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DOI: 10.35117/A_ENG_22_04-05_02

Development of rail connections in the Three Seas region

Abstract: The key condition for the implementation of the Three Seas Initiative is the creation of a modern transport network which integrates the economies of the countries included in this area and creates favorable conditions for the development of economic cooperation. This applies especially to railway networks, where it is necessary to eliminate the communication barrier of the Carpathians - to delineate new routes connecting the railway networks of the countries of the Three Seas Initiative. The subject of this paper is a proposal for the implementation of an investment that allows to create a route with the working name Rail Adriatica, which is an alternative variant (moved to the east) of the first TEN-T (Baltic-Adriatic) corridor; the variant including the so far omitted Hungary, Slovenia and Croatia. The aim of the investment is to create a new railway line with high operational parameters (construction of new sections along with the modernization and revitalization of the existing sections) which connects the Polish and Slovak railway networks in the Podhale and Orawa area - from the Polish Rabka to the Slovak Kralovan. It would be a natural extension of the already constructed "Podłęże-Piekiełko" line towards the south-west, giving the opportunity to delineate a new railway corridor with high operational parameters.

Keywords: Railway connections; Three Seas; Transport network

Introduction

The key condition for the implementation of the Three Seas Initiative project is the creation of a modern transport network integrating the economies of the countries included in this area, creating favorable conditions for cooperation. Meanwhile, the existing architecture of transport networks in these countries is extremely asymmetric - good and very good latitudinal connections prevail, building relations with the western part of our continent, with a quantitative deficit combined with a low standard of meridian connections building relations between countries interested in participating in the Three Seas Initiative project. It should be noted that the scale of this problem has a different qualitative dimension in roads and railways, which can be seen in the Polish example of connections going to Slovakia. Of the three modern expressways (S1, S7, and S19), the first two are practically nearing completion, while the third is in the advanced construction process. By 2030 at the latest, we will have three modern road routes, which, combined with the network of our southern neighbors, will practically solve the problem of road communication in the area of the Three Seas Initiative. Against the background of this uplifting perspective in road engineering, the situation in railway connections looks completely different. Of the three existing railway routes running through the Carpathians to the south of Europe, only one (lk 96 to the crossing in Muszyna) meets the minimum requirements for a route of this category. The other two lines (lk 107 and lk 139) are of marginal importance - their parameters, current technical condition, location,

and role in the railway network system only deepen this marginalization. A chance to change this situation is the implementation of the investment program - both the construction of new sections of the line and the modernization of the existing ones, but not all of these activities have sufficient justification.

The greatest hopes are associated with the implementation of the project commonly known as "Podłęże-Piekiełko", i.e. the construction of the Węgrzce Wielkie-Szczyrzyc-Mszana Dolna/Tymbark line with the comprehensive modernization of the line lk 104 Chabówka-Nowy Sącz. This project, which is over a quarter of a century old, assumed clearing access to the railway crossing in Muszyna by building a new section and the existing lines (lk104 and lk96). Launched with such a long delay, the investment in its originally assumed shape must raise some doubts. The first concerns the possibility of modernizing the section of line 96 from Nowy Sącz to Muszyna, which is not included in the scope of the planned investment. It runs along the Poprad valley and has a very unfavorable profile, the improvement of which on a large part of this section would involve huge expenditures. From Piwniczna to Muszyna, the line runs through a river gorge, overcoming several very sharp bends, the elimination of which would require piercing it in tunnels. The second doubt concerns the actual usefulness of this line. It was designed in the 1990s to serve the strong industrial centers of the eastern part of Slovakia and Hungary. Unfortunately, the economic geography of both countries has changed profoundly since then. In Slovakia, the largest industrial centers are Bratislava, Kosice, Žilina, Banská Bystrica, Martin, Nitra. Of the larger enterprises in the east of the country, practically only the US Steel plant in Košice is left. On the other hand, in Hungary, from the numerous heavy industry plants in the Borsod (Miskolc) county, practically none have been left. The same applies to the second largest city in Hungary - Debrecen. Meanwhile, during this quarter of a century, new industrial areas have sprung up in the western part of Hungary and Slovakia. In Hungary, these are factories such as: Suzuki in Esztergom (10,000 employees), AUDI in Győr (11,500 employees), and Mercedes Benz in Kecskemét (4,700 employees). Also in western Slovakia, numerous automotive companies have relocated their production plants - Volkswagen (plant in Bratislava), Peugeot (production in Trnava), Kia Motors (Žilina) Jaguar Land Rover (Nitra). Western Slovakia has also become a center of electronics production. In the last several years, factories of such electronic concerns as: Samsung Electronics (Galanta), Sony (Trnava and Nitra), as well as household appliances - Whirlpool (Poprad) have been built here. Taking into account this re-vectoring of the economies of both our southern neighbors, it would be reasonable to re-evaluate the assumptions for the construction of the "Podłęże-Piekiełko" line - making the south-eastern - Nowy Sącz branch clear for freight traffic and to analyze the extension of the line from Chabówka towards the west.

The modernization of railway line No. 139 Bielsko-Biała - Żywiec - Zwardoń - Skalite, which has been going on for several years, raises great doubts, since Poland acceded to the European Union, especially in the conditions of an open European railway market. The assumptions for the modernization of this railway line to a speed of 160 km/h (in passenger traffic), consisting in transforming it into a route with the highest parameters for freight traffic, will require huge expenditures not only on the Polish but also on the Slovak side. The very unfavorable profile of this line on the Polish side should be taken into account - from the station in Milówka to the border (21 km), the height difference reaches 221 meters, which is

