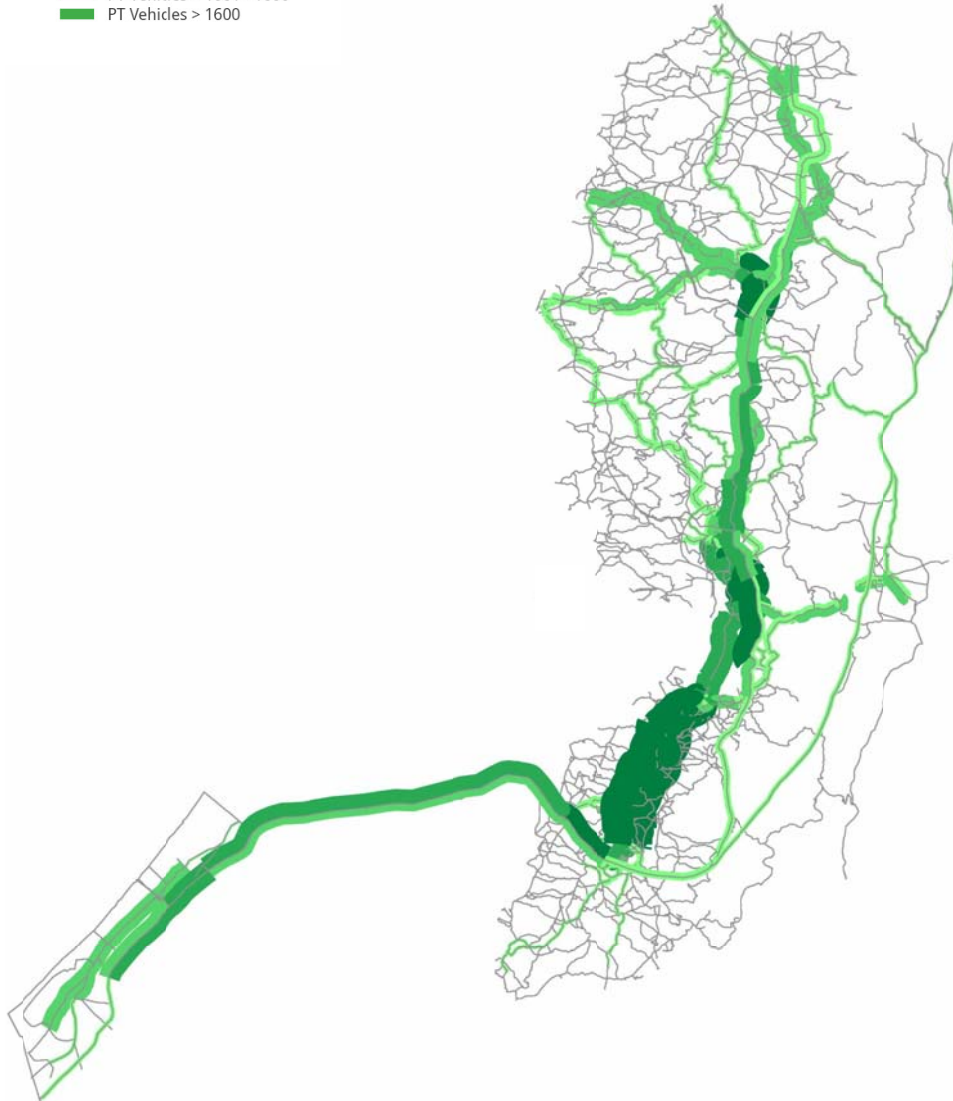


Figure 39. Phase 3, PT Ridership

- PT Vehicles = 0 - 550
- PT Vehicles = 551 - 1000
- PT Vehicles = 1001 - 1600
- PT Vehicles > 1600



8.5 Main Results

The network Outputare reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network;
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network;
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network.

