JOHN ALDRIDGE
CONSULTANCY

INTERNATIONAL ROAD SAFETY
SOLUTIONS • MANAGEMENT

Tivat to Jaz Beach Road, Montenegro

Results of Traffic and Pedestrian Counts completed 18th – 21st November 2020

Date: 10th December 2020
Report requested by: EBRD
Report prepared by: John Aldridge
Reference: jma_00029_002_

Document Control Sheet

Project Title	Tivat, to Jaz Beach, Montenegro Traffic & Pedestrian Counts
Report Title	Results of Pedestrian and Traffic Counts completed 18th to 21st November 2020 Reference: jma/00029/002
Revision	002
Status	Draft
Control Date	10/12/2020

John Aldridge Consultancy Ltd
70 Moggs Mead
Petersfield
Hampshire
GU31 4NX
Registered in England and Wales
Company Number 12054201

Table of Contents

Executive Summary

Following the completion of the Road Safety Audit report for the Tivat to Jaz Beach Road and the subsequent received Designers Response to the Road Safety Audit report, a number of road safety concerns remained unresolved. Some of the road safety issues related to the proposed junctions along the project road to support left turning movements in and out of minor junctions to the project road. Other issues related to the proposed infrastructure to support safe crossing of the project road for pedestrians.

If an effort to develop a better understanding of the utilisation of the locations where pedestrian crossings and left turn movements across the upgraded project road are proposed, traffic and pedestrian counts have been completed. The counts have been completed for four continuous days between the 18th – 21st November 2020 inclusive. The counts have been completed for 12 hours each day from 0600-1800hrs and have been completed from Wednesday to Saturday inclusive.

From the collected results from the surveys the recommendations raised within the road safety audit report have been revisited and based upon the survey results a further update for each survey location has been made based upon the additional survey information. These recommendations are summarised below and expanded within this report:

- Site 1 –Pedestrian and turning movements are high so a controlled crossing/junction is recommended. Solution to be developed after taking in account the newly installed roundabout close to the survey location.
- Site 2 – Close gap, vehicles to utilise nearby roundabouts to U turn. Push button pedestrian crossing to be added.
- Site 3 - Close gap, vehicles to utilise nearby roundabouts to U turn. Push button pedestrian crossing to be added.
- Site 4 - Close gap, vehicles to utilise nearby roundabouts to U turn. Push button pedestrian crossing to be added.
- Site 5 – Introduce signal controlled junction with pedestrian phase. Alternatively, vehicles to divert to nearby roundabouts to U turn, and introduce push button pedestrian facility crossing at the survey location.
- Site 6 - Close gap, vehicles to utilise nearby roundabouts to U turn. Push button pedestrian crossing to be added.
- Site 7 - Close gap, vehicles to utilise nearby roundabouts to U turn. Push button pedestrian crossing to be added.
- Site 8 - Close gap, vehicles to utilise nearby roundabouts to U turn. No pedestrian crossing demand recorded, remove crossing from design.

The results from the survey need to be interpreted with caution. The surveys have been conducted during the Covid-19 pandemic which has created travel restrictions and erratic travel patterns. Therefore the results achieved from the surveys may not truly be representative of typical travel patterns in a ‘normal’ November. It should be further noted that Montenegro is a tourist location and therefore there are seasonal variations in traffic flows, with much higher flows recorded in the summer months compared to those in the survey month of November.

1. Introduction

1.1 Background

At the request of EBRD traffic and pedestrian counts have been completed at 8 locations along the Tivat to Jaz Beach Road. The counts have been completed to help provide some further supporting evidence to make informed design decisions along the project road.

As a result of a previously completed Road Safety Audit report there were a number of road safety issues outstanding. Many of these issues related to concerns that the widening of the project road from one lane in each direction to a divided two lane arrangement, which may result in higher vehicle speeds and consequently a more challenging environment for left turning vehicles and crossing pedestrians. The completed surveys have therefore been conducted to ascertain the numbers and directions of movements at each of the 8 surveyed locations. Based on the collection of the additional information each of the comments raised at the surveyed locations identified in the initial Road Safety Audit report will be revisited and a further recommendation on the most appropriate treatment at each site location made based upon the assessment of the additional information from the traffic count data.

1.2 Methodology

The surveys have been completed between the 18th to the 21st November 2020. Surveys were conducted for 12hrs from Wednesday to Saturday inclusive from 0600-1800hrs. Surveys were conducted by video recordings opposed to manual counts so that a permanent record could be obtained of the results and the collection of movements was less likely to affected by human error. The results were broken down into 15 minute intervals so that peaks could be identified. Vehicle types were divided into different categories so that activity of groups such as cycles, motorcycles, bus and HGV trucks could be recorded.

There were challenges experienced within the collection of the results. This included lockdown restrictions due to Covid-19, bad weather which resulted in more frequent attendance to camera locations as battery life was shortened. There was also issues were cameras were moved and on one occasion stolen. Despite the challenges, all the survey results were collected.

The results for each location are presented in the following chapters and include the following:

- a description of the site location and site survey conditions,
- a review of the road safety issues from the road safety audit report,
- outline issues from the survey results
- a recommended solution for the site location based upon the assessment of the additional information.

The full results from the surveys will be made available as separate electronic files to the main report.

1.3 Interpretation of the Results

The results collected from the surveys need to be treated with a certain amount of caution. Traffic counts and pedestrian surveys have only been completed for a limited time period due to the requirement to obtain results fairly swiftly so the results can be analysed and design decisions finalised. The surveys have been collected for three work days and one day from the weekend. As a full week of data has not been collected it cannot be accurately forecast that the days in which the data was collected reflects patterns for days where data has not been collected.

Perhaps the factors which are most likely to affect the validity of the results is that traffic flows along the Jaz Beach Road to Tivat are historically seasonal with typically, at least a doubling of AADT in the summer months on the road. Another unknown variable is the effect Covid-19 has had on traffic flows and pedestrian movement. With government instruction around the world to ‘stay at home’, traffic patterns are typically lower than usually expected. Air travel has also been widely affected, with many flights cancelled. These factors are likely to affect results along the project road which would typically carry a high degree of airport and tourist related traffic. However, it should be noted that based on previous collected traffic flow data near Tivat Airport, the latest traffic flow data collected as part of this traffic survey study suggest a fall in flows of around 10-15% only. Changes in turning movements and pedestrian activity are not known.

2. Site 1: km 885+277 - Tivat Airport

2.1 Site Description

At site 1 the road alignment has changed from the conditions shown on Google Street View. The conditions on site now include a newly constructed roundabout as shown in the images in Figure 2.1 below. The new roundabout serves cargo and official access to the airport and is located just north of the survey site.

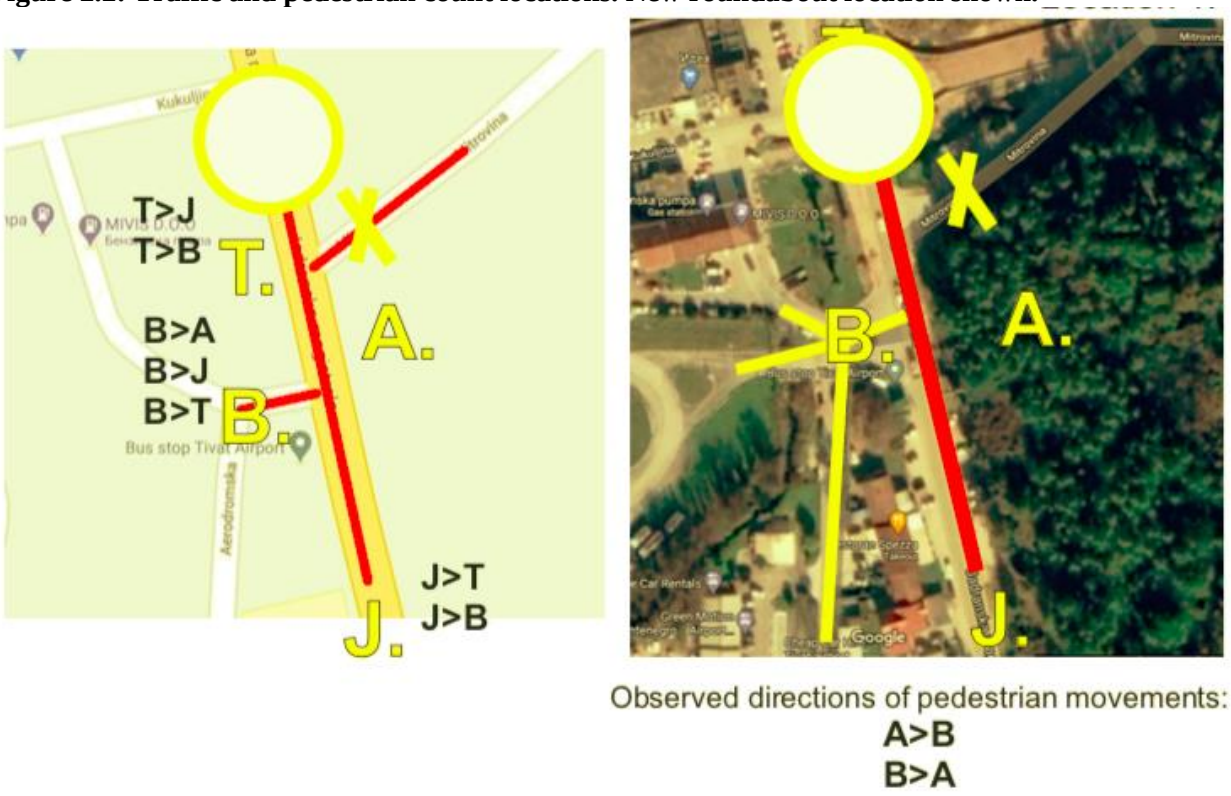
Figure 2.1: Newly constructed roundabout near the survey location

The survey site location has recorded turning movements into and out of the airport at location B as shown below in figure 2.2. Movements to the minor road (Mitrovina) at location A, were not recorded as part of the survey as this road has been temporarily closed with sandbags.

Due to the newly constructed roundabout close to the airport, which appears to be an additional roundabout to the one proposed in the submitted drawings for Road Safety Audit, it is unclear if there is likely to be a change to access arrangements to the airport following the completion of the Tivat to Jaz Beach Road upgrade to account for the additional new roundabout. As this is unknown, the survey results

are based upon the information and drawings as presented within the initial Road Safety Audit. The survey has therefore recorded the main traffic movements on the Tivat to Jaz Beach Road as well as turning movements into and out of Road B which serves the airport.

Figure 2.2: Traffic and pedestrian count locations. New roundabout location shown.



2.2 Traffic Survey approach to address Road Safety Audit concerns

As outlined in the Methodology within this report, traffic surveys have been completed at the site location for 4 continuous days for 12 hours (0600-1800hrs) on each day of the survey. The purpose of the survey was to identify the turning movements at the cross road junction and pedestrian crossing activity at the proposed pedestrian crossing as shown in Figure 2.3.

The initial road safety concern raised at this location was related to a concern of an anticipated high proportion of turning vehicles at the crossroad junction and also the risk to pedestrians to cross a multi lane road over an uncontrolled crossing. To address the road safety concern it was recommended that a roundabout or signalised junction was provided at the location which also included pedestrian facilities. The history of the raised road safety issues at this location within the road safety audit report and subsequent responses by the designer and road safety team are included in Figure 2.4.

The purpose of the survey was therefore to establish the number of turning and pedestrian crossing movements. The collection of the results of activity at the junction would provide a better understanding of the number of turning movements and pedestrian activity and the location and would therefore provide more clarity of the most appropriate junction type to consider at the site location.

As previously mentioned, movements to road A were not recorded as this road is temporarily closed with sand bags.

Figure 2.3: Proposed new junction and pedestrian crossing to the airport at Tivat.

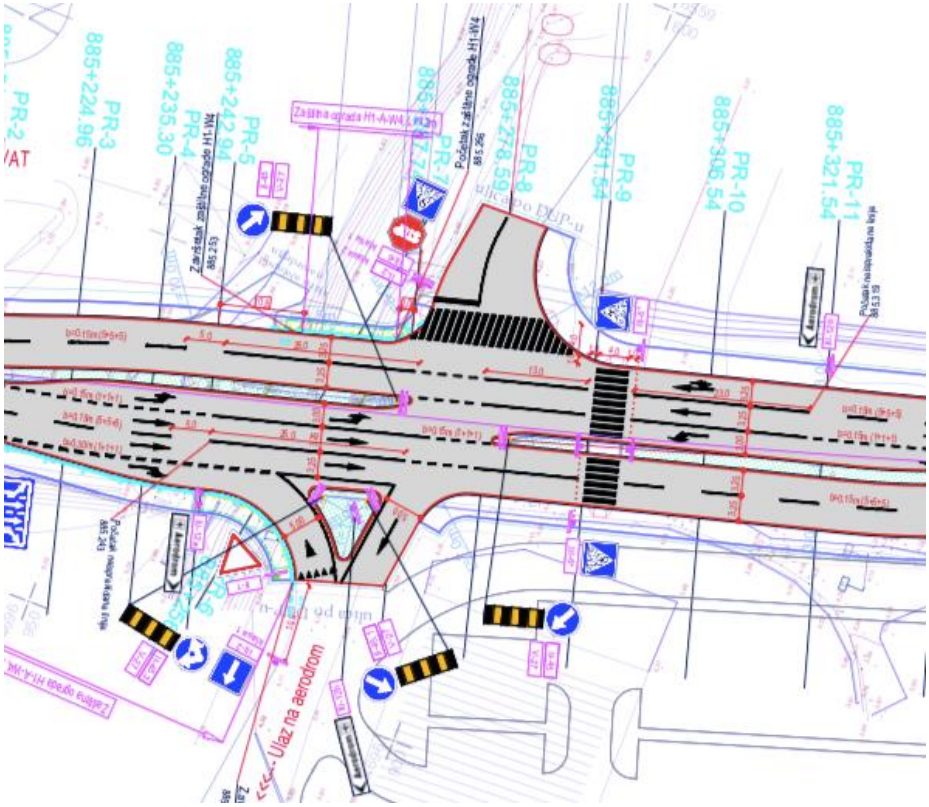
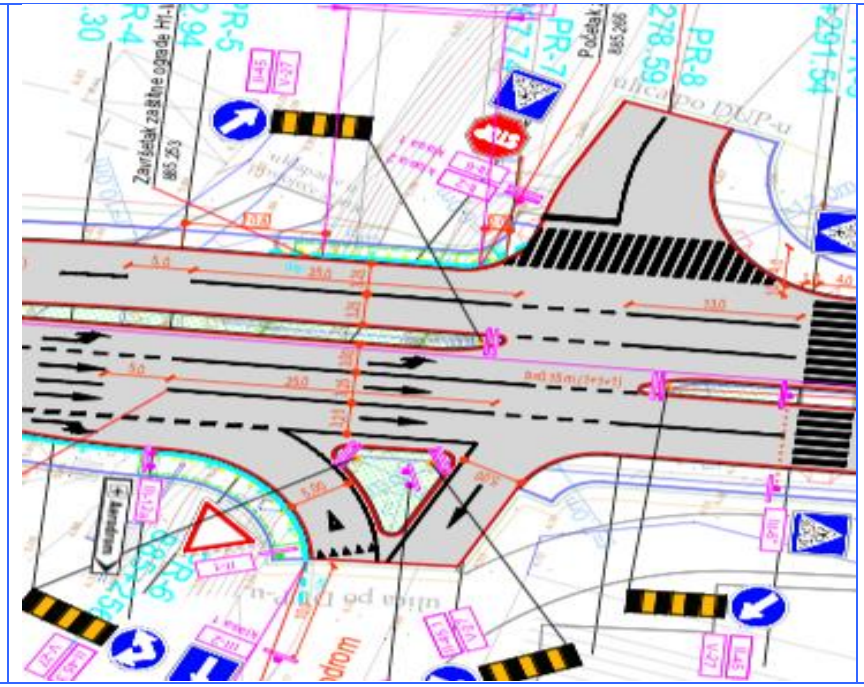