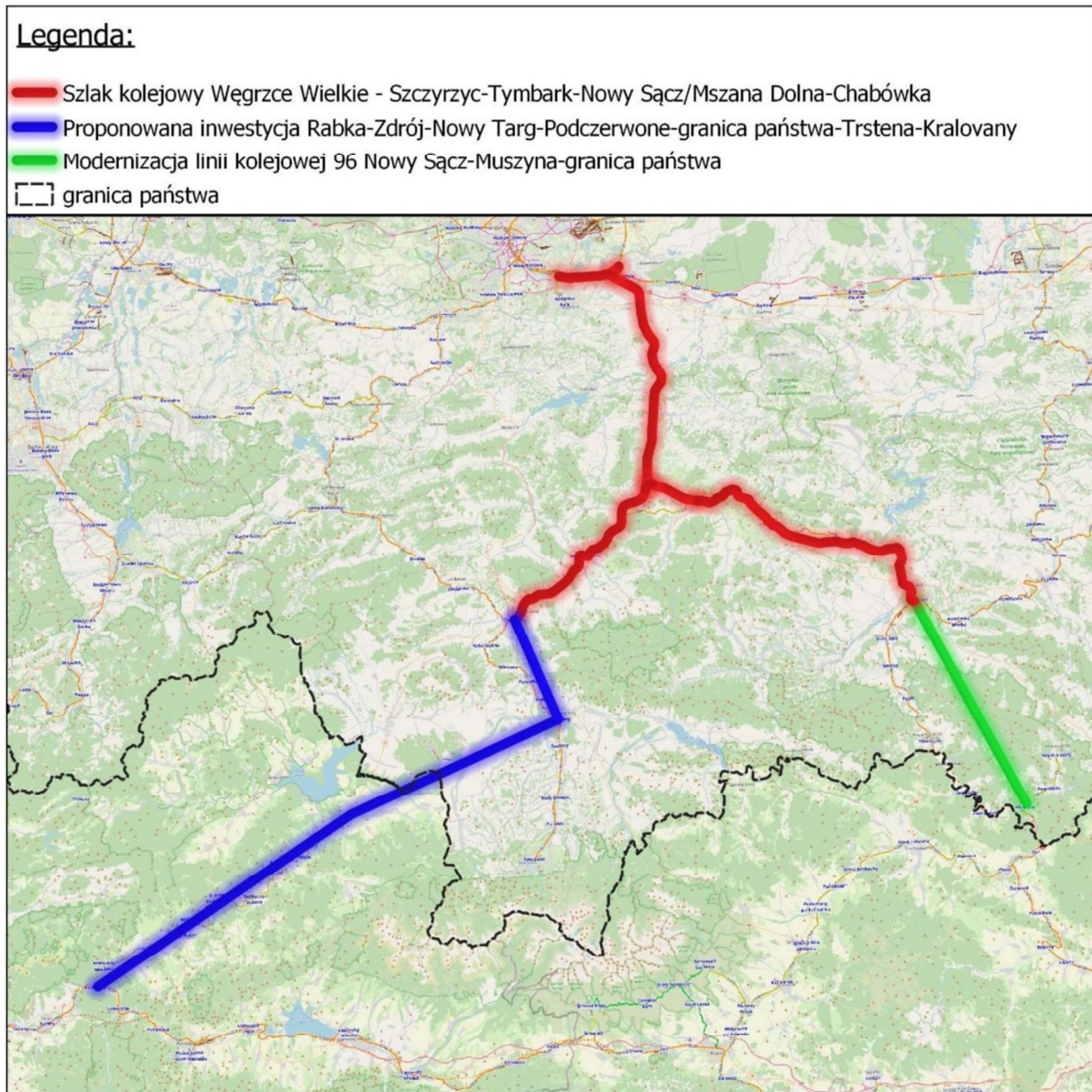
within the standard for freight traffic, but already on the section Sól - Zwardoń the average slope is already 1.5%, and at the border, it exceeds 1.7%. However, the main problem emerges only on the Slovak side, where on the section Skalité pod Poľanou - Skalité-Serafínov it exceeds 2.5%. In this state of affairs, maintaining the permissible slope of the line requires running it over a long cross-border section in a tunnel. Meanwhile, a simple analysis of the existing routes shows that this costly investment will in no way improve the current level of service for traffic heading from Upper Silesia to Western Slovakia. An alternative connection via Zaolzie and the Jabłonkowska Pass, with a similar length, already offers very good operational parameters. In the relation Wisła-Czadca Bridge, the route through Żywiec-Zwardoń will be only 7 km shorter (91 vs. 98 km) than the connection via Zebrzydowice-Petrovice-Jabłonków, but 7 km longer than the connection via Zebrzydowice-Cieszyn Marklowice-Jabłonków (84 km).

The last of the existing lines - lk 107 from Sanok-Zagórze to Łupków, paradoxically has the best geometry, therefore the greatest modernization potential. As the only one, it was designed as a main, double-track line for express connections between Budapest and Lviv. Undoubtedly, this line should be used to create a railway equivalent of Via Carpatia. The problem is the lack of a good connection to the Polish railway network. An opportunity is created by the CPK railway program, under which two new railway lines are to be built. In addition to line No. 58 (Łętownia – Rzeszów), line No. 122 (Rzeszów – Sanok) is of key importance as it opens the possibility of connecting line No. 107 with the rest of our railway network and allows us to realistically think about using this route to build Rail Carpatia. Considering the existing condition of the infrastructure of railway routes in the area of the Three Seas Initiative and the geographical conditions existing in this area, it is reasonable to concentrate efforts on clearing the two routes serving this area for rail traffic. The first one - going south-east, is the aforementioned Rail Carpatia, intended to connect the Baltic States and Polish seaports with the eastern part of the Pannonian Basin, Romania, and the Balkans as far as Istanbul and Thessaloniki. In the southern part of Rail Carpatia (on the Hungarian-Romanian border), it would connect with the long-functioning fourth corridor of the TEN-T network (Eastern Mediterranean). The second route - which is the subject of this study, is Rail Adriatica. Being an alternative route of the first TEN-T (Baltic-Adriatic) corridor shifted to the east and included previously overlooked Hungary, Slovenia, and Croatia. This route going southwest would connect the Baltic countries and our seaports with the western part of the Pannonian Basin, with Croatia, Slovenia, and Northern Italy reaching the ports of the northern Adriatic. Such a route could be an alternative to the current branch of the Silk Road leading from Transcarpathian Ukraine to Hungary, Austria, Southern Germany, and Northern Italy, leading to these areas from the border terminals in Małaszewicze (and in the future also in Chełm).

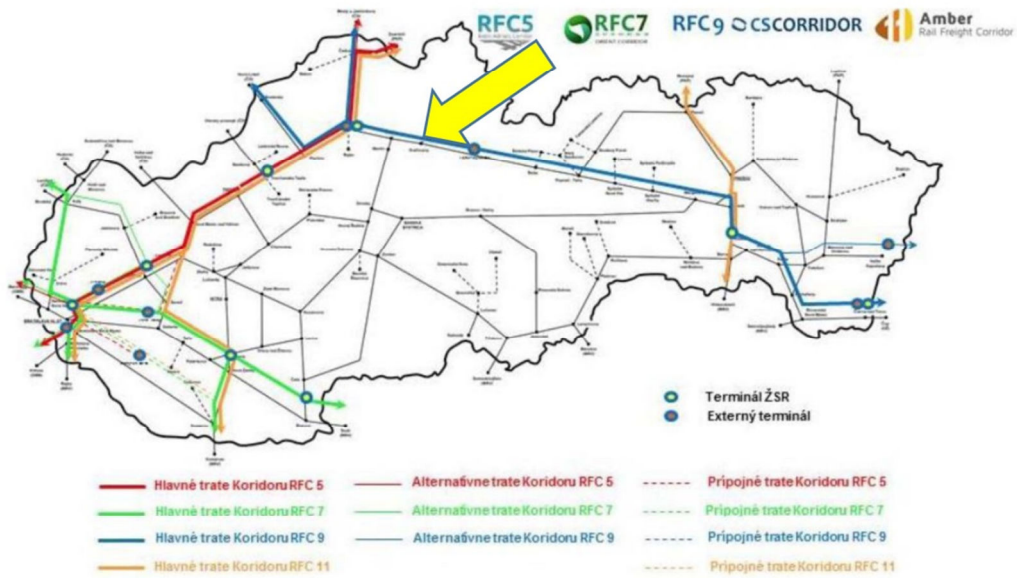
Purpose of the investment

The investment aims to create a new railway line with high operational parameters (construction of new sections along with modernization and revitalization of existing sections), which will connect Polish and Slovak railway networks. It is to be a natural extension of the already built "Podłęże-Piekiełko" line in the south-western direction, giving the possibility of setting out a new railway corridor with high operational parameters.