Tab 23. Phase 3, Road NetworkMain Results

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,633.47	7,444,992.99	97,801.83	76.12
Other a	281.00	262,100.33	5,242.01	50.00
Other b	24.00	3,151.79	63.04	50.00
Local a	22.36	740.80	24.70	30.00
Local b	17.38	0.00	0.00	0.00
Third Class Road	71.62	11,713.99	391.65	29.91
Second Class Road	3,226.40	654,961.79	15,824.57	41.39
Primary Class Road a	3,052.84	2,476,731.59	35,517.37	69.73
Primary Class Road b	98.15	109,445.53	1,094.82	99.97
Other c	1,821.90	3,922,058.26	39,223.63	99.99

Regarding the Public Transport System, in the **Phase 3** scenario there are **1,066,567passengers*km** for an average of **13,616passengers*hour**.

The following table shows the border crossing data.

Tab 24. Phase 3, Border Crossing

Border Crossing	Total Vehicles	Car	Taxi	Collective Taxi	Moto	LCV	HCV	PT passengers
Rafah_BCP	329	0	0	0	329	0	0	0
Karem_Abu_Salem_BCP	0	0	0	0	0	0	0	0
Bayt_Hanoun	5,645	3,231	295	217	360	94	1,447	2,291
Freijat (Al Dahriya)_BCP	19	14	4	1	0	0	0	0
Tarqumiya-Idhna	7,311	4,287	408	284	350	94	1,888	0
Bayt Jala_BCP	3,161	1,966	518	123	105	132	317	0
Tulkarm	149	38	12	3	0	60	36	0



Al_Jalameh_BCP	76	64	9	3	0	0	0	0
Tell_Al_Bayda_BCP	140	43	26	5	0	0	65	0
Damyeh_Bridge_BCP	251	115	61	10	0	0	65	0
Karama_Bridge_BCP	26	9	6	1	0	0	10	0
King_Abdallah_BCP	689	281	99	19	0	0	290	0

During the "Phase" scenarios several projects are implemented. The following table shows the traffic data for each considered section. If the project is not implemented in the current Phase scenario, the table reports the actual data.

Tab 25. Phase 3, Project Sections Data

Sn	Length [km]	veh*km	veh*h	Ave Speed [km/h]
1	7	915	13	70.00
3	127	579,098	8,301	69.76
4	4	2,482	35	70.00
5	12	1,022	15	70.00
6	109	72,667	1,039	69.97
8	70	3,283	47	69.99
9	20	30,026	300	100.00
10	7	95	1	70.00
11	20	14,532	208	69.99
12	10	7,688	77	99.54
13	65	260,870	2,609	100.00
14	49	58,021	829	69.96
16	733	104,299	2,426	42.99
19	75	8,450	121	70.00
20	25	74,877	1,072	69.88
21	96	330,510	3,305	99.99
22	323	598,868	6,003	99.77
24	110	1,852	21	87.82
26	212	203,661	2,639	77.16
27	37	73,925	739	100.00
28	115	177,749	2,525	70.39
29	40	22,089	316	69.93
30	55	55,254	578	95.54
31	213	409,576	4,156	98.54
32	81	291,184	2,912	100.00
33	30	6,079	61	100.00
34	206	194,977	2,346	83.10
35	0	0	0	0.00
36	17	10,191	102	100.00

9 Transport Model Outputs for Phase 4 (2038 – 2045)

This chapter described the model's outputs of the **Phase 4** scenario. Information about the modeled network for both the private traffic and public transport system, trip generation/attractions, modal split, public transport fares, vehicle and passenger volumes are reported. Statistical data of the network's performances are reported at the end of the chapter. The modeled reference year for Phase 4 is the end of 2045.

9.1 Networks

The following picture shows the modelled road and PT networks at Phase 4.