Figure 2.4: Extract from the Road Safety Audit Report outlining comments raised by Audit Team and Design Team

Previous report Ref	Safety Problem	Recommendations	Ranking H/M/L	Cost in €	Accept/ Decline	Designers Response	Audit Response
2	At KM 885+277 approx. the proposed entrance to the airport is identified. The entrance to the airport is identified as an uncontrolled crossroad junction and entry movements to the airport are one way only. Crossroad junctions typically have a poor crash record as there are numerous turning movements present which have potential for conflicts. In addition, it is assumed that the entrance to the airport is likely to attract a high number of turning movements and therefore not only is the likelihood of conflict further increased at this location, but there is also a risk that congestion may also result as turning movements may be difficult to make due to high summer traffic volumes. Merging arrangements of the two, one way entry lanes is also not clear and may also result in potential conflicts. It is further noted at this location that an uncontrolled pedestrian crossing is proposed. The crossing necessitates pedestrians to negotiate 5 lanes of traffic, and as there may be potentially fast moving through traffic at this location there is an increased likelihood of conflict for any pedestrian who attempts to cross.	It is recommended that the junction type at this location is reviewed and ideally a traffic signalised junction or roundabout is introduced.	HIGH	Signalised junction EUR 50K. Roundabout EUR 80k.	It is not accepted.	Traffic lights at intersections were not the topic of the projected task, therefore, it is not even considered at the level of the design solution. If the Investor deems it necessary to do so, this should be the subject of a separate project.	The proposed junction layout remains a road safety concern as there are muliple uncontrolled turning points. There is no detail of traffic flows and turning movement numbers but analysising these may provide some justification for the most appropriate junctino type. The proposed

							uncontrolled pedestrian crossing over multiple lanes remains a high risk to pedestrians.

2.3 Traffic Survey Results

The traffic surveys have indicated AADT rates of between 12,139 and 12,527 during the week day survey. For the survey completed on Saturday the AADT figure fell to 6493. These weekday figures do not differ significantly to the traffic count figures recorded on the 16th & 17th February 2019 for another project at a traffic counter site close to Tivat Airport which recorded an AADT rate of 12,191. In addition, reference to traffic surveys on the Tivat to Jaz Beach Road in November 2018 indicate AADT of around 13,000 to 14,000 AADT during the weekdays with a fall to around 8,000 to 10,000 AADT at the weekend. Therefore, it can be concluded that Covid-19 restrictions do not appear to have a significant impact on traffic volumes at the airport location. Note, the impact on pedestrian and turning movements from the pandemic is not known.

In terms of vehicle mix, cars and small vans represent the highest proportion of vehicle type, accounting for around 91% of the flow. Typically, HGVs represented about 1% of vehicle fleet and buses and cycles around 0.5%, so these vehicles have limited impact on the total flows.

Turning movements between the project road and the airport will have an impact of the operation of the proposed junction type, with left turn movements in and out the airport likely to be the most challenging in terms of road safety and perhaps capacity. The turning movements for vehicles heading towards Tivat and turning left into the airport, and those turning left from the airport in the direction towards Tivat are the most important movements to consider in terms of junction operation, capacity and road safety.

Based on the collected results from the 4 days of survey vehicles travelling from Jaz Beach and then left turning into the airport have been recorded as follows:
265 Wednesday,
307 Thursday,
233 Friday,
152 vehicles on the Saturday.

For day 1 the peak turning times for vehicles from Jaz Beach into the airport were as follows:

- 10:45 -11:00 14 vehicle movements,
- 11:15-11:30 11 vehicle movements,
- 15:00-15:15 16 vehicle movements

Day 2

- 08:15-08:30 15 vehicle movements,
- 09:00-09:15 15 vehicle movements
- 15:30-15:45 19 vehicle movements

Day 3

- 10:00-10:15 8 vehicle movements,
- 10:15-10:30 9 vehicle movements,
- 12:00-12:15 8 vehicle movements,
- 12:15-12:30 8 vehicle movements,
- 13:15-13:30 9 vehicle movements,

Day 4

- 08:30-08:45 6 vehicle movements,
- 09:45-10:00 6 vehicle movements,
- 10:30-10:45 7 vehicle movements,

Peak left turn movements for vehicles from the airport to Tivat were as follows:

Day 1

- 09:45-10:00 19 vehicle movements,
- 10:15-10:30 17 vehicle movements,
- 17:00-17:15 22 vehicle movements,

Day 2

- 0900 -09:15 18 vehicle movements,
- 10:15-10:30 19 vehicle movements,
- 10:30-10:45 25 vehicle movements,

Day 3

- 10:00 -10:15 16 vehicle movements,
- 13:45-14:00 17 vehicle movements,
- 14:30-14:45 16 vehicle movements,
- 17:00-17:15 16 vehicle movements,

Day 4

- 10:30-10:45 18 vehicle movements,
- 11:45-12:00 22 vehicle movements,
- 12:00-12:15 19 vehicle movements,

Based upon the peak turning periods identified above there wasn't a consistent time on each day where peaks were the same. Nevertheless, typically one vehicle turning left into the airport, and one vehicle turning out of the airport occurred approximately every minute in the peak times. These turning demands together with the traffic flows on the main Tivat to Jaz Beach Road may result in some stacking for turning vehicles at the junction location and therefore an increased risk of potential for conflicts and perhaps capacity issues.

Pedestrian movements recorded over the Tivat to Jaz Beach Road at the survey location have been recorded as follows:

Wednesday 134,
Thursday150,
Friday 128,
Saturday 77.

There were no typical peaks identified for pedestrian activity, instead crossing demand tended to occur throughout the survey period.

2.4 Recommended actions for Survey site 1

The introduction of the recent new roundabout close to the survey site will need to be considered as part of the further works which are proposed to be completed as part of the upgrade of the Tivat to Jaz Beach Road. Access arrangements to and from the airport may be changed to account for the new roundabout.

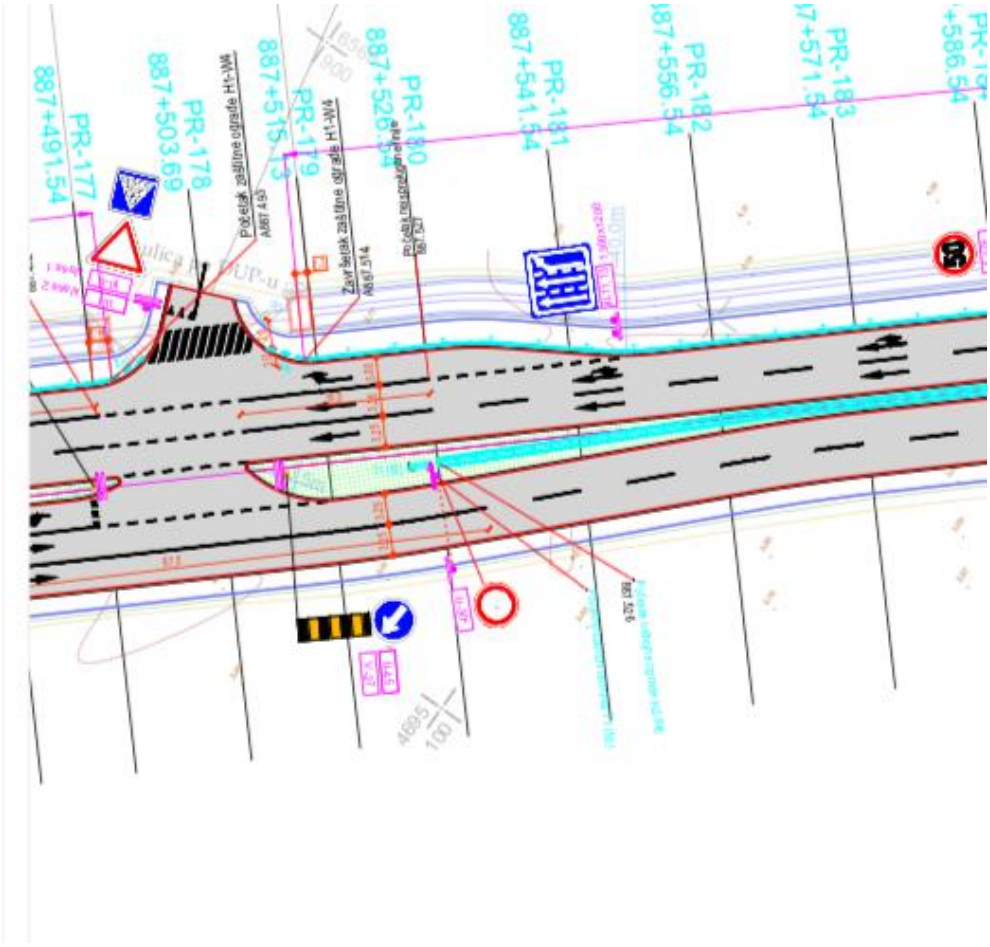
Based on the conducted traffic surveys there is a demand for left turning vehicles into and out of the airport, there is also a right turn demand too, at the junction. The recorded figures from the traffic survey are expected to be lower than normally expected as the current Covid-19 pandemic is assumed to result in decreased aircraft travel and therefore less turning movements into and out of the airport. Taking into account the recorded turning movements during a pandemic and within the low season (traffic flows are typically twice as high in the summer) the recommendation remains that a traffic signal or roundabout is introduced at this location (subject to review and clarification of access arrangements permitted at the new, nearby recently introduced roundabout). It is further recommended that a controlled pedestrian crossing facility is also introduced at this location. Pedestrian activity across the Tivat to Jaz Beach Road were recorded throughout the survey period, and again this activity is likely to be higher during the summer and when the current pandemic crisis has ended. Note, again the location of any pedestrian crossing needs to be reviewed in liaison with the newly introduced roundabout close to the survey site as this may result in a change in pedestrian desire lines due to changes in future entry points to the airport.

3. Site 2: 887+503

3.1 Site Description

At site 2 the proposed new project road includes a slightly revised geometry as the project road diverts to the east slightly, away from its current parallel alignment to the airport runway. Access remains from the project road to a minor junction to an industrial site which is assumed is also be a land fill site. Access to the minor junction is possible for traffic approaching from both Tivat and Jaz Beach directions. The Road Safety Audit report raised concerns about the left turn movement across the project road. It was recommended instead, that the proposed break in the median (as shown in Figure 3.1) is closed and the junction is modified to right-in and right-out movements only, with reverse turning movements completed through the nearby roundabouts.

Figure 3.1: Proposed at-grade junction along the project road at km 887+503

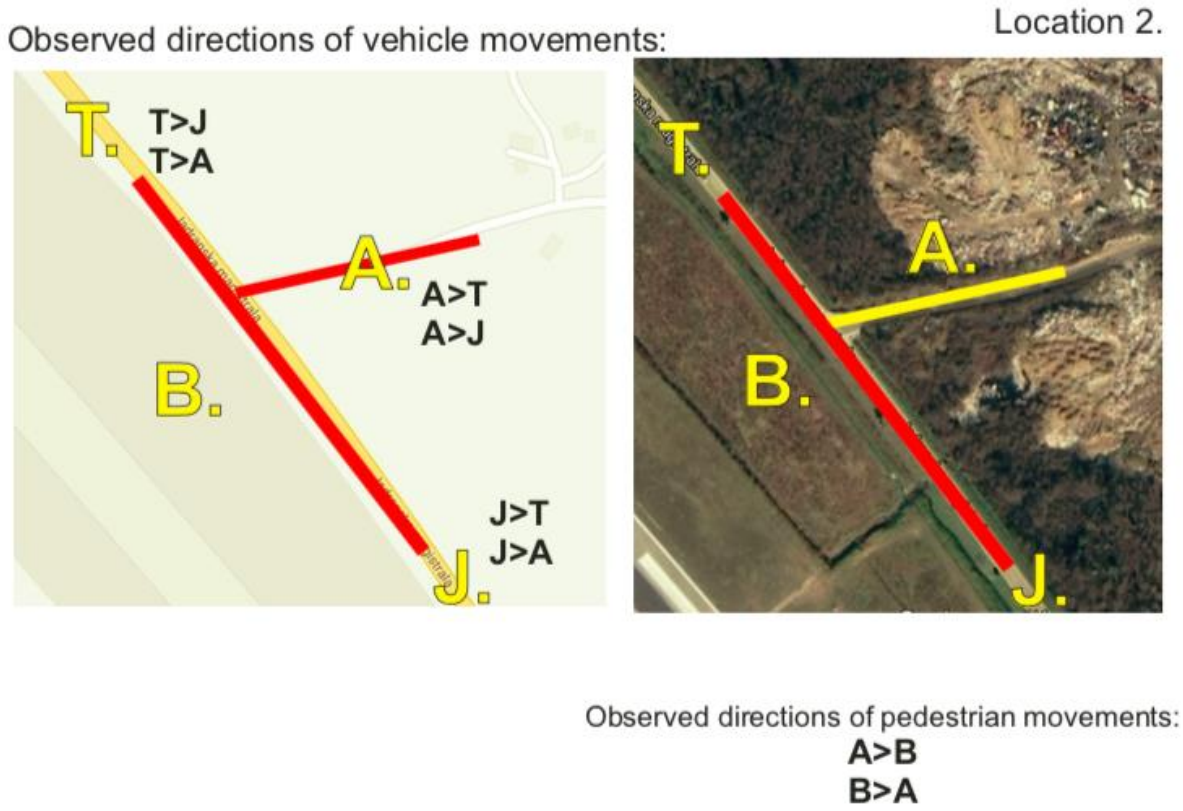


3.2 Traffic Survey approach to address Road Safety Audit concerns

Traffic surveys have been completed at the site location as outlined in Chapter 1.2, Methodology, in this report.