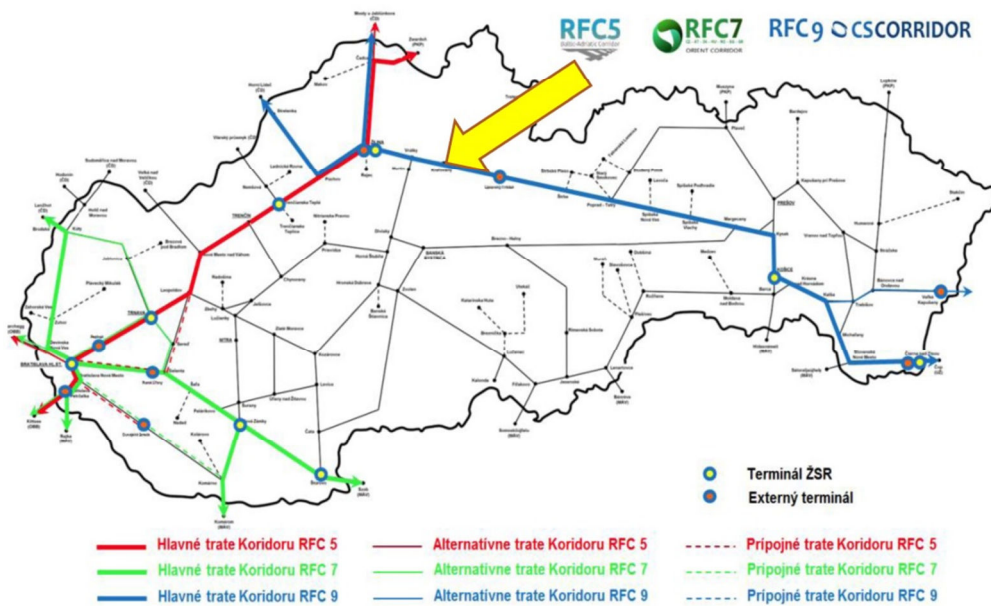
Implementation of the project in the assumed shape will require - apart from investments on the Polish side - also adequate investment activities on the Slovak side. From a broader perspective, the proposed investment is to connect two separate railway networks in Central and Eastern Europe, separated by the Carpathian chain, which may result in the creation of a new communication corridor in the area of the Three Seas Initiative. For the implementation of the Rail Adriatica corridor concept outlined above, this investment is of key importance as it complements the missing element of this route. This investment is intended to improve freight transport. Nevertheless, significant benefits should also be expected for passenger traffic, significantly improving the rail service in the Podhale area, including increasing the share of rail in passenger traffic to Zakopane. Therefore, the proposed solution should significantly increase the benefits resulting from the implementation of the “Podłęże-Piekiełko” connection, enhancing the assumed communication effect on this route, and as a result, increasing the projected economic indicators of the investment. It should be noted that long before the concept of the Three Seas Initiative was created, there was a serious – albeit unsuccessful at the time – attempt to chart such a route. In the autumn of 2005, the Italian, Slovenian, and Hungarian railways joined forces to form a consortium to participate in the privatization of Železničná spoločnosť Cargo Slovakia, which was being prepared by the then Slovak government. PKP Cargo was also invited to join this consortium and declared its interest in participating in it. The involvement of PKP SA and PKP Cargo significantly increased the chances of success of the project. Unfortunately, the prospect of the forthcoming parliamentary elections in Slovakia and their subsequent outcome slowed down the investment.



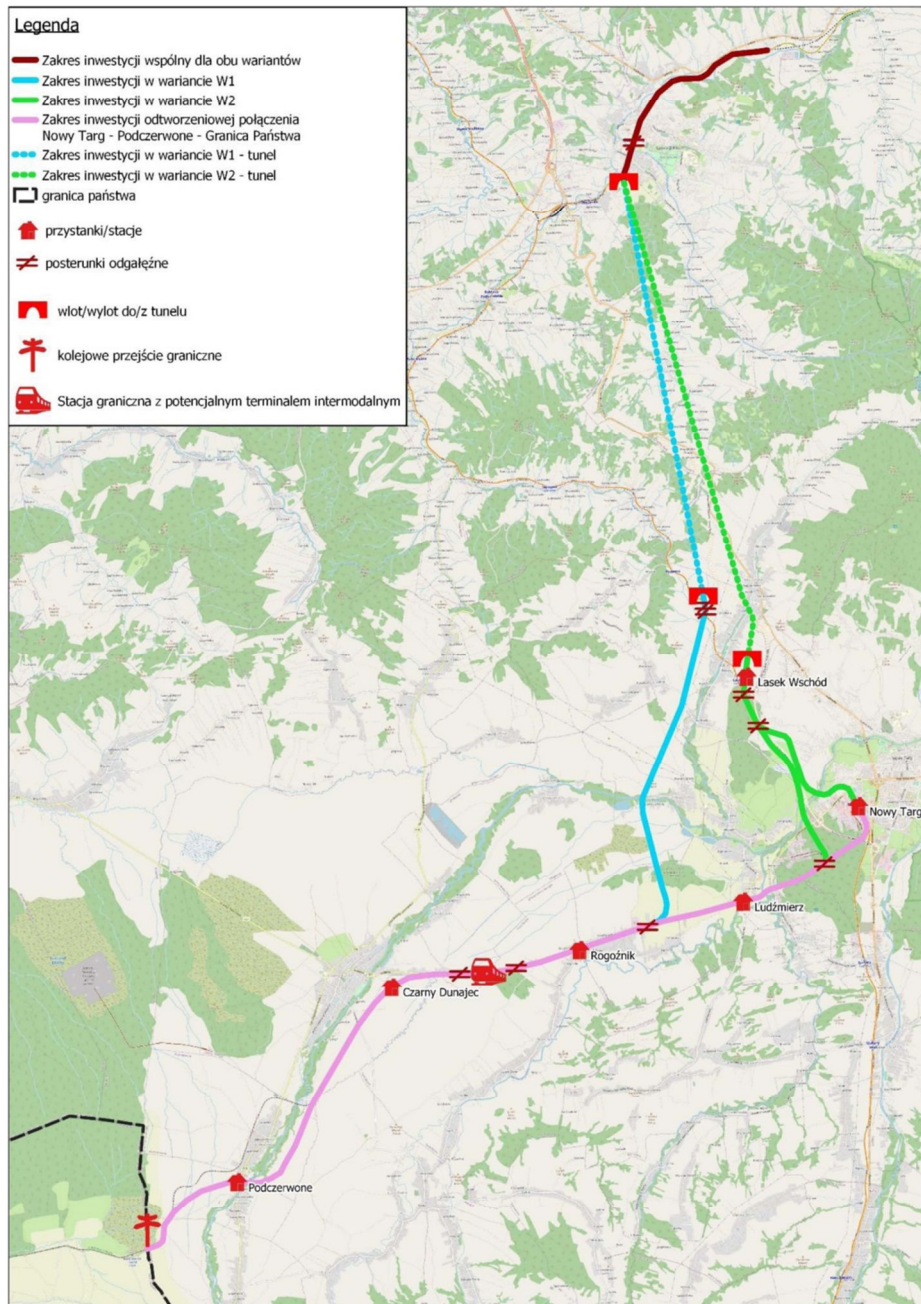
1. The area of the Podlęża _ Piekielko investment and accompanying tasks