Figure 40. Phase 4, Road Hierachy





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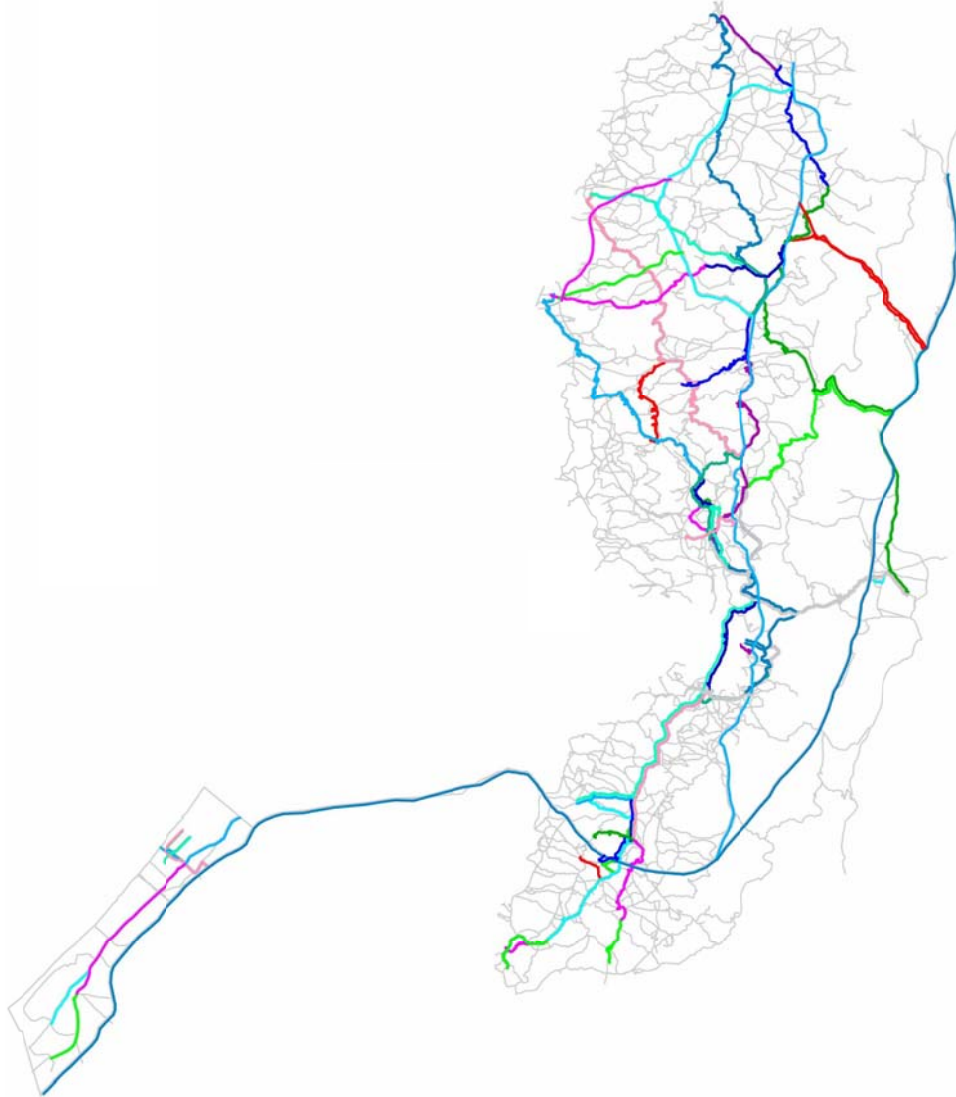
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Figure 41. Phase 4, PT Lines





The origins and destinations of the PT lines are reported in the following table.

Tab 26. Phase 4, PT Lines

FROM	TO
Ramallah	Tarqumiya
Ramallah	Hebron
Ramallah	Bethlehem
Ramallah	East Jerusalem
Ramallah	Bir Zayt
Ramallah	Jericho
Ramallah	Nablus
Ramallah	Qalqilya
Ramallah	Tulkarm
Ramallah	Jenin
Ramallah	Freijat (Al Dahriya)BCP
Ramallah	Jalameh BCP
Ramallah	Al Karama Bridge BCP
Nablus	Tarqumiya
Nablus	Hebron
Nablus	Bethlehem
Nablus	Ramallah
Nablus	East Jerusalem
Nablus	Bir Zayt
Nablus	Jericho
Nablus	Qalqilya
Nablus	Tulkarm
Nablus	Jenin
Nablus	Freijat (Al Dahriya)BCP
Nablus	Jalameh BCP
Nablus	Al Karama Bridge BCP
Hebron	Tarqumiya
Hebron	Bethlehem
Hebron	Ramallah
Hebron	East Jerusalem
Hebron	Bir Zayt
Hebron	Jericho
Hebron	Nablus
Hebron	Qalqilya
Hebron	Tulkarm
Hebron	Jenin
Hebron	Freijat (Al Dahriya)BCP
Hebron	Jalameh BCP
Hebron	Al Karama Bridge BCP
East Jerusalem	Tarqumiya
East Jerusalem	Hebron
East Jerusalem	Bethlehem
East Jerusalem	Ramallah
East Jerusalem	Bir Zayt
East Jerusalem	Jericho
East Jerusalem	Nablus
East Jerusalem	Qalqilya
East Jerusalem	Tulkarm
East Jerusalem	Jenin
East Jerusalem	Freijat (Al Dahriya)BCP
East Jerusalem	Jalameh BCP
East Jerusalem	Al Karama Bridge BCP
Gaza	Khan Younis
Gaza	Rafah
Gaza	Bayt Hanoun
Gaza	Rafah BCP
Nablus	Salfit
Nablus	Tubas
Hebron	Dura
Hebron	Dahriya