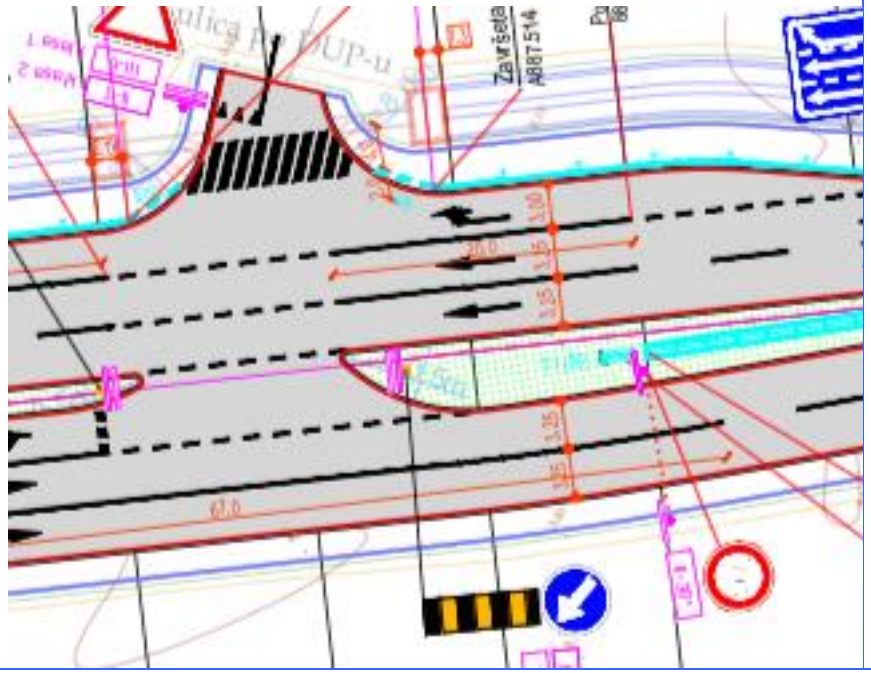
To monitor traffic movements at the site location turning and through traffic movements were recorded as outlined in Figure 3.2. As a pedestrian crossing is proposed across the minor side road at the site location, pedestrian activity was also monitored over the four-day count period as also outlined in Figure 3.2.

Figure 3.2: Vehicle turning movements and pedestrian counts completed at location 2



The road safety concern was raised in the initial Road Safety Audit report at this location, on the basis of an anticipated high proportion of turning vehicles across the project road to an industrial site. The concern was further exacerbated by the industrial nature of the site which may result in a high proportion of trucks turning at the site further increasing the risk of turning conflicts due to the presence of larger, and slower moving turning vehicles. The history of the raised road safety concern including designer and road safety audit team comments and recommendations is outlined in the Road Safety Audit report extract included in Figure 3.3.

Figure 3.3: Extract from the Road Safety Audit Report outlining comments raised by Audit Team and Design Team.

Previous report Ref	Safety Problem	Recommendations	Ranking H/M/L	Cost in €	Accept/ Decline	Designers Response	Audit Response
5	At km. 887+503 a break in the median is proposed and left turn junction is introduced. The introduction of a break in the median to enable turning movements introduces a potential conflict between high speed through traffic and low speed turning vehicles to the detriment of road safety. 	It is recommended that the break in the median is removed and instead the junction is made a right in/right out arrangement only with left turn movements instead completed through the nearby roundabouts.	HIGH	The changes are likely to reduce project costs.		We consider that you are right, but the positions of the intersections are designed in accordance with the valid planning documentation.	Road safety concern still remains, although it is accepted that changes may be difficult to achieve if the design is in accordance with planning documentation.

3.3 Survey Results

Two-way traffic flows on the main Tivat to Jaz Beach Road varied between 4,982 and 6,458 vehicles on weekdays. On Saturday the two-way traffic flow fell to 1,092 vehicles during the 12 hour monitoring period. These figures appeared to be low and are therefore the site was re-surveyed for 12hrs on the 8th December 2020 as there was a concern that all movements had not been captured in the initial survey. The additional surveys recorded turning movements into and out of the minor junction only as this was the specific area of interest along the project road.

Vehicles turning left into the minor road (marked as A in Figure 3.2) have been recorded as an average of 48 turning movements a day from Tivat, and a similar number of right turning into the minor road from Jaz Beach direction. There was a reduction in turning movements on Saturday. The additional traffic survey conducted on Tuesday 8th December 2020 to record turning movements to and from the minor road recorded similar results to the initial survey as outlined in Table 3.1 below.

	Side Road To/From Main road Traffic Comparision	
	Location 2 Daily AVG 18th-21st November 2020	Location 2 - One day New recording 8th December 2020
(T>A)	**48**	**43**
A>T	27	34
J>A	49	48
A>J	35	58
	159	**183**

Table 3.1: Surveyed turning movements from local road (A) between Tivat (T) and Jaz Beach (J) directions

For vehicles turning left from the Minor Road (A) onto the project road toward Jaz Beach, approximately 40 vehicles a day made this movement during the weekdays recorded. This reduced to 10 vehicles on the Saturday.

An analysis of the flows by 15 minute periods does not indicate a peak 15-minute turning period. The highest number of turning movements into the Minor Road A, from Tivat (left turn movement) occurred on a Monday between 10:15 – 10:30hrs where 4 cars/small vans, and 2 HGVs turned left into the minor road. Two vehicles turned left out of the minor junction during the same time period. The numbers for the rest of the survey period indicated lower peak turning movements.

The initial concern at this location as raised within the Road Safety Audit report related to a concern of a high proportion of trucks turning to and from the project road to the industrial area. The movements which were considered to have the greatest impact on traffic flow and potential for road safety concerns were the left turn movements of vehicles travelling from Tivat and turning into the Minor Road A, and vehicles turning left out of the Minor Road A in the direction towards Jaz Beach, in particular trucks making this manoeuvre. The collected traffic flow and turning count information has indicated low turning movements at this site location for all vehicle types. There were no high number of commercial vehicles present in the traffic data.

A pedestrian analysis was also completed at the site location. Pedestrian flows were very low at the location. A total of 12 pedestrians were counted during the whole study period with 7 of these counted on the Monday.

3.4 Recommended actions for Survey site 2

Based upon 4 days of 12 hour surveys, turning movement observed from the project road into the Minor road serving the industrial area were low. These initial low survey numbers were reflected in the additional count conducted on the 8th December 2020.

The area of concern raised in the Road Safety Audit report mostly related to the left turn movements in and out of the minor junction. The results from the traffic count indicate a low turning volume throughout the 12 hour surveys with no clearly defined peak period, instead turning movements occurred throughout the day. In addition, the survey results did not indicate a high proportion of trucks making the left turn movements.

Although the collected information from the traffic surveys has not indicated a high left turn movement the recommended road safety solution raised in the Road Safety Audit report which was to close the gap in the median and direct vehicles to turn at the nearby roundabouts is still the recommended solution in terms of maximising road safety. Left turning vehicles introduce a potential turning conflict that could be reduced if the turning movement was instead completed at the nearby roundabouts. The retention of the gap is still not recommended, even though a low number of turning movements were observed during the surveys.

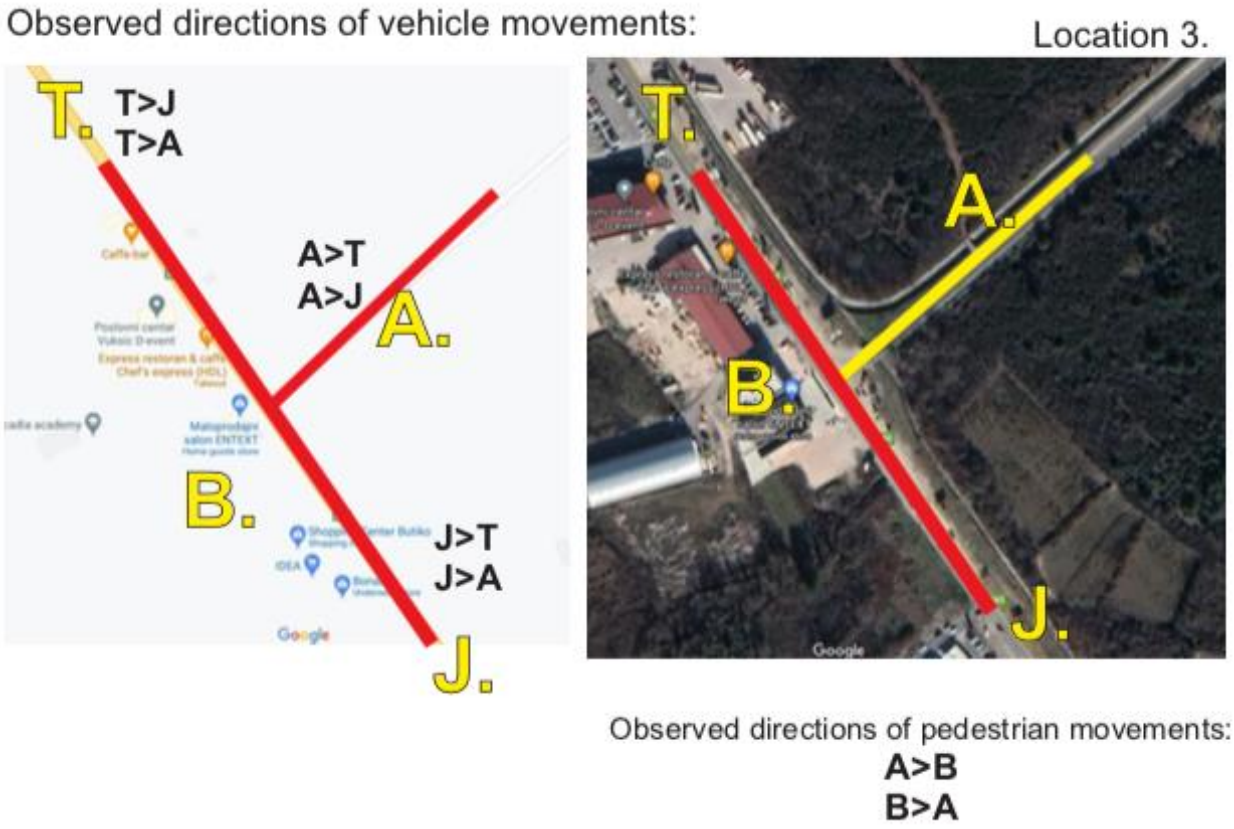
Pedestrian movements along the project road were recorded on three of the four survey days, with only a total of 12 movements recorded altogether. The pedestrian movements were pedestrians walking along the Tivat to Jaz Beach Road. The introduction of the proposed pedestrian crossing over the Minor Road A, will therefore provide a safer environment for pedestrians crossing at this location noting that there is no supporting pedestrian infrastructure along the project road such as footways. To account for the low number of pedestrians a no supporting pedestrian infrastructure, the introduction of a warning sign to advise drivers of pedestrians potentially being present in the road would be an appropriate solution to account for the low numbers of pedestrians.

4 Site 3: 888+755 Pedestrian movements and turning movements into Ljesevici

4.1 Site Description

Site 3 on the Tivat to Jaz Beach Road includes a minor turning to the east to the local road marked as location A in figure 4.1 below. Location B includes vehicles turning into the existing commercial properties along the project road. As part of the proposed works at this location an at-grade uncontrolled pedestrian crossing is proposed. The location will include a central median so left turn vehicle movements will no longer be possible.

Figure 4.1: Observed directions of movement for counts of pedestrians and traffic at Site 3.



4.2 Traffic Survey approach to address Road Safety Audit concerns

The road safety audit report completed for the Tivat to Jaz Beach Road raised concerns about the proposed uncontrolled pedestrian crossing at this location across multiple lanes of traffic as shown in the drawing extract in figure 4.2. The survey has therefore counted pedestrian movements at the location for 4 days from 0600 – 1800hrs on each day to ascertain pedestrian demand and to help determine what sort of crossing is appropriate for pedestrians at this location.

As survey cameras were being installed at this location, turning counts for vehicles have also been completed to determine vehicle movements in each of the different directions outlined in figure 4.1.

Concerns with vehicle turning movements was not raised as a road safety concern in the Road Safety Audit report (see Figure 4.3) as there will be a continuous central median at this location and therefore vehicles wishing to turn left will instead utilise the proposed nearby roundabouts at km 889+500 approximately to the south, or km 888+280 approximately, to the north.

Figure 4.2: Proposed uncontrolled pedestrian crossing over multiple traffic lanes at Site 3.