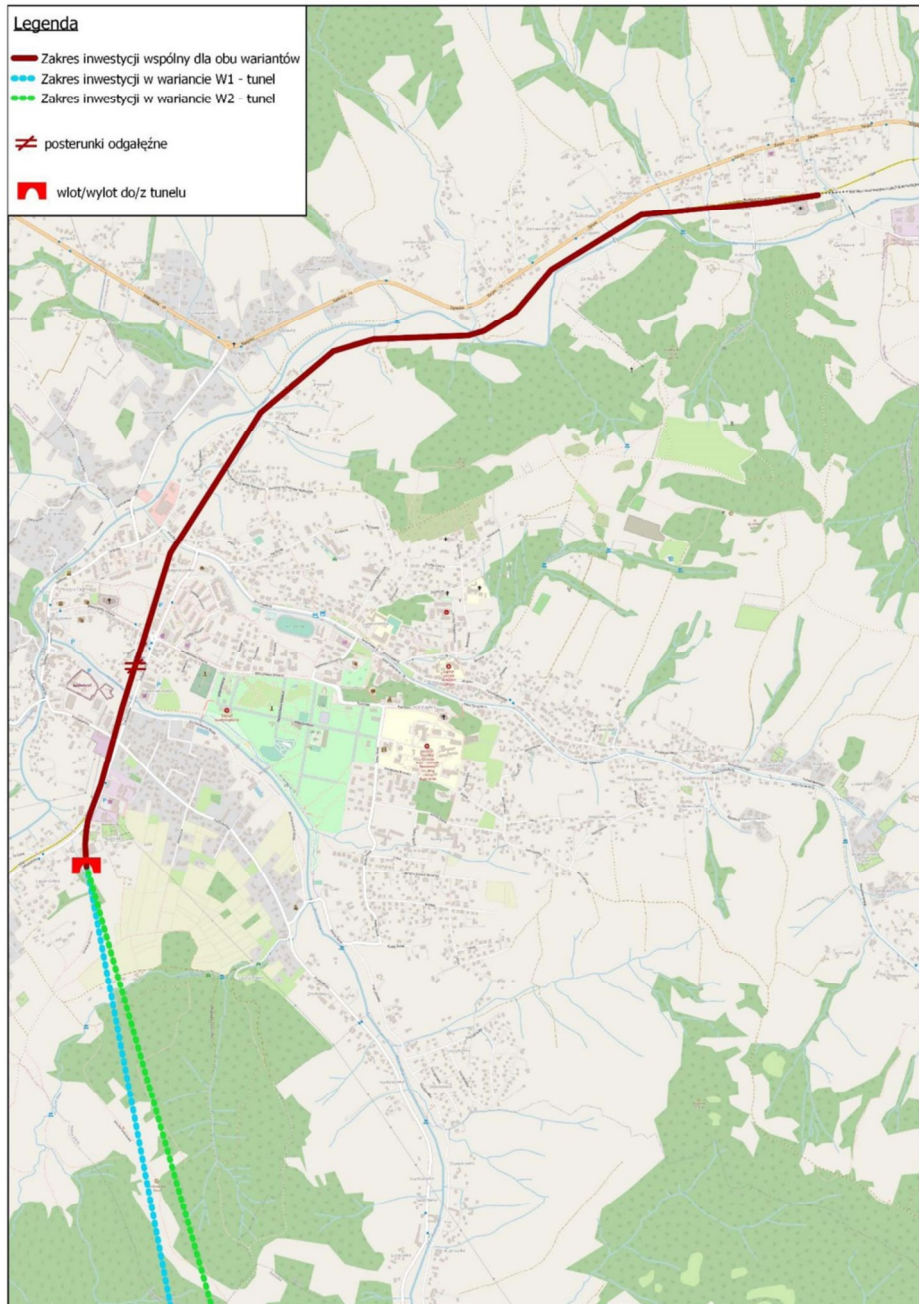
2. The Slovak part of the route Rabka - Nowy Targ - State Border - Trstena - Kralovany (yellow arrow) against the background of the RFC railway network in Slovakia



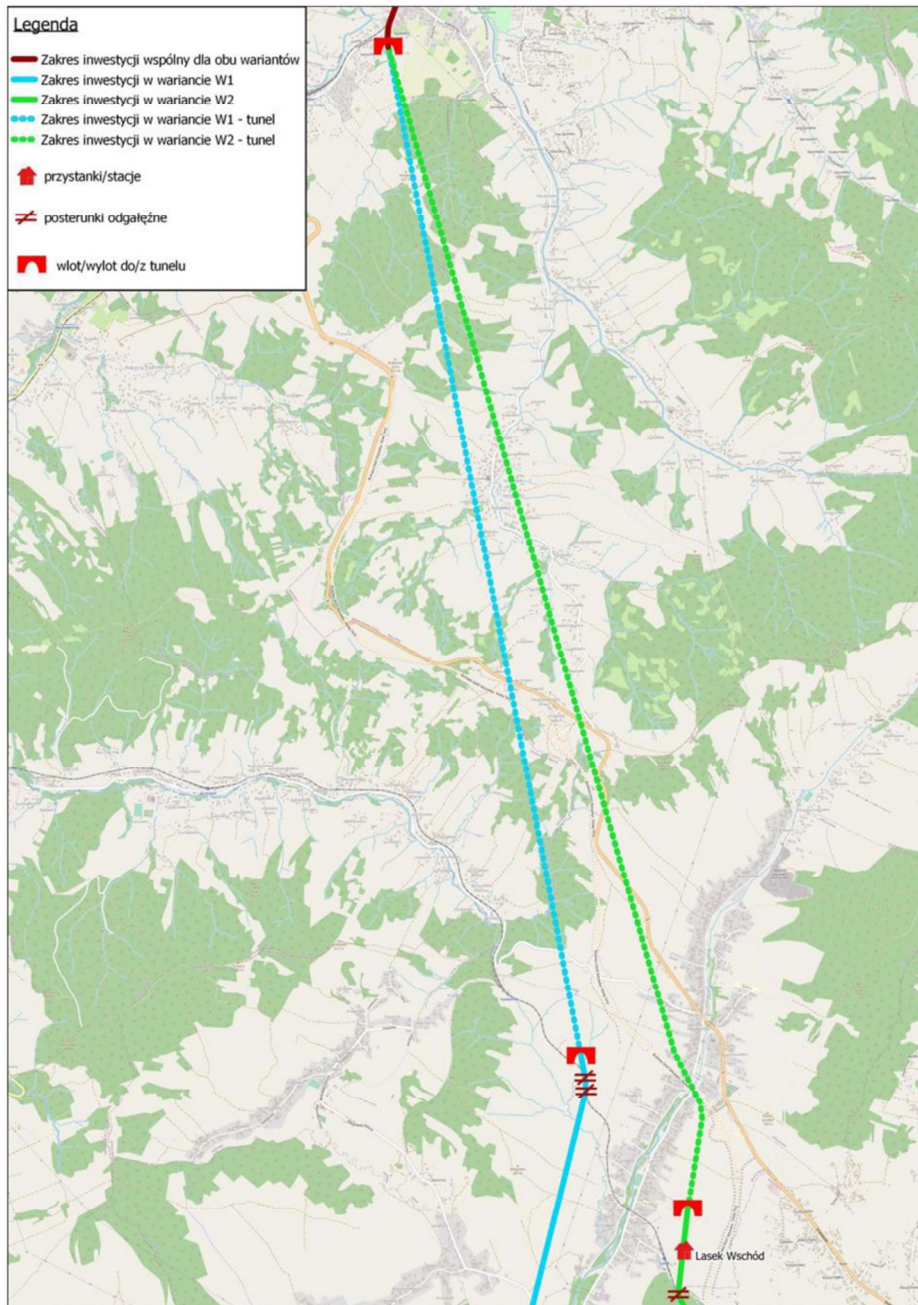
3. The Slovak part of the route Rabka - Nowy Targ - State Border - Trstena - Kralovany (yellow arrow) against the background of the TEN-T railway network in Slovakia