Hebron	Samu'a
Hebron	Yatta
BRT Ramallah	BRT Al Bireh/Beitunia/Qalandiya
BRT Nablus	BRT Station South/Station North/Rafidia
BRT East East Jerusalem	BRT Old Citadel/Abu Dis
BRT Bethlehem	BRT Bayt Jalah/Bayt Sahur
BRT Hebron	BRT Dura/Tapuah/Halhul
BRT Gaza	BRT Gaza Station/Fishery Port/Jabaliya
Rail Bani Na'im	Rail Jenin
Rail Rafah BCP	Rail Tell Al Beyda BCP

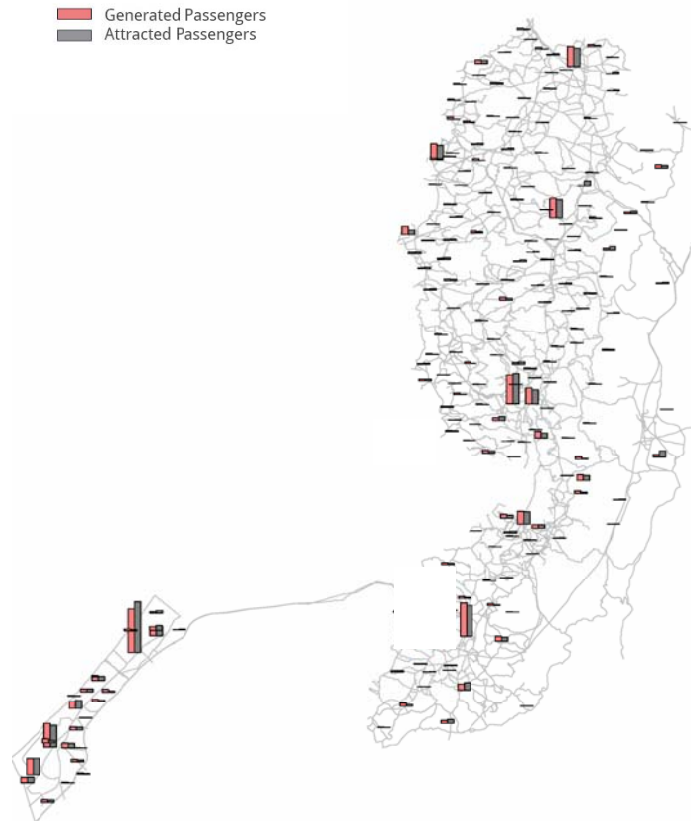
9.2 Trip Generation

In the Phase 4 scenario the trip generation/attractions figures are:

- 767,445 generated passengers trips
- 604,541 attracted passengers trips
- 21,399 LCVs
- 62,326 HCVs
- 11,262 International passengers

The following picture shows the origin and destination trips by histograms.

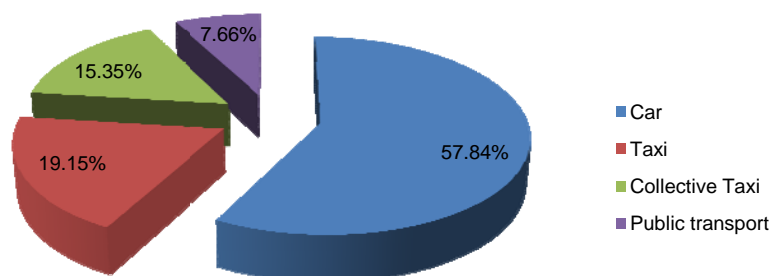
Figure 42. Phase 4, Trip Generations and Attractions



9.3 Modal Split

The following graph shows the modal split in the Phase 4 scenario:

Figure 43. Phase 4, Modal Split



The following table shows the trips by mode for the main cities.