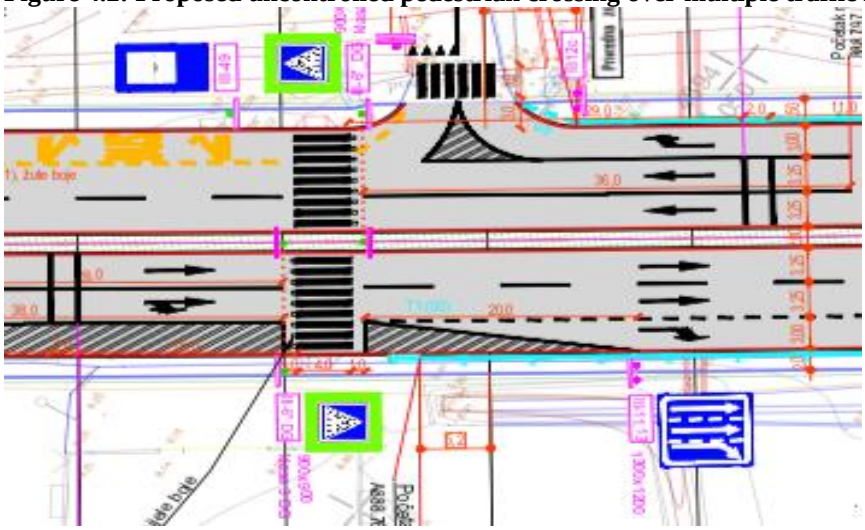
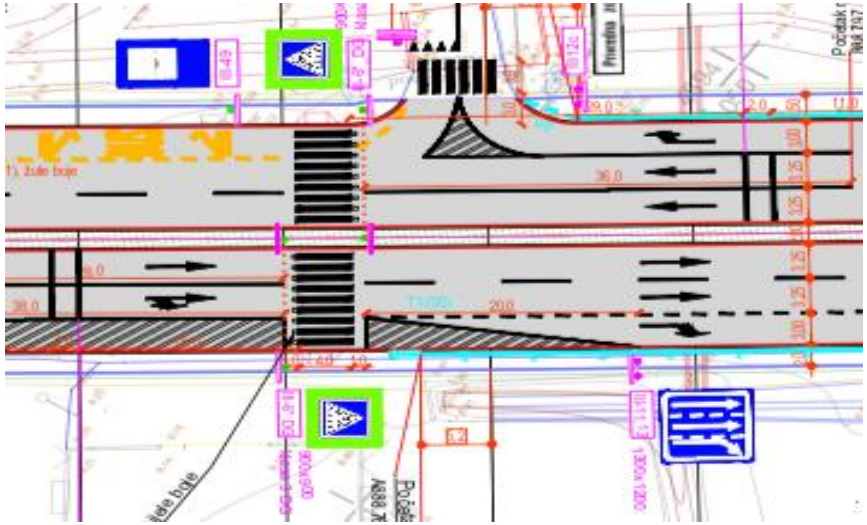


Figure 4.3: Extract from the Road Safety Audit report

10	An uncontrolled pedestrian crossing is proposed at km 888+755. A pedestrian crossing over a multiple lane highway where speeds are likely to be high (although posted as low speed), and where there is an additional danger of a vehicle stopping in one lane, but not the other lane, puts pedestrians at an increased risk of being struck by passing vehicles. It is further noted on the west side of the carriageway that the hatched road markings may provide an unclear message to road users. Pedestrians may stand in the area as they consider it a sheltered area to wait to cross, whilst the area may also be driven over by motorists who drive over the hatched area to make the right turn lane ahead. This ambiguity may lead to positive increased likelihood of conflict between pedestrians and motorists. 	It is recommended that grade separated pedestrian crossings (bridges) are introduced on multiple lane roads where vehicle speeds are expected to be high. Alternatively, a push button signalised pedestrian crossing is introduced. Rumble strips are not likely to obtain the required speed reduction.	HIGH	Bridge EUR 100k. Signalised push button pedestrian crossing EUR 30k.	It is not accepted.	The traffic lights at the intersection, as well as the foot-bridge project, were not the topic of the projected task, therefore, it is not even considered at the level of the design solution. If the Investor deems it necessary to do so, this should be the subject of a separate project.	The road safety concern remains. The higher cost for an appropriate solution may be justified in terms of road safety. The justification for the pedestrian crossing type is usually determined by the number of pedestrian movements and vehicle speeds and volumes. This information is not available to the RSA Team.

4.3 Traffic Survey Results

Observed pedestrians crossing during the survey at the location of the proposed pedestrian crossing were low. A total of 27 pedestrian crossing movements were recorded over the 4 days. The highest number of pedestrian activity on any day was 9 pedestrian movements, and this number was recorded on both the Thursday and Friday. The majority of the pedestrian crossing movements occurred in the direction from the minor road labelled A, towards the commercial buildings labelled as B in Figure 4.1. There were no noticeable peak in pedestrian activity, instead there were low number of movements throughout the day.

In terms of vehicle turning movements at the site location, the vehicle movements which will be affected by the project works due to the introduction of a central median, are the turning movements as follows which will no longer be possible:

i) Jaz Beach to Commercial premises (B)
ii) Location (B) to Tivat
iii) Minor Road (A) to (B)
iv) Commercial Premises (B) to Local Road (A)

The introduction of the median will not permit the above vehicle movements. Instead vehicles wishing to conduct these movements will need to continue to the nearest roundabout and then U turn to complete the required manoeuvre.

Based on the traffic surveys the following traffic count information was collected for each of the site locations:

i) Jaz Beach to Commercial premises (B). Total 205 vehicle movements over 4 days. Highest number of 68 recorded on Friday.
ii) Location (B) to Tivat. Total 206 movements over 4 days. The highest number of 75 vehicles was recorded on both Thursday and Friday.
iii) Minor Road (A) to (B). Total of 75 vehicles over 4 days. On Friday, 49 vehicles completed this manoeuvre.
iv) Commercial Premises (B) to Local Road (A). Total of 41 vehicles over 4 days. On Saturday, 14 vehicles completed this manoeuvre.

4.4 Recommended actions for Survey site 3

Based on the road safety concerns raised within the Road Safety Audit report a traffic signal controlled pedestrian crossing was recommended at this location. The conducted pedestrian count survey has recorded a low number of pedestrian activity at this location. These figures may be lower than usual due to Covid-19 and accounting for the low season, as flows may be higher in the summer.

Although the pedestrian flows recorded are low, the upgraded road still results in the introduction of multiple lanes of traffic. In addition, vehicle flows are relatively high (recorded AADT at this site location was 15,498 on day 3 of the survey) and double during the summer months. This makes it a challenging and dangerous environment for pedestrians to cross. Therefore the introduction of a push button traffic signal operated crossing is still recommended at this location.

Based upon the recorded vehicle turning movements at the site location, the numbers were not considered excessively high, and due to the close proximity of a roundabout in each direction of the site location, it was considered an acceptable length detour for the small number of vehicles recorded, to U turn as necessary.

5. Site 4: 890+618

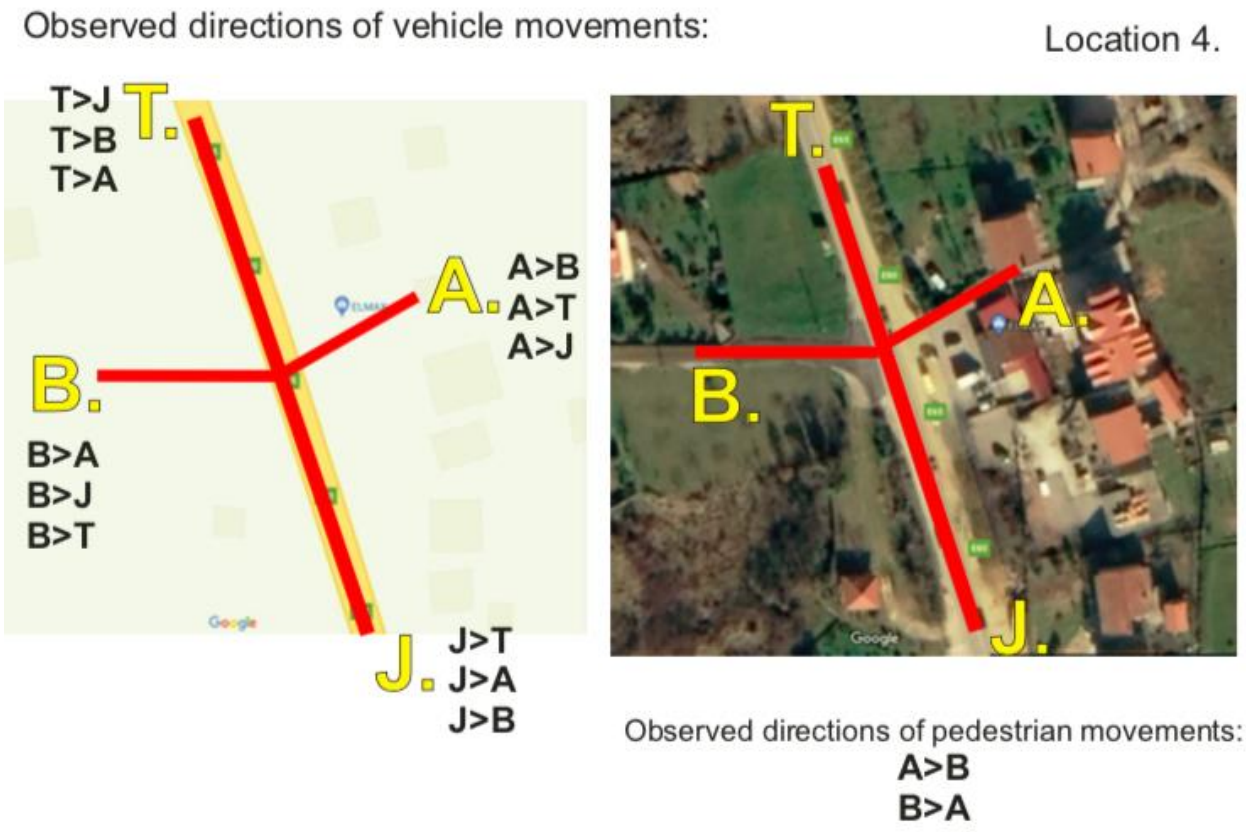
5.1 Site Description

Site 4 on the Tivat to Jaz Beach Road includes a minor turning to the east to the local road marked as location A in figure 5.1 below (next to a Minimart store). Location B represents an additional minor access on the westside of the project road.

At this study site location it is proposed that a central median will be constructed and therefore no turning movements will be permitted at this location. Instead vehicles wishing to turn to access these minor roads from the project road will need to either utilise the roundabout at approximate km 889+500 to the north, or the roundabout at approximate km 891+750 to the south. Note, there is also a gap in the median at km 891+018, this gap was recommended to be closed in the recent Road Safety Audit report. If the gap is closed vehicles will need to proceed to the roundabout location as noted above.

As part of the project works it is proposed to introduce an at-grade pedestrian crossing at this location. There is no pedestrian crossing currently at this location and therefore it is useful to ascertain whether a pedestrian demand is currently present at this location.

Figure 5.1: Observed directions of movement for counts of pedestrians and traffic at Site 4.



5.2 Traffic Survey approach to address Road Safety Audit concerns

The road safety audit report completed for the Tivat to Jaz Beach Road raised concerns about the proposed uncontrolled pedestrian crossing at this site location across multiple lanes of traffic as shown in the drawing extract in figure 5.2. The survey has therefore counted pedestrian movements at the location for 4 days from 0600 – 1800hrs on each day to ascertain pedestrian demand and to help determine what sort of crossing is appropriate for pedestrians at this location.

Note, the pedestrian crossing location surveyed is at km 890 + 618. A similar concern was raised at the pedestrian crossing at km 890+386. As the two crossings were in close proximity to each other it was decided to record activity at the site near the minimart only, as there was more pedestrian activity expected at this location.

As survey cameras were being installed at this location, turning counts for vehicles have also been completed to determine vehicle movements in each of the different directions as outlined in figure 5.1. Concerns with vehicle turning movements was not raised as a road safety concern in the Road Safety Audit report (see Figure 5.3) at this location, as there is no break in the median at this location and therefore vehicles wishing to turn will instead utilise the proposed nearby roundabouts. Nevertheless, it is still useful to understand turning demand to ensure closed turning movement does not displace excessive amounts of traffic.

Figure 5.2: Proposed uncontrolled pedestrian crossing over multiple traffic lanes at Site 4.