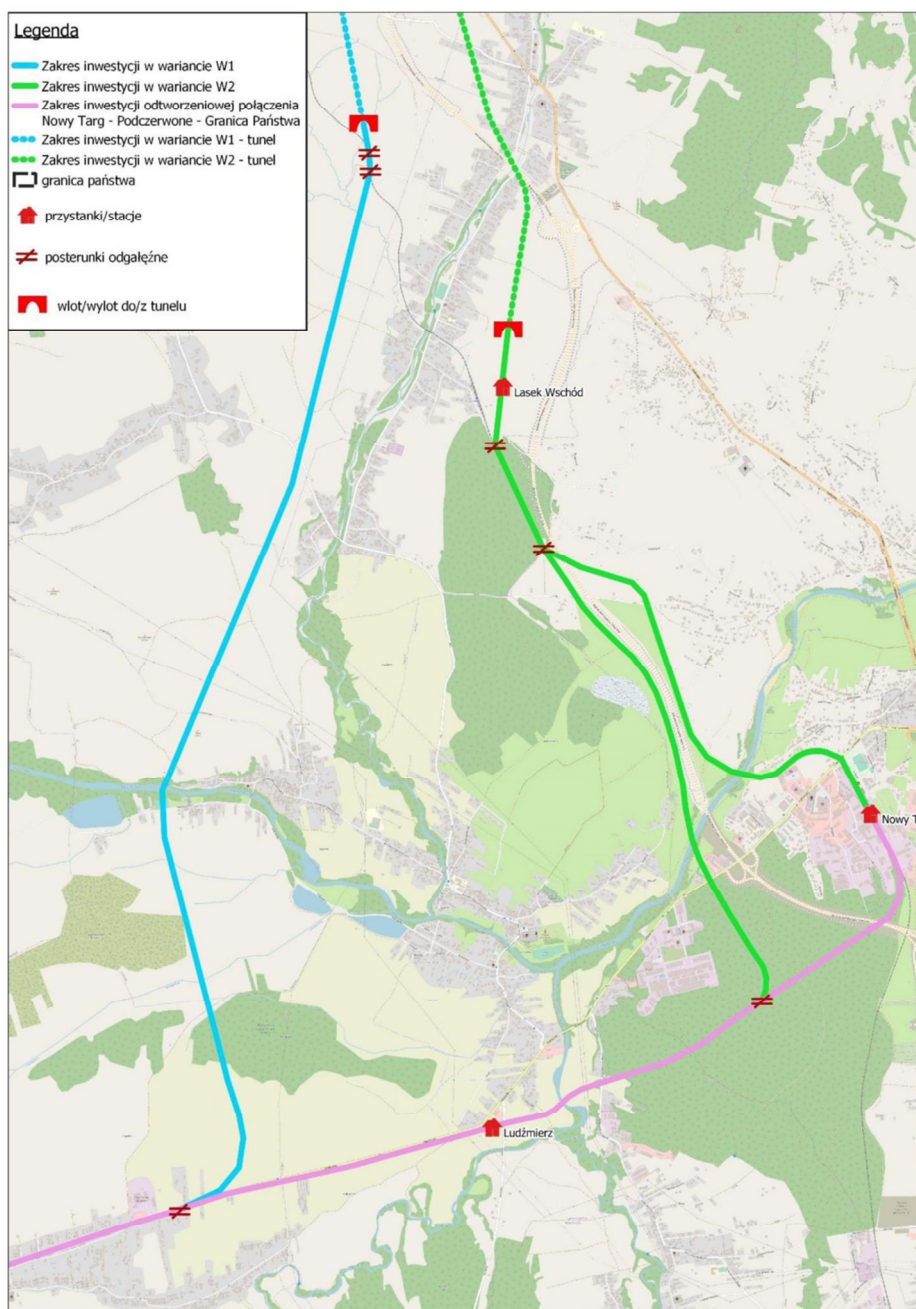
4. Railway route Rabka Zaryte - Nowy Targ - Podczerwone - State border



5. Railway route Rabka Zaryte - Nowy Targ - Podczerwone - State border - section Rabka Zaryte - Tunnel



6. Railway route Rabka Zaryte - Nowy Targ - Podczerwone - State border - section in the course of a tunnel.



7. Railway route Rabka Zaryte - Nowy Targ - Podczerwone - State border - Nowy Targ section

Description of the investment

Section Rabka Zaryte - Lasek

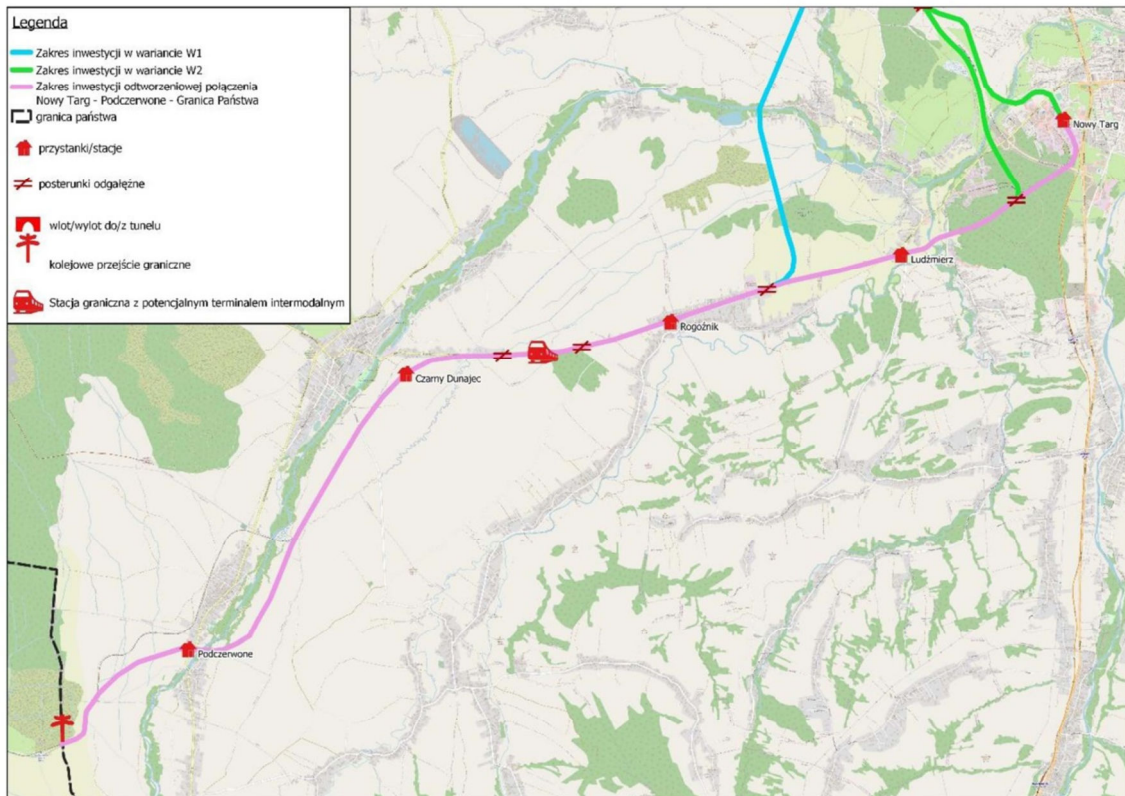
The planned line could start at the Rabka Zdrój station, while the branch from line 104 will take place about a kilometer before the Chabówka station. For this purpose, it is necessary to rebuild the track system in Rabka Zdrój, including the extension of the Rabka Zaryte station and the extension of the second track of line 104. In turn, the current Rabka Zdrój stop will become a junction station, from which two single-track lines will start eastwards: the existing line 104 and the new line running under the Gorce massif towards Nowy Targ and the border with Slovakia. From the Rabka station, the tracks of both lines would run together on an