Tab 27. Phase 4, Trips by Mode

City	CAR gen	CAR att	Taxi gen	Taxi att	CTaxi gen	Ctaxi att	PT gen	PT att
Bethlehem	23,959	22,563	7,552	7,255	6,078	5,783	2,197	3,281
Deir Al Balah	25,848	22,226	10,078	8,537	7,611	6,528	2,240	1,633
Gaza	40,675	47,134	15,503	17,141	11,884	13,415	6,416	8,569
Hebron	66,704	67,105	22,019	22,406	17,640	17,881	14,344	12,360
Jenin	35,637	35,620	11,623	11,759	9,428	9,530	3,434	3,476
East Jerusalem	22,475	16,803	7,224	5,380	5,788	4,326	2,869	2,184
Jericho	3,020	8,689	836	2,152	714	1,929	359	1,091
Khan Younis	38,300	32,407	13,917	11,996	11,012	9,356	3,363	2,413
Nablus	32,374	42,947	9,715	12,803	7,956	10,522	5,888	6,556
North Gaza	11,044	17,513	3,937	5,991	3,052	4,724	1,937	2,171
Qalqilya	15,694	13,799	4,458	3,999	3,763	3,353	1,751	1,782
Ramallah/Al Bireh	65,685	64,201	20,335	20,282	16,635	16,458	8,314	8,268
Rafah	22,646	22,958	7,909	8,188	6,341	6,466	1,544	1,546
Salfit	7,208	7,009	2,073	2,031	1,780	1,730	1,120	1,049
Tubas	28,179	19,801	8,439	6,110	7,025	5,045	2,552	2,131
Tulkarm	4,409	3,084	1,381	969	1,116	778	424	241

9.4 Traffic Assignment

The following pictures show the traffic and passengers volumes on the road and PT networks and the volume over capacity ratio.