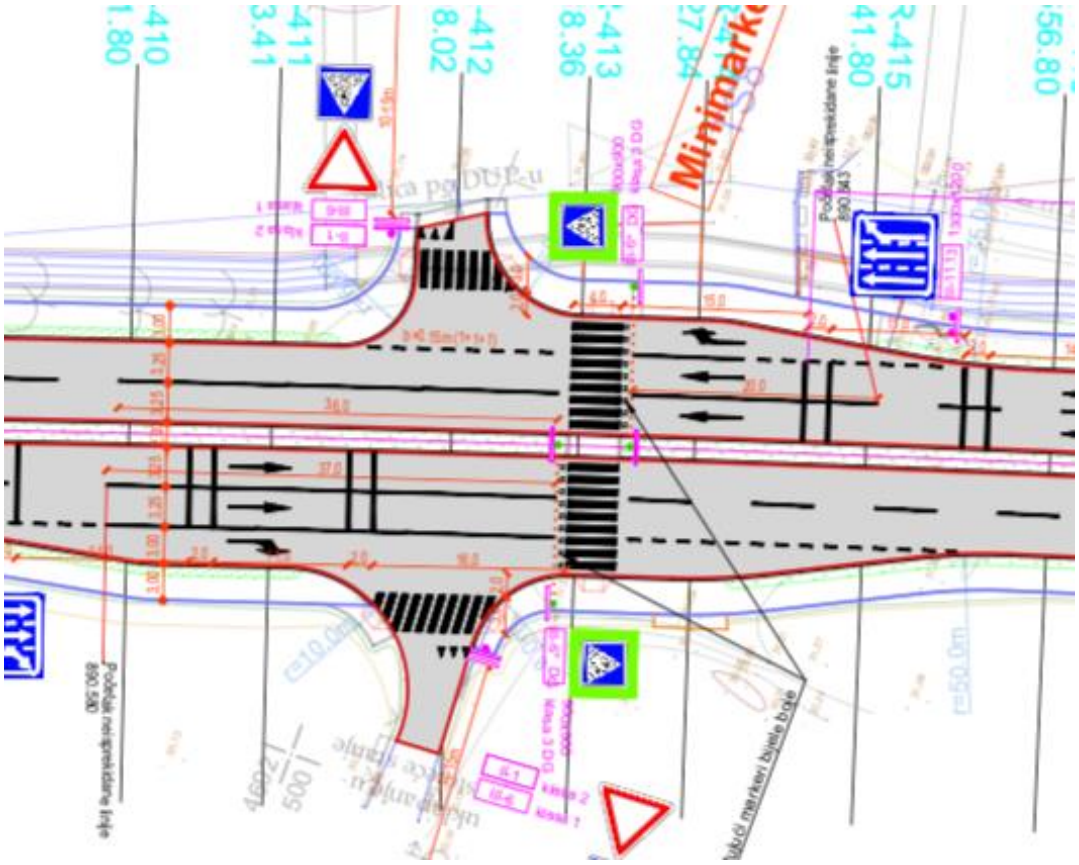
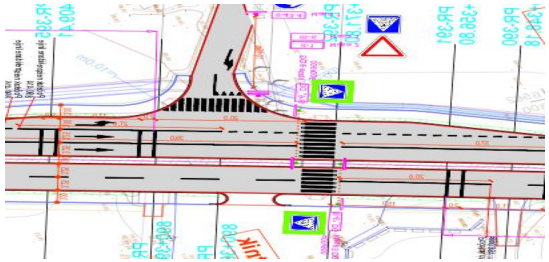


Figure 5.3: Extract from the Road Safety Audit report

13	An uncontrolled pedestrian crossing is proposed at km 890+386. & km 890+618. Pedestrian crossings over a multiple lane highway where speeds are likely to be high (although posted as low speed), and where there is an additional danger of a vehicle stopping in one lane, but not the other lane, put pedestrians at an increased risk of being struck by passing vehicles. 	It is recommended that grade separated pedestrian crossings (bridges) are introduced on multiple lane roads where vehicle speeds are expected to be high and breaks in the traffic are limited, especially during peak summer flows. Alternatively a push button pedestrian crossing is introduced.	HIGH	Bridge EUR 100k. Signalised pedestrian push button crossing EUR 30k.	It is not accepted.	The traffic lights at the intersection, as well as the foot-bridge project, were not the topic of the projected task, therefore, it is not even considered at the level of the design solution. If the Investor deems it necessary to do so, this should be the subject of a separate project.	The road safety concern remains. The higher cost for an appropriate solution may be justified in terms of road safety. The justification for the pedestrian crossing type is usually determined by the number of pedestrian movements and vehicle speeds and volumes. This information is not available.

5.3 Traffic Survey Results

Pedestrian crossing activity at the location of the proposed pedestrian crossing were recorded as 246 pedestrians over the 4 days of surveys. The highest number of pedestrian activity on any day was 81 pedestrian movements recorded on the Saturday. There were 43 pedestrian movements recorded on both the Wednesday and Thursday and 79 pedestrians on the Friday.

Pedestrian activity was mostly crossing between the two minor roads marked A and B in figure 5.1. Some limited pedestrian activity was recorded walking along the main project road. Pedestrian movements between location A and B were equally balanced between the 4 survey days. There was a noticeable peak in pedestrian activity between 1700-1800hrs. In addition, there was some pedestrian activity throughout the day.

In terms of vehicle turning movements at the site location, the vehicle movements which will be affected by the project works through the introduction of a continuous central median are the turning movements as follows:

i) Jaz Beach to Minor Road (B)
ii) Minor Road (B) to Tivat
iii) Minor Road (A) to Minor Road (B)
iv) Minor Road (B) to Minor Road (A)

The introduction of the median will not permit the above vehicle movements. Instead vehicles wishing to conduct these movements will need to continue to the nearest roundabout and then U turn to complete the required manoeuvre. (Or utilise the gap in the median at km 891+018 if this remains open).

Based on the traffic surveys the following traffic count information was collected for each of the site locations:

i) Jaz Beach to Minor Road (B). Total 53 vehicle movements over 4 days. Highest number of 19 recorded on Friday.
ii) Minor Road (B) to Tivat. Total 131 movements over 4 days. The highest number of 37 vehicles was recorded on Friday.
iii) Minor Road (A) to Minor Road (B). Total of 4 vehicles over 4 days. One vehicle each day completed this manoeuvre.
iv) Minor Road (B) to Minor Road (A). No vehicles completed this manoeuvre.

5.4 Recommended actions for Survey site 4

Based on the road safety concerns raised within the Road Safety Audit report a traffic signal controlled pedestrian crossing (or pedestrian bridge) was recommended at this location. The conducted pedestrian count survey has recorded a total of 246 pedestrian crossing movements at this location over the 4 days with 81 pedestrians recorded on the Saturday. These figures may be lower than usual due to Covid-19 and accounting for the low season, as flows may be higher in the summer.

As there appears to be consistent pedestrian demand at this location a facility for safe pedestrian crossing movements should be provided. The proposed works on the project road result in the widening of the road to multiple lanes in each direction with a median. This creates a more challenging crossing environment for pedestrians as well as potentially higher speeds. Therefore the introduction of a push button traffic signal operated crossing is still recommended at this location. A pedestrian bridge is considered inappropriate based upon the recorded pedestrian numbers.

Based upon the recorded vehicle turning movements at the site location, the numbers were not considered excessively high, and due to the relatively close proximity of a roundabout in each direction of the site location, it was considered an acceptable length detour for the small number of vehicles recorded, to U turn as necessary.

6. Site 5: 891+018

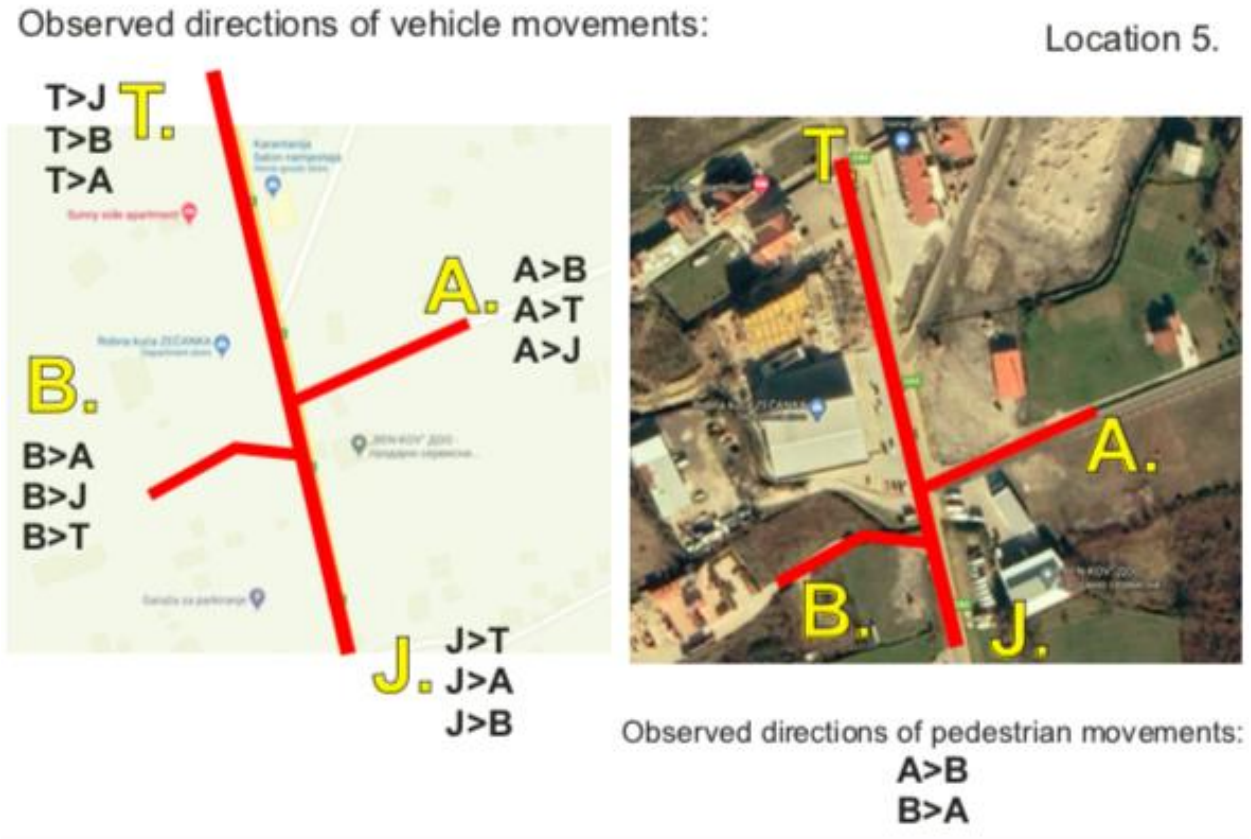
6.1 Site Description

Site 5 on the Tivat to Jaz Beach Road includes a minor turning to the east to the local road marked as location A in figure 6.1 below. Location B represents an additional minor access on the westside of the project road.

At this study site location there is a break in the central median which will permit turning movements across the highway, including potentially U turn movements.

An at-grade pedestrian crossing is also proposed at this location. The traffic surveys conducted at this location have therefore recorded both vehicle turning and pedestrian activity during the 4 days of surveys.

Figure 6.1: Observed directions of movement for counts of pedestrians and traffic at Site 5.



6.2 Traffic Survey approach to address Road Safety Audit concerns

The road safety audit report completed for the Tivat to Jaz Beach Road raised concerns about the proposed crossroad at this location as these types of junctions have a poor crash record. It was therefore recommended that a roundabout or traffic signal junction is introduced in place of the proposed gap in the median. There was also a concern raised regarding the uncontrolled pedestrian crossing across multiple lanes of traffic as shown in the drawing extract in figure 6.2. The survey has therefore counted pedestrian

and traffic movements at the location for 4 days from 0600 – 1800hrs on each day to ascertain pedestrian and vehicle turning demand at this location.

An extract from the Road Safety Audit report for the Tivat to Jaz Beach Road is included in Figure 6.3. This represents the road safety concerns and subsequent dialogue with the Designers which has been made for the proposed junction and pedestrian crossing at this site location.

Figure 6.2: Proposed uncontrolled pedestrian crossing over multiple traffic lanes and crossroad junction at Site 5.

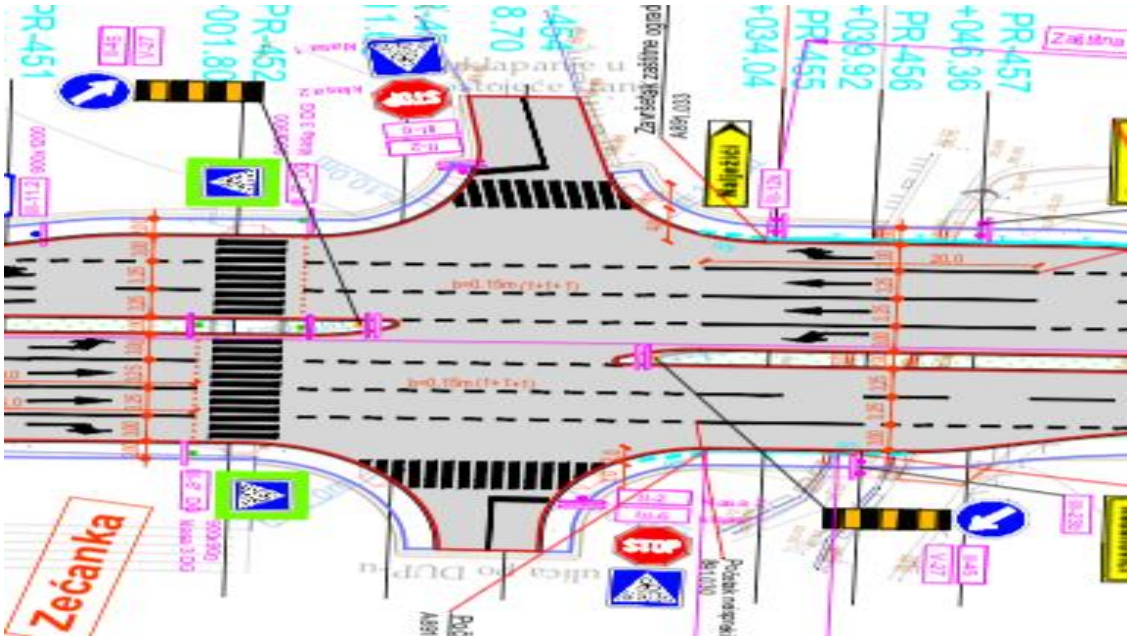
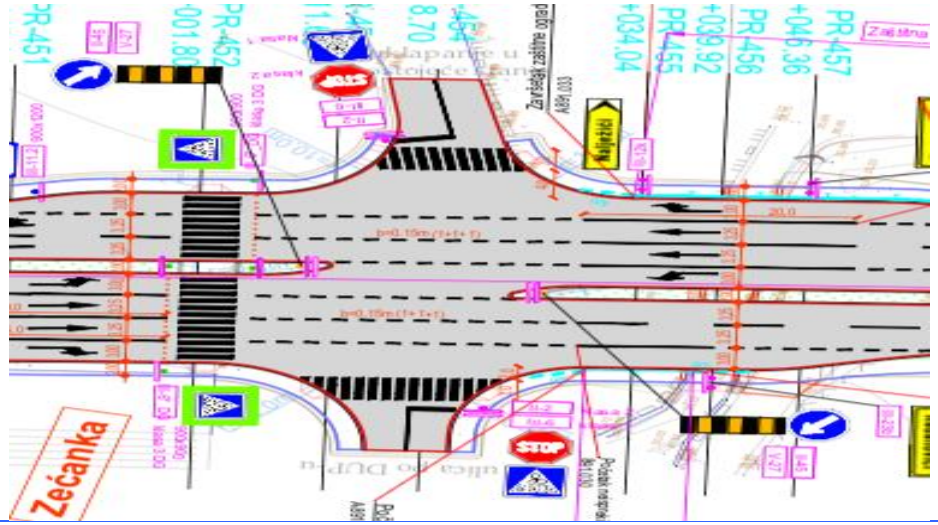


Figure 6.3: Extract from the Road Safety Audit report

15	A crossroad junction with an at-grade uncontrolled pedestrian crossing is proposed at km.891+018. Crossroad junctions have a poor crash history as multiple turning points are present and therefore there are many potential conflict locations. For pedestrians at this location their safety is compromised as there are potentially 7 lanes of traffic to cross therefore exposing pedestrians at a high risk of being struck by a passing vehicle. 	It is recommended that the crossroad junction is replaced with a roundabout. This will also provide a safer environment for crossing pedestrians.	HIGH	Roundabout estimated at EUR 50k>.		Designing a roundabout at this intersection would lead to the demolition of existing commercial buildings on both the left and right sides of the boulevard.	In the absence of a roundabout an alternative solution should be sought, i.e traffic signals. This is a potentially high risk location for pedestrians and turning vehicles if it remains as a multi-lane, uncontrolled junction.