upward embankment to the viaduct over Podhalańska Street and then after about 400 m. The new rope will lead to the viaduct over Zakopiańska Street. The entrance to the tunnel will take place at an altitude of 499 m above sea level. (in the first variant W1), or 496.5 m above sea level (in the second variant W2). From here, the newly built line will be directed south through a tunnel with a length of 9.6 km (in the first variant) or 11.3 km (in the second variant) under the Gorcse massif. The difference in the location of the inlet height results from the assumed necessity to obtain the lowest possible index of the maximum inclination of the line for the section from the Rabka Zdrój station to the tunnel exit in Kotlina Nowotarska.

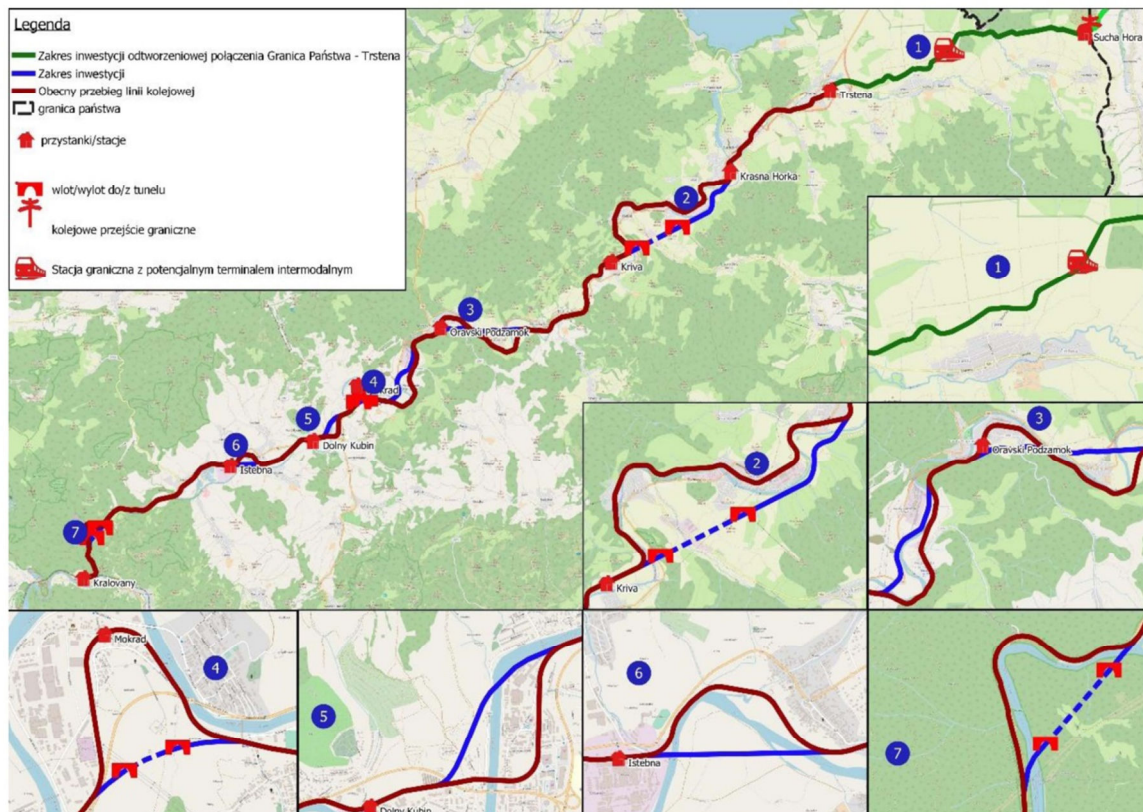
Section Lasek – Nowy Targ/Czarny Dunajec

The first variant

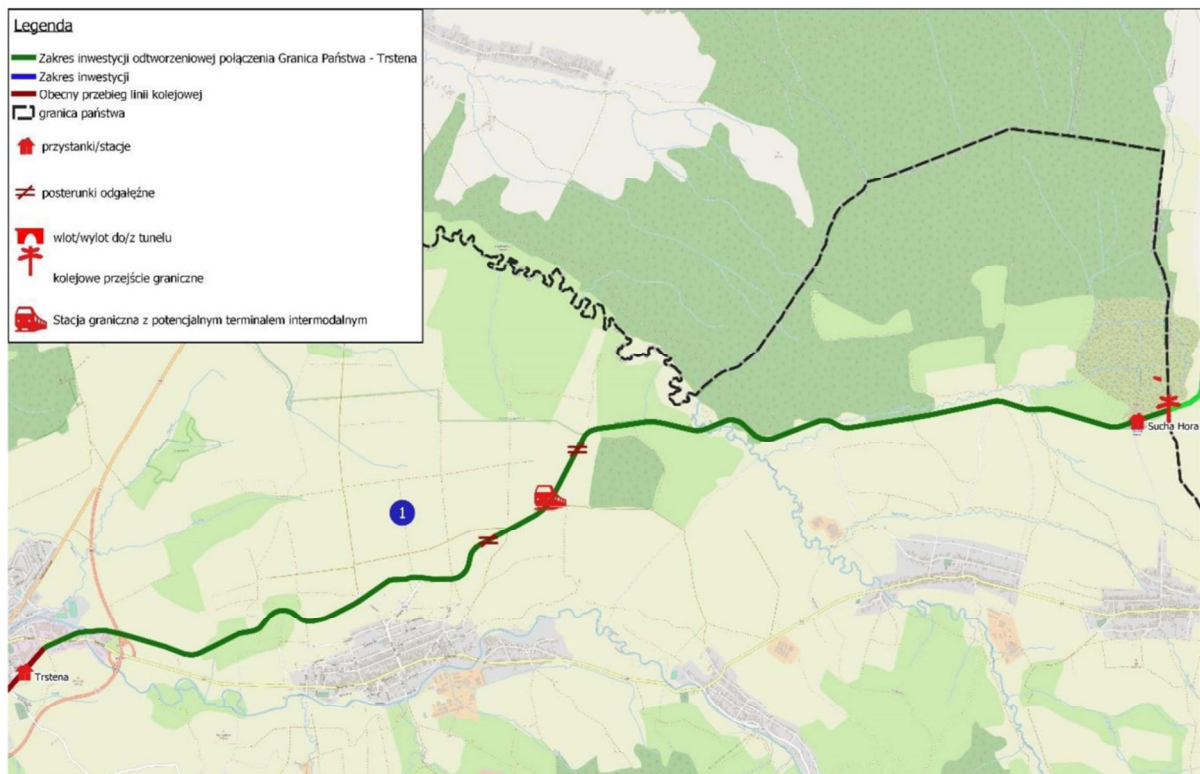
In this variant, the exit of the tunnel and its connection to line 99 Chabówka - Nowy Targ is located in the area of kilometer 17.3 of this line - 1800 meters before the Lasek station. The ordinate of the tunnel outlet will be 674 m above sea level. which gives an average inclination of the line in the tunnel of about 17.0 ‰ - slightly exceeding the standard indicator of the maximum track inclination (16 ‰) and ensuring relatively good conditions for freight traffic. At the point of contact with line 99 in the area of the northern entrance of the tunnel, passenger traffic and freight transit to Slovakia will be separated. Due to the assumed significant freight traffic and the high inclination of line 99 on the Lasek - Nowy Targ section, it will be necessary to build a slip road between lines 99 and 118, bypassing the city and the Nowy Targ station from the west (approximately 10 km long). This railway bypass of Nowy Targ will connect the exit of the tunnel at the junction with line 99 with the rebuilt line 118 behind the provincial road No. 957 Nowy Targ - Czarny Dunajec in the area between the towns of Rogoźnik and Czarny Dunajec (the ordinate of the point of contact with line 118 is 658 m above sea level. In addition, in the area directly behind the tunnel exit and the intersection with line 99, it will be necessary to locate a passing loop that will reduce the sequence times of trains passing through the tunnel and thus increase its capacity. In turn, to improve the quality of passenger traffic, the modernization of the 6.3 km section of line 99 from the junction of the planned line to Nowy Targ should be considered - the suggested speed limit is at least 120 km/h. Further, from the Nowy Targ station, passenger traffic would be divided into two routes: to Zakopane by line 99 and to Slovakia by the rebuilt line 118.