Figure 44. Phase 4, Traffic Volumes

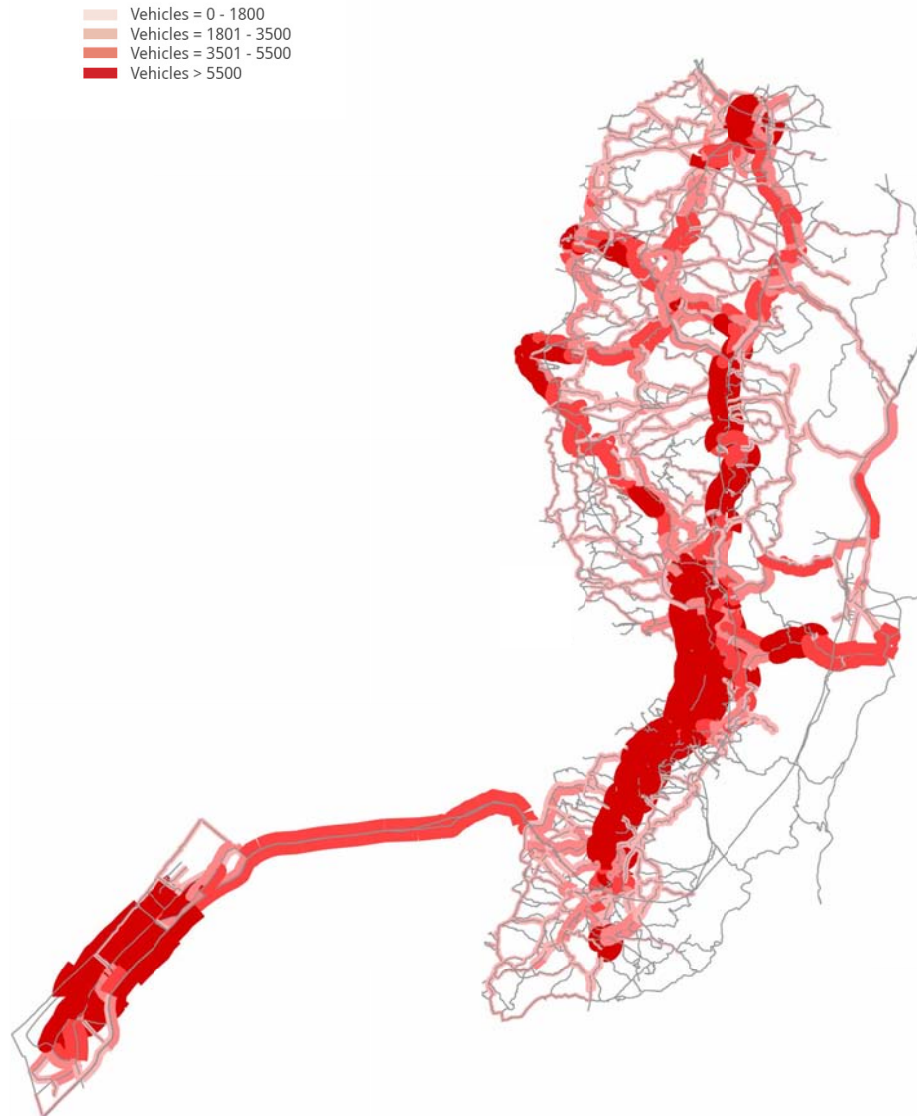


Figure 45. Phase 