6.3 Traffic Survey Results

Pedestrian activity at the location of the proposed pedestrian crossing were recorded as 201 pedestrians over the 4 days of surveys. The highest number of pedestrian activity on any day was 57 pedestrian movements recorded on the Friday. There were 49 pedestrian movements recorded on the Saturday, 45 on Wednesday and 50 on Thursday. Therefore pedestrian activity remained fairly consistent each day of the surveys.

Pedestrian activity was slightly higher crossing between the two minor roads marked A and B in figure 6.1. There was however, pedestrian activity recorded walking along the main project road. Pedestrian movements between location A and B were fairly equally balanced between the 4 survey days as were the pedestrian flows in both directions along the project road. There was a noticeable peak in pedestrian activity in the am period around 0800hrs and in the evening around 1600 to 1615hrs. During the 3 week days surveyed, 29 pedestrian movements were recorded between 1600-1615hrs, more than 10% of the total pedestrian activity at this location.

In terms of vehicle turning movements at the site location, the proposed junction at the survey location as part of the project works will be a crossroad junction as there will be a gap in the median as indicated in Figure 6.2. All direction turning movements will therefore be possible at this location.

During the traffic surveys over the four days the movements indicated in Table 6.1 below were recorded at the site location.

	T>J	T>B	T>A	B>A	B>J	B>T	A>B	A>T	A>J	J>T	J>A	J>B
Day 1	3365	49	273	3	18	80	3	287	94	4182	93	24
Day 2	3666	43	242	7	21	41	10	269	108	4520	121	25
Day 3	3723	51	262	1	21	83	2	318	102	4479	127	25
Day 4	1329	36	243	4	10	57	2	266	70	1876	74	23
TOTAL	**12083**	**179**	**1020**	**15**	**70**	**261**	**17**	**1140**	**374**	**15057**	**415**	**97**

Table 6.1: traffic movements at the survey location

Apart from the traffic on the main Tivat to Jaz Beach Road the highest turning movement at the site location was from local road A turning right towards Tivat. The next highest movement was the left turn movement for vehicles coming from Tivat and turning left into local road A. There were 1,020 vehicles making this turning, fairly evenly distributed throughout the 4 days as illustrated in Table 6.1. Other left turn movements (or conflicting straight ahead movements) at this site location include the following:

- Local Road B to Tivat, 261 vehicles over 4 days
- Local Road B to Local Road A, 15 vehicles over 4 days
- Jaz Beach to Local Road B, 97 vehicles over 4 days
- Local Road A to Local Road B, 17 vehicles over 4 days
- Local Road A to Jaz Beach, 374 vehicles over 4 days

There are therefore 6 potential areas of turning conflicts at this location, not including any potential displaced vehicles from nearby areas which may attempt to U turn at this location due to the introduction of the central median preventing left turns at other locations.

In terms of peak periods of turning traffic, there was an increased demand for turning left from location B towards Tivat at 1500-1515hrs over the survey period. Throughout the rest of the day, traffic flows remained fairly balanced.

Vehicle movements between location A and B were low in both directions and there was no peak period of activity identified. There was also no peak period of activity noted between left turn movements to location B from vehicles approaching from the Jaz Beach direction.

There were 374 vehicles recorded over the four days turning from local road A towards Jaz Beach. The turning flows were fairly balanced throughout the survey period it was noted however, that HGVs make this turning movement with 20 HGVs turning on Wednesday, 21 Thursday, 26 Friday and 19 on Saturday. These larger turning vehicles have a potential impact on the junction capacity and safety.

As previously noted, the highest turning left movement was from Tivat into local road A with 1,020 movements. These turning movements were recorded throughout the day with no noticeable peak period. There were however, also HGVs recorded on each day, Wednesday 37, Thursday 27, Friday 48, Saturday 25. These larger vehicles have a potential impact on capacity.

6.4 Recommended actions for Survey site 5

There are multiple turning movements present at this location, including straight ahead, and left turn vehicle movements which have the potential conflicts. There may also be U turn movements completed at this location once a central median prohibits left turn movements at other locations nearby. Turning movements at this location include HGV trucks which increase the road safety concern due to their size and slow speed to accelerate and turn safely.

The previously completed Road Safety Audit report recommended that the proposed gap in the median was replaced with a roundabout. Based on the results from the survey this remains the recommended solution. However, as the design team has stated this would not be possible due to land appropriation, the introduction of a traffic signalised junction could be considered as an alternative arrangement together with facilities to provide a pedestrian phase to enable safe pedestrian crossing.

In the absence of a roundabout or a signalised crossing, the next alternative would be to close the gap in the median and to expect vehicles to U turn at the nearby roundabouts at km 889+500 approximately to the north, or km 891+950 to the south. As turning movements are relatively high at survey site 5, it is recommended that additional turning movements which will be displaced to the neighbouring roundabouts should be modelled to ensure that the displaced movements do not exceed the operational capacity of the roundabouts at these nearby locations. If the gap in the median is closed at Site 5, it is still recommended that a pedestrian crossing facility is provided at this location. A signalised pedestrian crossing activated by a push button would be appropriate.

7. Site 6: 893+231

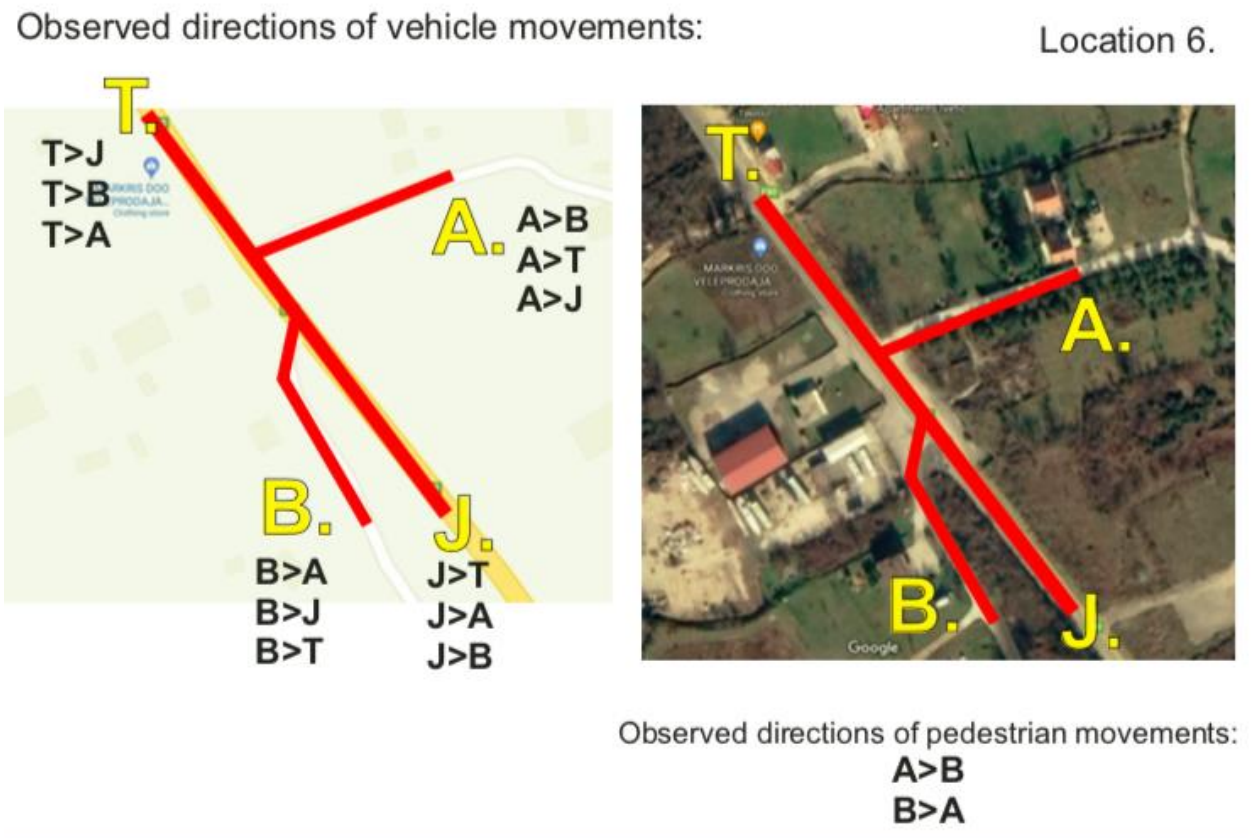
7.1 Site Description

Site 6 on the Tivat to Jaz Beach Road includes a minor turning to the east to the local road marked as location A in figure 7.1 below. Location B represents an additional minor access on the westside of the project road.

At this study site location there is a continuous central median proposed which will prohibit turning movements across the highway. Instead vehicles wishing to turn to access these minor roads from the project road will need to either utilise the roundabout at approximate km 892+700 to the north, or the roundabout at approximate km 894+900 to the south.

An at-grade pedestrian crossing is also proposed at this location. The traffic surveys conducted at this location have therefore recorded both vehicle turning and pedestrian activity during the 4 days of surveys.

Figure 7.1: Observed directions of movement for counts of pedestrians and traffic at Site 6.



7.2 Traffic Survey approach to address Road Safety Audit concerns

The road safety audit report completed for the Tivat to Jaz Beach Road raised concerns about the proposed uncontrolled pedestrian crossing at this site location across multiple lanes of traffic as shown in the drawing extract in figure 7.2. The survey has therefore counted pedestrian movements at the location

for 4 days from 0600 – 1800hrs on each day to ascertain pedestrian demand and to help determine what sort of crossing is appropriate for pedestrians at this location.

As survey cameras were being installed at this location, turning counts for vehicles have also been completed to determine vehicle movements in each of the different directions as outlined in figure 7.1. Concerns with vehicle turning movements was not raised as a road safety concern in the Road Safety Audit report (see Figure 7.3) at this location, as there is no break in the median at this location and therefore vehicles wishing to turn will instead utilise the proposed nearby roundabouts. Nevertheless, it is still useful to understand turning demand to ensure closed turning movement does not displace excessive amounts of traffic.

Figure 7.2: Proposed uncontrolled pedestrian crossing over multiple traffic lanes

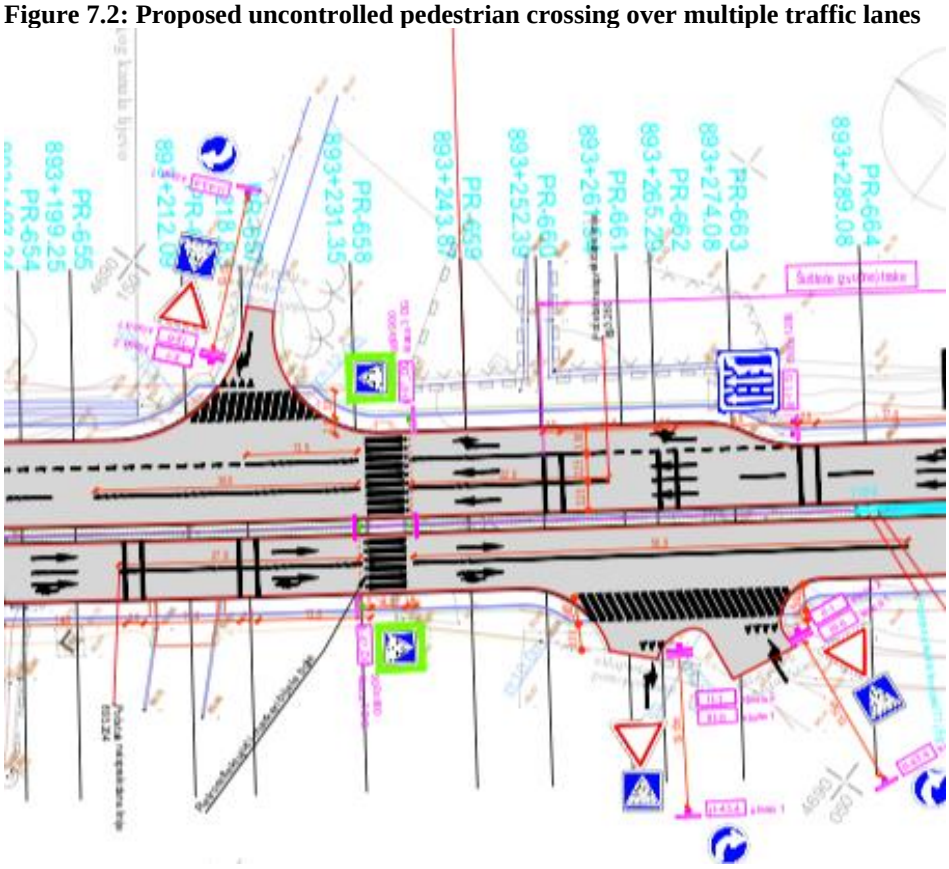


Figure 7.3: Extract from the Road Safety Audit report

22	At km 893+231 an at-grade pedestrian crossing is proposed. An at-grade uncontrolled pedestrian crossing across five lanes of traffic of traffic places pedestrians at risk. There is the potential danger that a vehicle in one lane may stop to allow a pedestrian to cross, and then another vehicle travelling in another lane may fail to stop thereby potentially striking the crossing pedestrian.	It is recommended that a pedestrian bridge is introduced. Alternatively a traffic signalised, push-button pedestrian crossing is introduced.	HIGH	Pedestrian bridge estimated at EUR 100k. Signalised pedestrian crossing EUR30k.	It is not accepted.	The traffic lights at the intersection, as well as the foot-bridge project, were not the topic of the projected task, therefore, it is not even considered at the level of the design solution. If the Investor deems it necessary to do so, this should be the subject of a separate project.	The road safety concern remains. The higher cost for an appropriate solution may be justified in terms of road safety. The justification for the pedestrian crossing type is usually determined by the number of pedestrian movements and vehicle speeds and volumes. This information is not available.