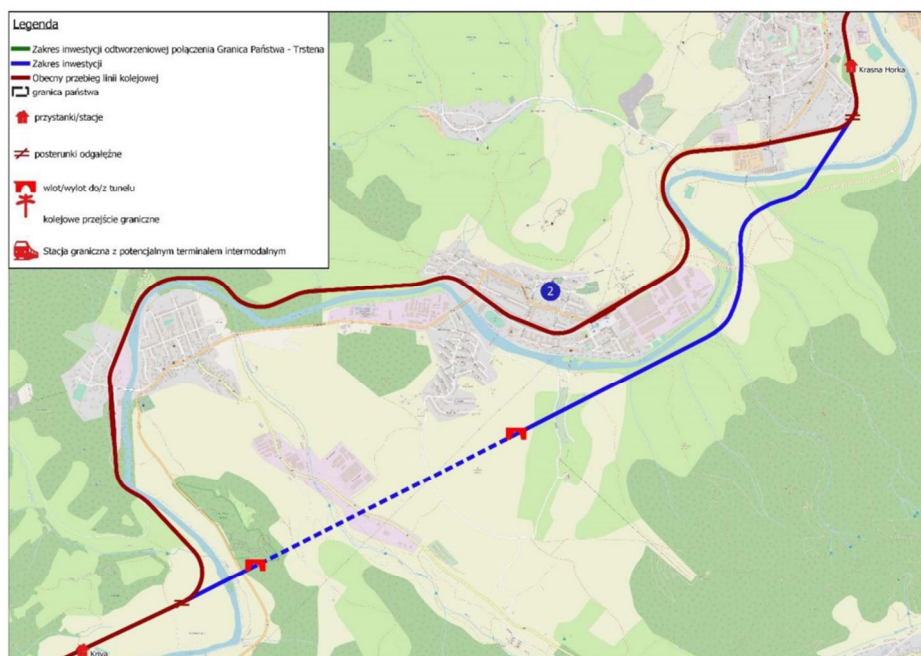
8. Railway route Rabka Zaryte - Nowy Targ - Podczerwone - State border - section Nowy Targ - Border