4, Volume/Capacity Ratio

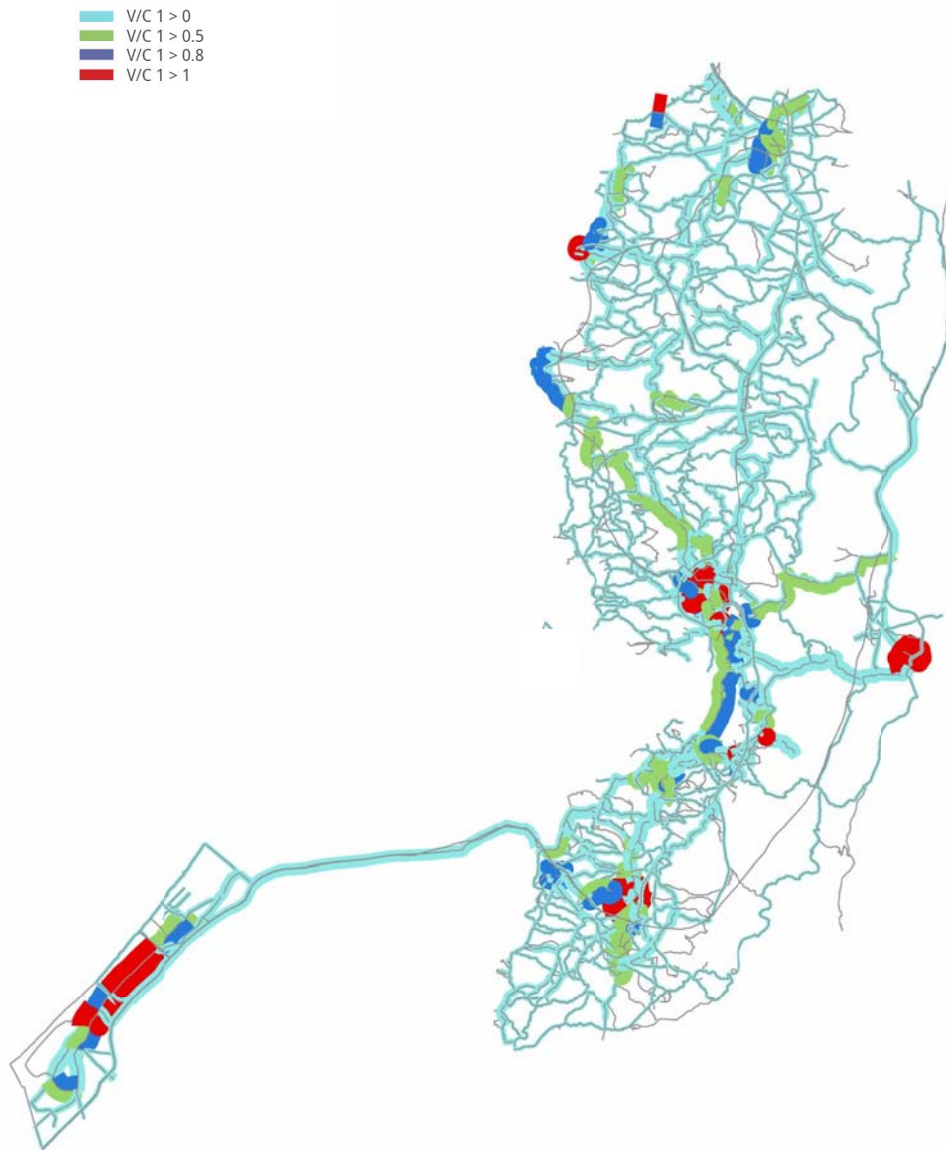
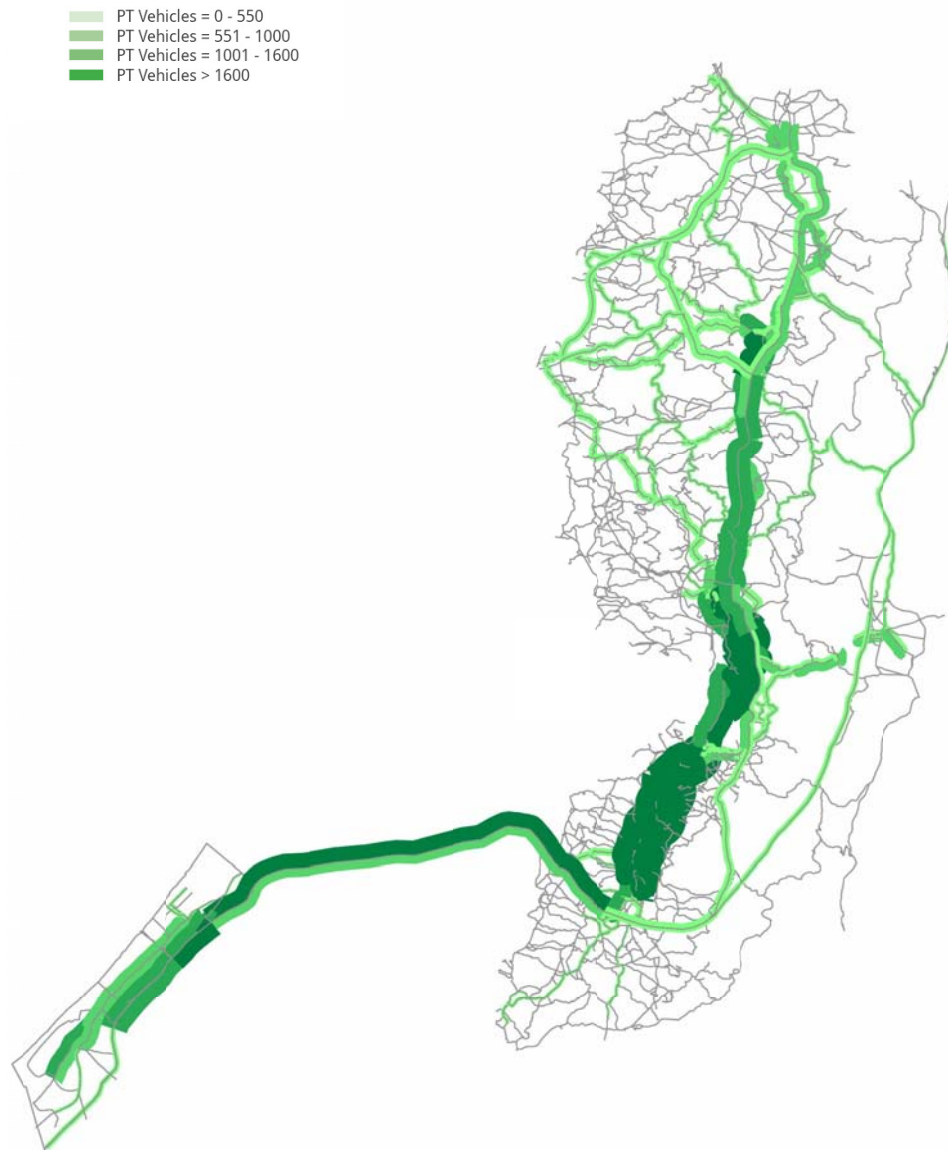