7.3 Traffic Survey Results

Pedestrian activity at the location of the proposed pedestrian crossing were recorded as 11 pedestrians over the 4 days of surveys. The highest number of pedestrian activity on any day was 5 pedestrian movements recorded on the Friday. Three of the pedestrian movements out of a total of 11 did not cross the road, instead the pedestrians were recorded walking along the Jaz Beach to Tivat road. With low pedestrian flows observed, there is no defined peak of activity.

In terms of vehicle turning movements at the site location, the vehicle movements which will be affected by the project works through the introduction of a continuous central median are the turning movements as follows:

i) Jaz Beach to Minor Road (B)
ii) Minor Road (B) to Tivat
iii) Minor Road (A) to Minor Road (B)
iv) Minor Road (B) to Minor Road (A)

The introduction of the median will not permit the above vehicle movements. Instead vehicles wishing to conduct these movements will need to continue to the nearest roundabout and then U turn to complete the required manoeuvre.

Based on the traffic surveys the following traffic count information was collected for each of the site locations:

i) Jaz Beach to Minor Road (B). Total 17 vehicle movements over 4 days. Highest number of 10 recorded on Saturday.
ii) Minor Road (B) to Tivat. Total 41 movements over 4 days. The highest number of 27 vehicles was recorded on Saturday.
iii) Minor Road (A) to Minor Road (B). Total of 3 vehicles over 4 days.
iv) Minor Road (B) to Minor Road (A). Total of 4 vehicles over 4 days

7.4 Recommended actions for Survey site 4

Based on the road safety concerns raised within the Road Safety Audit report a traffic signal controlled pedestrian crossing (or pedestrian bridge) was recommended at this location. The conducted pedestrian count survey has recorded a total of 11 pedestrian crossing movements at this location over the 4 days with 5 pedestrians recorded on the Friday. These figures may be lower than usual due to Covid-19 and accounting for the low season, as flows may be higher in the summer.

As there appears to be a low pedestrian demand at this location a pedestrian bridge is not justified. However, it is still recommended that a facility for safe pedestrian crossing movements should be provided. The proposed works on the project road result in the widening of the road to multiple lanes in each direction with a median. This creates a more challenging crossing environment for pedestrians as well as potentially higher speeds. Therefore the introduction of a push button traffic signal operated crossing is still recommended at this location. If funds are low to provide such a facility and only limited numbers of signalised crossing could be provided, this would be considered a lower priority site.

Based upon the recorded vehicle turning movements at the site location, the numbers were not considered excessively high, and due to the relatively close proximity of a roundabout in each direction of the site location, it was considered an acceptable length detour for the small number of vehicles recorded, to U turn as necessary.

8. Site 7: 898+231

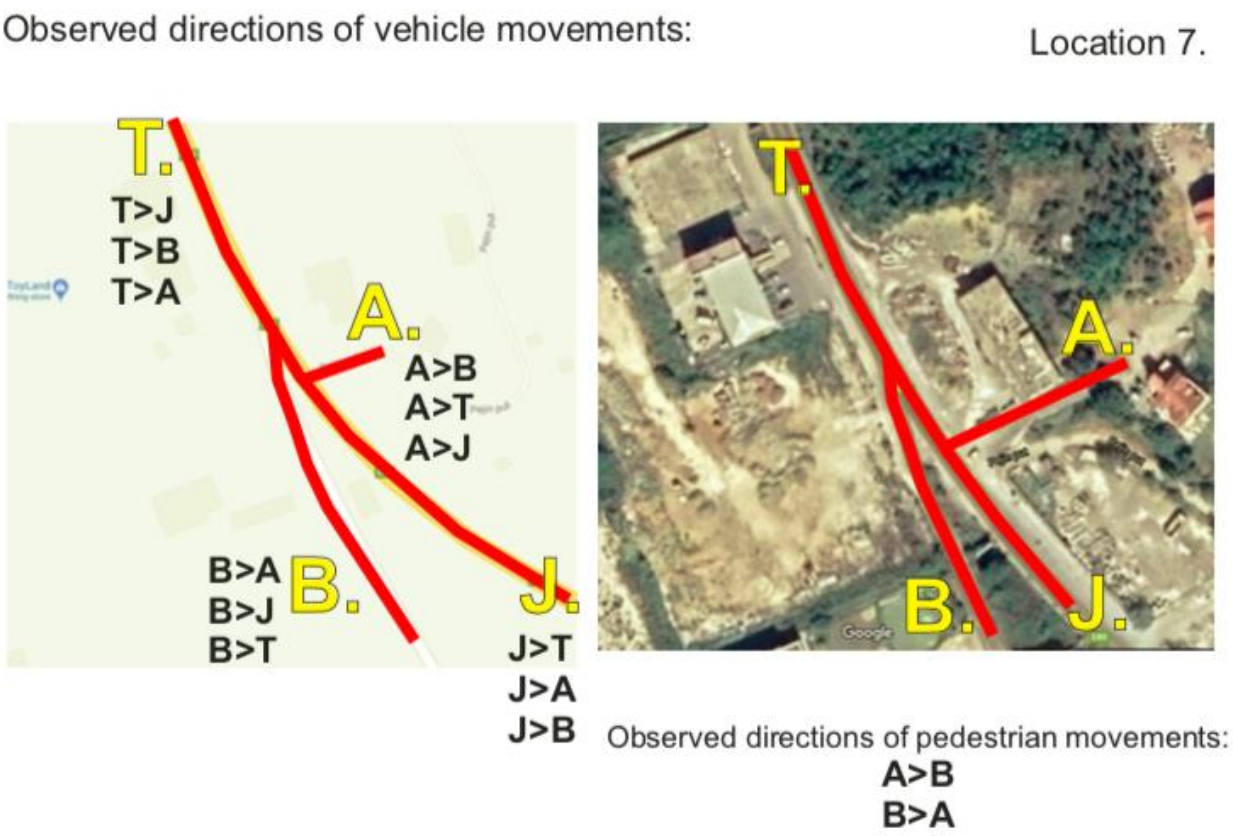
8.1 Site Description

Site 7 on the Tivat to Jaz Beach Road includes a minor turning to the east to the local road marked as location A in figure 8.1 below. Location B represents an additional minor access on the westside of the project road.

At this study site location there is a break in the central median which will permit turning movements across the highway, including potentially U turn movements.

An at-grade pedestrian crossing is also proposed at this location. The traffic surveys conducted at this location have therefore recorded both vehicle turning and pedestrian activity during the 4 days of surveys.

Figure 8.1: Observed directions of movement for counts of pedestrians and traffic at Site 7.



8.2 Traffic Survey approach to address Road Safety Audit concerns

The road safety audit report completed for the Tivat to Jaz Beach Road raised concerns about the gap in the median which will permit left turn movements across the project road. In addition, a proposed uncontrolled pedestrian crossing at this site location across multiple lanes of traffic as shown in the drawing extract in figure 8.2 provides a challenging and unsafe environment for pedestrians to cross. The survey has therefore counted pedestrian movements at the location for 4 days from 0600 – 1800hrs on

each day to ascertain pedestrian demand and to help determine what sort of crossing is appropriate for pedestrians at this location.

Vehicle turning counts have also been completed to determine vehicle movements in each of the different directions as outlined in figure 8.1 to understand turning demand at this location and to ensure that if the gap is closed, the displaced traffic does not create excessive turning movements on the nearest roundabouts..

Figure 8.2: Proposed uncontrolled pedestrian crossing over multiple traffic lanes

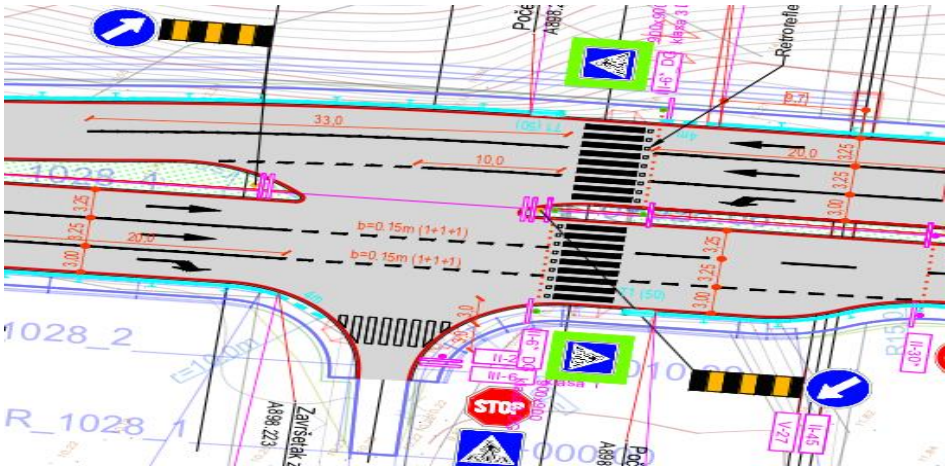
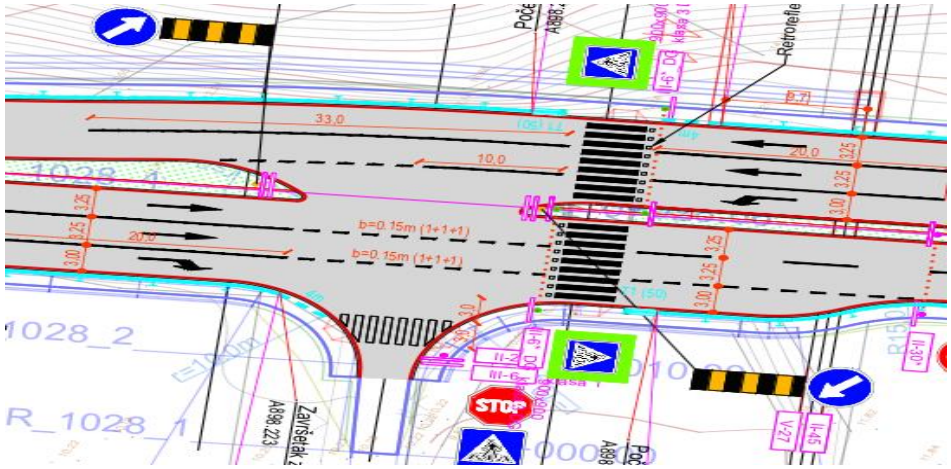


Figure 8.3: Extract from the Road Safety Audit report

30	At km 898+231 there is a proposed break in the median to permit left turn movements, in addition there is a proposed at grade uncontrolled pedestrian crossing over 6 lanes of traffic. At grade crossings for traffic and pedestrians on multiple lane roads increase the risk of conflicts as generally through traffic is travelling at higher speeds due to the design nature of the road and the likelihood of turning vehicles and crossing pedestrians is less likely to be expected.  	It is recommended that the junction design is replaced with a roundabout, this also provides a slower speed for crossing pedestrians. Alternatively the median gap is closed and signalised pedestrian crossing or pedestrian bridge is introduced.	HIGH	Roundabout estimated at EUR 50k >. Pedestrian bridge EUR 100k and signalised pedestrian crossing EUR 30k.	It is not accepted.	The traffic lights at the intersection, as well as the foot-bridge project, were not the topic of the projected task, therefore, it is not even considered at the level of the design solution. If the Investor deems it necessary to do so, this should be the subject of a separate project. At this location, the planned documentation does not provide a roundabout, and at a distance of 400 m there is a projected roundabout.

8.3 Traffic Survey Results

Pedestrian activity at the location of the proposed pedestrian crossing were recorded as 19 pedestrians over the 4 days of surveys. The highest number of pedestrian activity on any day was 6 pedestrians which occurred on both the Thursday and the Friday. As the pedestrian flows were low there were no noticeable peaks identified.

In terms of vehicle turning movements at the site location, the proposed junction at the survey location as part of the project works will be a three arm junction as there will be a gap in the median as indicated in Figure 8.2. There is also an additional minor junction, local road A, which has been recorded as part of the survey as this is an additional traffic movement which is affected by the project works.

During the traffic surveys over the four days the movements indicated in Table 8.1 below were recorded at the site location.

	T>J	T>B	T>A	B>A	B>J	B>T	A>B	A>T	A>J	J>T	J>A	J>B
Day 1	3547	43	1	0	26	59	0	2	5	3501	12	34
Day 2	4215	82	5	1	41	61	0	3	11	4049	12	37
Day 3	4664	65	1	1	34	60	0	4	6	4253	123	25
Day 4	596	23	1	1	4	19	1	1	2	485	4	7
TOTAL	**13022**	**213**	**8**	**3**	**105**	**199**	**1**	**10**	**24**	**12288**	**151**	**103**

Table 8.1: traffic movements at the survey location

Apart from the traffic on the main Tivat to Jaz Beach Road the highest turning movement at the site location was from Tivat to the local road B. The next highest movement was the left turn movement from local road B to Tivat. There were 199 vehicles making this turning over the 4 days as illustrated in Table 8.1. Other left turn movements (or conflicting straight ahead movements) at this site location include the following:

- Local Road B to Local Road A, 3 vehicles over 4 days
- Jaz Beach to Local Road B, 103 vehicles over 4 days
- Local Road A to Local Road B, 1 vehicle over 4 days
- Local Road A to Jaz Beach, 24 vehicles over 4 days
- Tivat to Local Road A, 8 vehicles over 4 days.

There are therefore 6 potential areas of turning conflicts at this location, although it should be noted that the proposed design for the project road will create a three arm junction and therefore the straight ahead potential conflicts between road A and B will be removed.

There is no high turning demand on any of the potential turning options. The highest demand for a left turn movement which is the turning movement across the potential gap in the median, is the movement from the local road B in the direction to Tivat. The next busiest left turn movement is the turning into road B from Jaz Beach Road.

For the turning from the local road B to Tivat, the highest turning movement number was on the Thursday with 61 vehicles, the lowest on Saturday with 19 vehicles. In terms of peak periods of turning traffic, there was clearly identifiable peak movement for the local road B to Tivat turning.