Figure 46. Phase 4, PT Ridership





9.5 Main Results

The network Outputare reported in the following table, where:

- Vehicles x kilometer (veh*km)
Combination, extended to all the links of the network, of the products of the number of vehicles driving on each link and the length of the link; it represents the total distance travelled by all the vehicles in the network;
- Vehicles x hour (veh*h)
Combination, over all the links of the network, of the product of the number of passing vehicles on each link and the travel time of the link; it represents the total time spent by the all vehicles in the network;
- Average network speed (ave speed)
Ratio between veh*km and veh*h; it consists of the average speed of the entire network.

Tab 28. Phase 4, Road Network Main Results

Type	Length [km]	veh*km	veh*h	Ave Speed [km/h]
All	8,811.84	8,810,649.56	121,120.37	72.74
Other a	283.00	311,186.71	6,223.73	50.00
Other b	24.00	3,807.29	76.15	50.00
Local a	22.36	966.83	32.23	29.99
Local b	17.38	0.00	0.00	0.00
Third Class Road	68.60	11,619.48	390.66	29.74
Second Class Road	3,224.02	816,793.66	20,949.14	38.99
Primary Class Road a	3,216.94	3,032,661.69	46,538.59	65.16
Primary Class Road b	98.15	136,146.83	1,362.45	99.93
Other c	1,839.57	4,492,174.72	44,930.65	99.98

Regarding the Public Transport System, in the **Phase 4** scenario there are **1,288,889 passengers*km** for an average of **17,054 passengers*hour**.

The following table shows the border crossing data.

Tab 29. Phase 4, Border Crossing

Border Crossing	Total Vehicles	Car	Taxi	Collective Taxi	Moto	LCV	HCV	PT passengers
Rafah_BCP	329	0	0	0	329	0	0	0
Karem_Abu_Salem_BCP	0	0	0	0	0	0	0	0
Bayt_Hanoun	6,353	2,975	273	197	405	94	2,408	2,507
Freijat (Al Dahriya)_BCP	19	14	4	1	0	0	0	0
Tarqumiya-Idhna	9,112	4,923	479	330	412	94	2,874	0
Bayt Jala_BCP	4,062	2,544	645	189	160	154	370	0
Tulkarm	426	37	12	3	0	82	293	0



Al_Jalameh_BCP	76	63	9	3	0	0	0	0
Tell_Al_Bayda_BCP	156	46	28	5	0	0	77	0
Damyeh_Bridge_BCP	259	111	61	9	0	0	78	0
Karama_Bridge_BCP	29	10	6	1	0	0	12	0
King_Abdallah_BCP	791	276	100	19	0	0	396	0

During the "Phase" scenarios several projects are implemented. The following table shows the traffic data for each considered section. If the project is not implemented in the current Phase scenario, the table reports the actual data.

Tab 30. Phase 4, Project Sections Data

Sn	Length [km]	veh*km	veh*h	Ave Speed [km/h]
1	7	859	12	70.00
3	127	802,670	14,364	55.88
4	4	2,579	37	70.00
5	12	1,237	18	70.00
6	109	92,115	1,317	69.96
8	70	3,917	56	69.98
9	20	34,141	341	99.99
10	7	105	2	70.00
11	20	14,977	214	69.99
12	10	8,688	87	99.39
13	65	286,089	2,861	99.99
14	49	61,960	886	69.93
16	733	125,344	3,179	39.43
19	75	14,238	203	70.00
20	25	63,269	906	69.86
21	96	323,339	3,234	99.99
22	318	674,667	6,762	99.77
24	110	2,233	25	88.89
26	212	232,710	3,208	72.55
27	37	91,434	914	100.00
28	111	206,535	2,927	70.57
29	40	22,114	317	69.83
30	55	56,444	589	95.75
31	209	475,928	4,846	98.21
32	81	365,003	3,650	99.99
33	30	7,460	75	100.00
34	206	242,751	2,939	82.58
35	347	84,985	1,129	75.25
36	17	11,286	113	100.00