For Jaz Road left into local road B, the highest movement occurred on a Thursday with 37 recorded turning movements. The lowest number was on a Saturday with 7 vehicles. Again, there was no identifiable peak time where traffic movements were higher.

The movements at the other turning locations are not considered high enough to warrant further analysis.

8.4 Recommended actions for Survey site 7

The previously completed Road Safety Audit report recommended that the proposed gap in the median was replaced with a roundabout. Based on the results from the survey the addition of a roundabout at this location does not seem justified. There is not a high turning demand at this location. It is therefore recommended that the gap in the median is closed and instead vehicles at the nearby proposed roundabouts which include the roundabout to the south at km 898,625 and the roundabout to the north at km 896,650.

If the gap in the median is closed at Site 7, it is still recommended that a pedestrian crossing facility is provided at this location. Pedestrian movements are low at this location, but the dualling of the road is likely to result in higher speeds and therefore presents a more challenging crossing environment for pedestrians. A signalised pedestrian crossing activated by a push button would be appropriate.

9 Site 8: 900+296

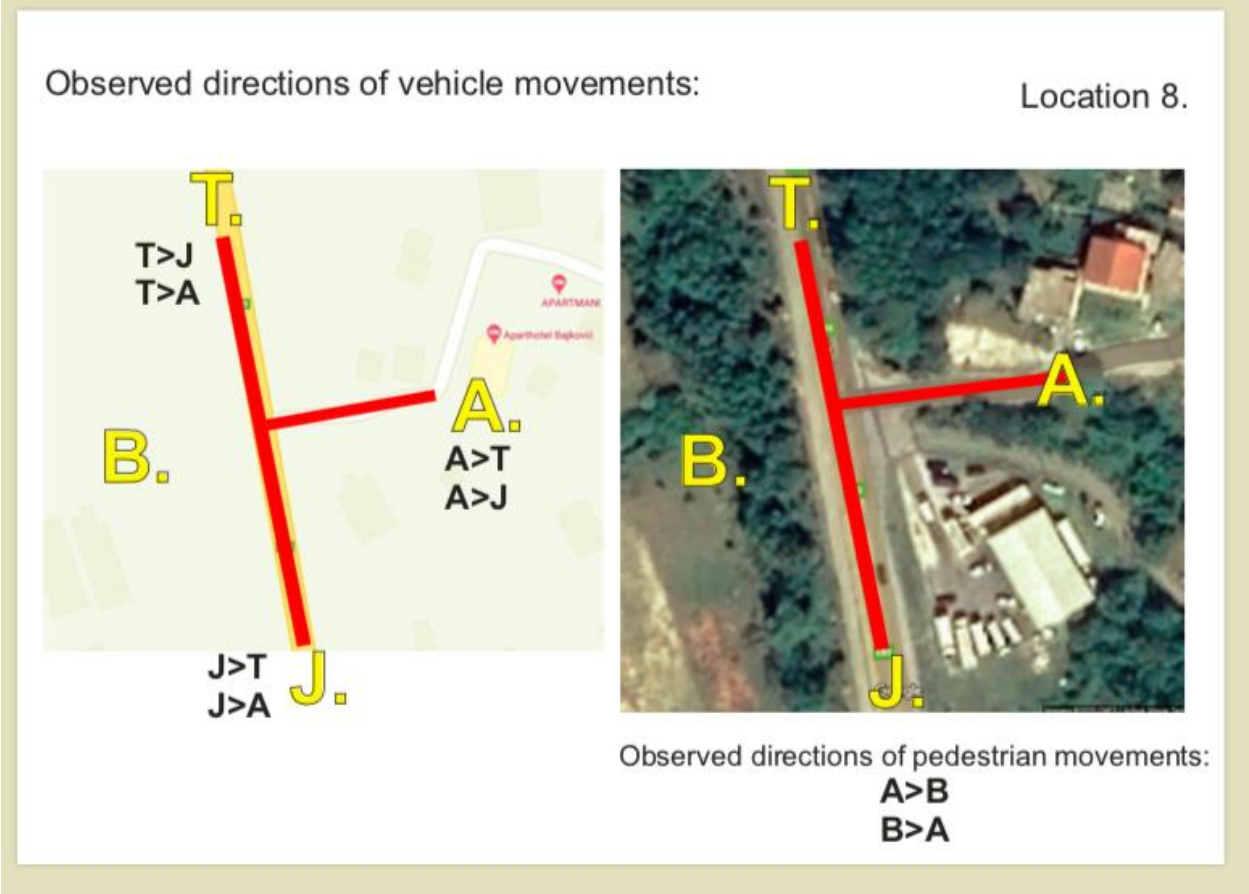
9.1 Site Description

Site 8 on the Tivat to Jaz Beach Road includes a minor turning to the east to the local road marked as location A in figure 8.1 below. There is no Location B on the westside of the project road.

At this study site location there is a break in the central median which will permit turning movements across the highway, including potentially U turn movements.

An at-grade pedestrian crossing is also proposed at this location. The traffic surveys conducted at this location have therefore recorded both vehicle turning and pedestrian activity during the 4 days of surveys.

Figure 9.1: Observed directions of movement for counts of pedestrians and traffic at Site 8.



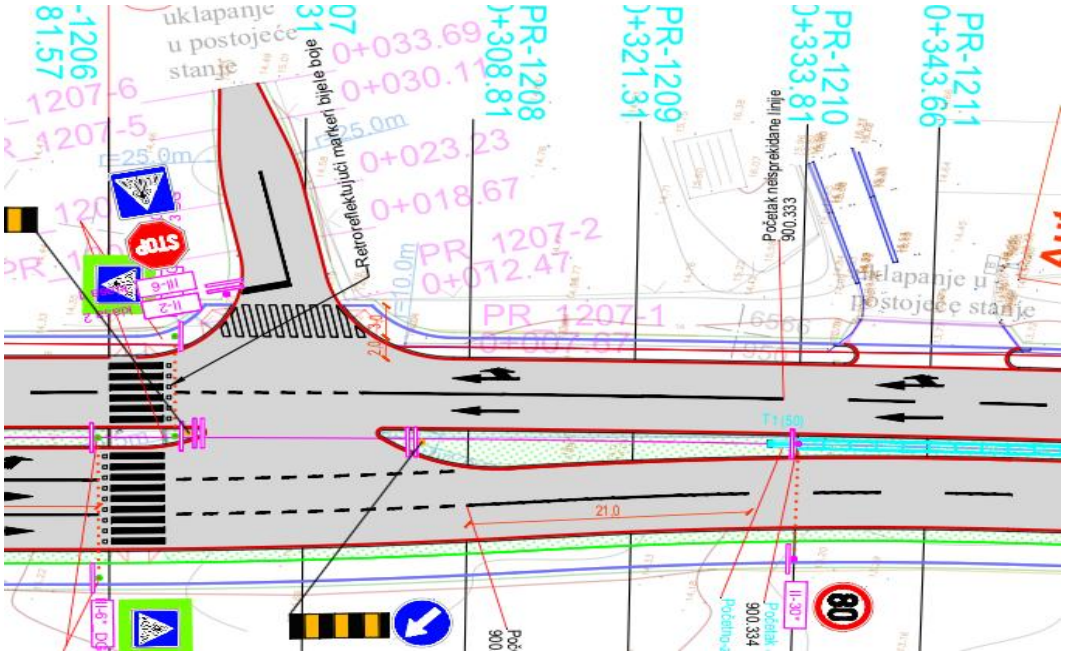
9.2 Traffic Survey approach to address Road Safety Audit concerns

The road safety audit report completed for the Tivat to Jaz Beach Road raised concerns about the gap in the median which will permit left turn movements across the project road. In addition, a proposed uncontrolled pedestrian crossing at this site location across multiple lanes of traffic as shown in the drawing extract in figure 9.2 provides a challenging and unsafe environment for pedestrians to cross. The survey has therefore counted pedestrian movements at the location for 4 days from 0600 – 1800hrs on

each day to ascertain pedestrian demand and to help determine what sort of crossing is appropriate for pedestrians at this location.

Vehicle turning counts have also been completed to determine vehicle movements in each of the different directions as outlined in figure 9.1 to understand turning demand at this location and to ensure that if the gap is closed, the displaced traffic does not create excessive turning movements on the nearest roundabouts..

Figure 9.2: Proposed uncontrolled pedestrian crossing over multiple traffic lanes



35	At km. 900+296 a minor junction is proposed. Also at this location there is a break in the median to enable left in and left out movements. The presence of an at-grade junction on a multi-lane road has the risk of an increased likelihood of high speed turning conflicts as multi lane roads tend to encourage higher vehicle speeds and the presence of at-grade turns is not usually expected. There are also other road safety concerns at this location as follows: i) There is a proposed at-grade uncontrolled pedestrian crossing. The crossing is over 5 lanes of traffic and there is a risk of high speeds. Both of these factors increase the risk to crossing pedestrians. ii) 40m south of the proposed minor junction there is an access to a commercial premises, 'Auto Perionica'. There is a danger that vehicles which exit this commercial premises and then wish to proceed southbound may attempt to turn left at the nearby break in the median. This will necessitate vehicles moving across to the left side of the road over a short time at low speed therefore resulting with possible conflicts with traffic on the main road. It is further noted that the proposed access from the commercial premises provides a challenging radius which will result in slow entry and exit speeds to the project road to the detriment of road safety.	It is recommended that the gap in the median is closed, and instead vehicles use the nearby roundabouts for turning movements. It is further recommended that at-grade pedestrian crossing is replaced with a pedestrian bridge or a push button signalised pedestrian crossing. This may be upgraded to a signalised junction if turning movements justify the cost. The minor junction serving Auto Perionica should be closed and instead access made through the minor at km.900+296.	HIGH	Costs vary on options taken forward. Signalised junction estimated at EUR 80k. Closure of median, combination of access roads and acceleration and deceleration lanes estimated at EUR 10k. Pedestrian bridge EUR 100k. Signalised pedestrian crossing EUR 30k.	It is not accepted.	The traffic lights at the intersection, as well as the foot-bridge project, were not the topic of the projected task, therefore, it is not even considered at the level of the design solution. If the Investor deems it necessary to do so, this should be the subject of a separate project. The traffic solution will be supplemented by prohibiting left turns from the approach road.	The road safety concern remains. The higher cost for an appropriate solution may be justified in terms of road safety. The justification for the pedestrian crossing type is usually determined by the number of pedestrian movements and vehicle speeds and volumes. This information is not available.

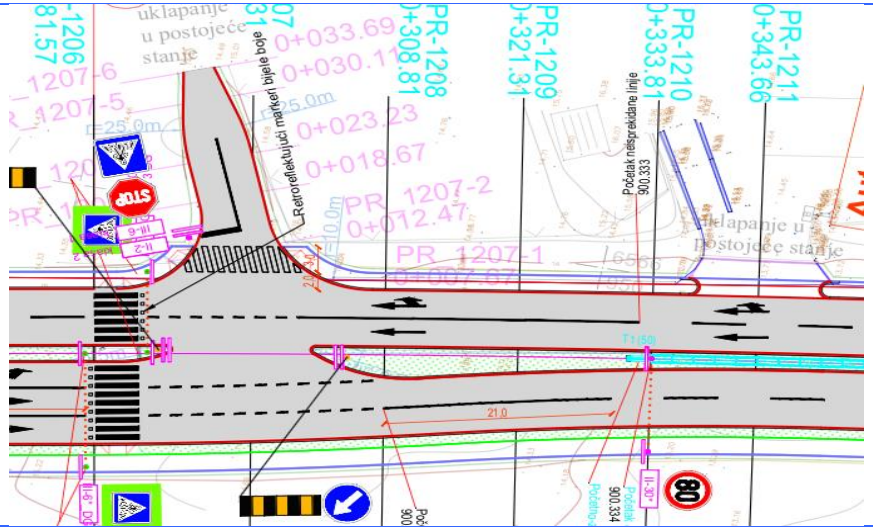
		The minor junction at km. 900+296 should be upgraded to include acceleration and deceleration lanes unless it is ungraded to signalised operation.					

Figure 9.3: Extract from the Road Safety Audit report

9.3 Traffic Survey Results

Pedestrian activity at the location of the proposed pedestrian crossing were recorded as 626 pedestrians over the 4 days of surveys. The highest number of pedestrian activity on any day was 223 pedestrians which occurred on the Wednesday. On Thursday there were 162 pedestrian movements, 148 on Friday and 93 on the Saturday. All recorded pedestrian activity has been identified as either from Jaz Beach Road to Tivat or Tivat to Jaz Beach Road, i.e either north or southbound. No actual crossing movements over the project road have been identified at this location.

In terms of vehicle turning movements at the site location, the proposed junction at the survey location as part of the project works will be a three arm junction as there will be a gap in the median as indicated in Figure 9.2. There one minor junction, local road A, which has been recorded as part of the survey.

The proposed gap in the median will permit left turn movements into and out of local road A, there is also the potential for vehicles to attempt to U turn if a gap in the median is retained. Left turn movements over a multi lane road where speeds are expected to be higher have the potential for increased likelihood of turning conflicts. Therefore the left turning movements are studied below in further detail to determine whether there is a high demand for them at this location.

Two left turn movements are possible at the junction location. Local road A to Jaz Beach Road recorded 240 movements over the 4 days. The highest number of turning movements occurred on the Saturday with 82 movements, the lowest on the Thursday for 43 movements. There was no obvious peak turning movement time, instead turning movements were distributed throughout the day.

The other left turning movement occurred from Tivat to local road A. At total of 244 were recorded making this movement over the 4 days. The highest number occurred on the Thursday with 76 turning movements, the lowest was Wednesday with 45 movements. There was no identifiable peak turning movement time during the surveys.

9.4 Recommended actions for Survey site 7

The previously completed Road Safety Audit report recommended that the proposed gap in the median was closed and instead traffic turned at the nearby roundabouts. Based on the results from the survey there is not a high turning demand at this location. It is therefore recommended that the gap in the median is closed and instead vehicles use the nearby proposed roundabouts which include the roundabout to the south at km 901,350 and the roundabout to the north at km 899,650.

There was no pedestrian activity recorded crossing the road at this location therefore it is recommended that the proposed pedestrian crossing is closed.

Report End.