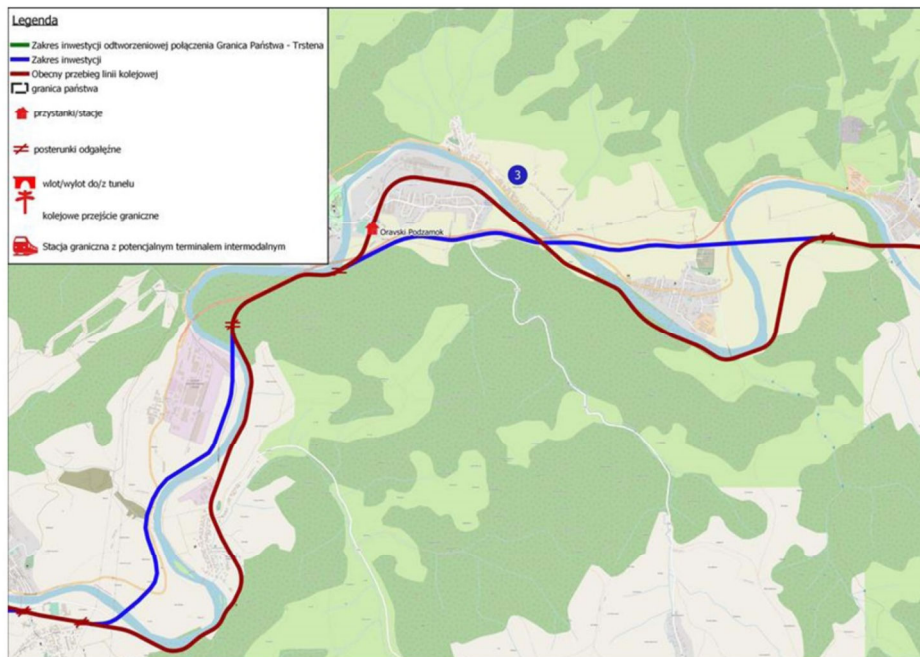
9. The planned route on the Slovak side



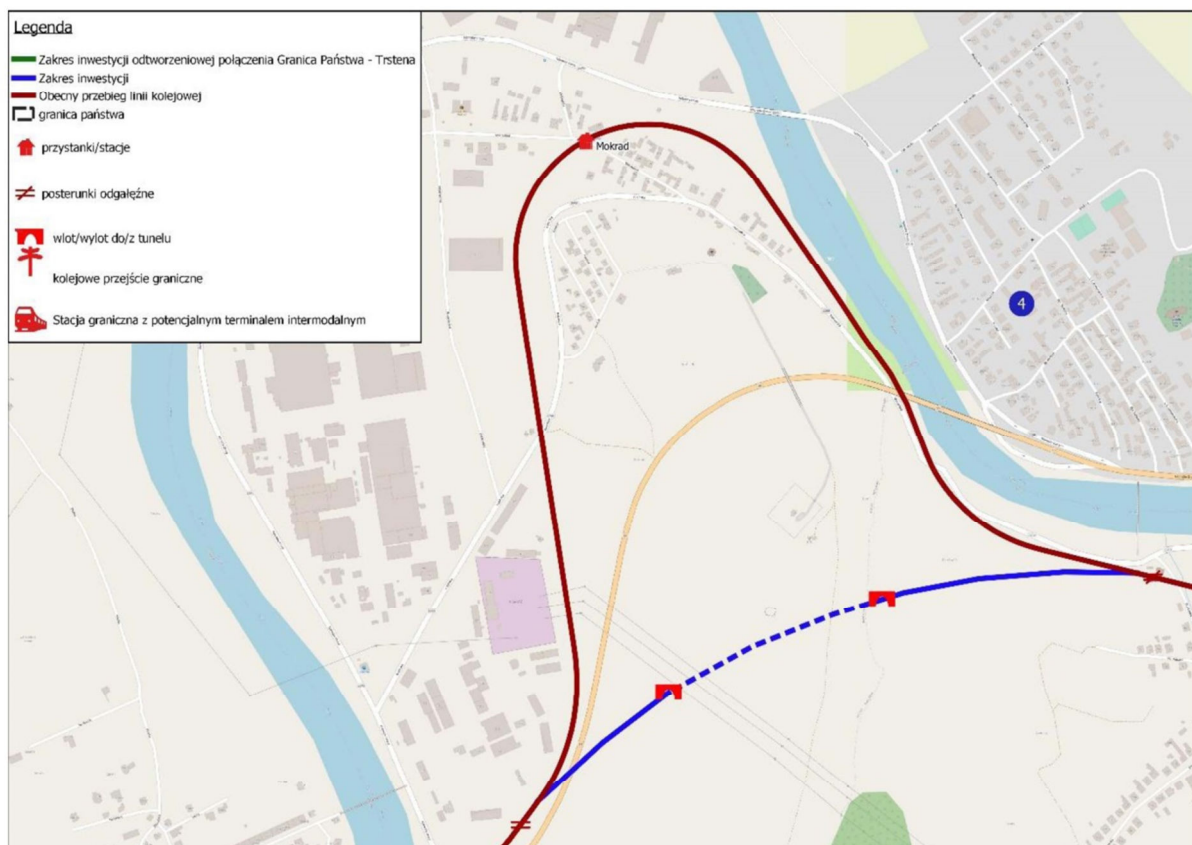
10. The trail on the Slovak side - the course of the rebuilt section of the State Border - Sucha Hora - Trstena



11. The trail on the Slovak side - the proposed route of the Krasna Horka-Kriva section



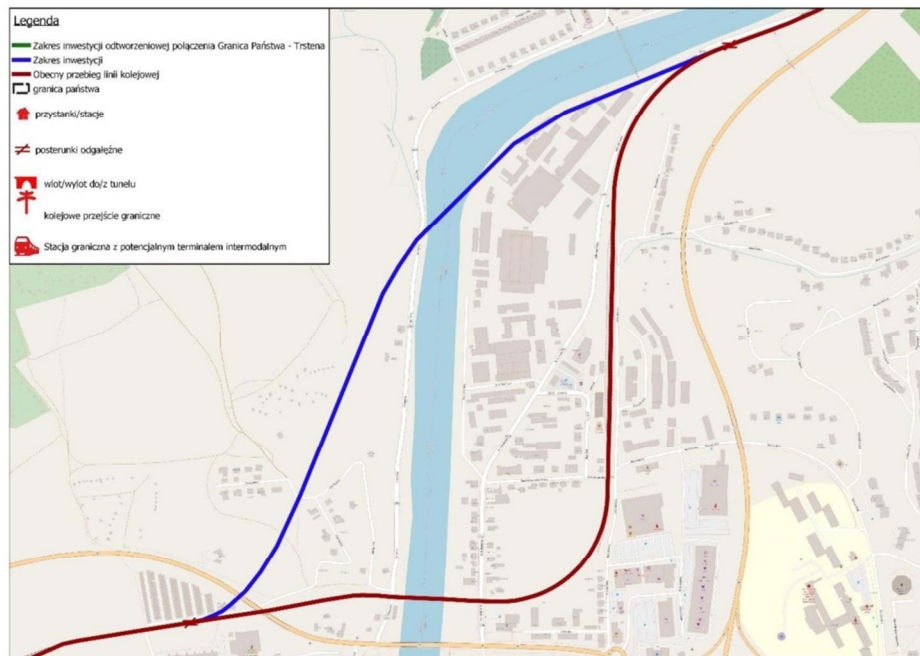
12. The route on the Slovak side - the proposed route of the section in the area of Oravski Podzamok



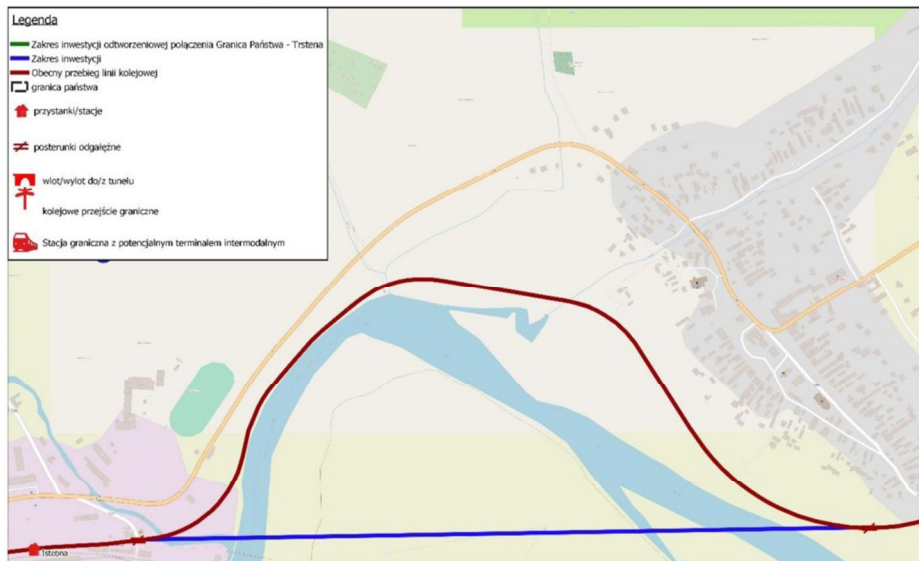
13. The route on the Slovak side - the proposed route of the section in the vicinity of the village of Mokrad

The second variant

Chabówka – Nowy Targ will be located approximately 200 m to the east of the Lasek station. The ordinate of the tunnel exit will be at a height of 660 m, which gives an average inclination of the line in the tunnel of about 14.5‰ - not exceeding the standard maximum inclination of the track (16‰) and ensuring good conditions for freight traffic. After about 400 m from the tunnel exit, the planned line will meet line 99 located (approx. km 18.5). As in the first variant, this variant also proposes the target separation of freight and passenger traffic within Nowy Targ itself, to eliminate the passage of freight trains through the city centre. For this purpose, in the area in front of the viaduct of the Nowy Targ Bypass under construction on the route DK 47 - on the 19.2 km of line 99, a branch post should be located for the exit of the freight slipway, bypassing the station and the city of Nowy Targ from the west, running towards the former line 118. starting from it in the area of the bridge on the Dunajec River in a southerly direction to the point of contact with the rebuilt line 118 in the area of 1.7 km.



14. The trail on the Slovak side - the proposed course of the section bypassing Dolny Kubin



15. The trail on the Slovak side - the proposed course of the Velicna - Istebne section



16. The route on the Slovak side - the proposed route of the section in the area of the Kralovany Zastavka stop

Tab. 1. The scope of investments on the Slovak side

L.P	Odcinek do realizacji	Długość całkowita (w km)	Tunele (w km)	mosty	uwagi
1	Granica SK/RP - Sucha Hora – Trstena	14,0	-		Odtworzenie linii po starym śladzie
2	Krasna Horka - Kriva	6,4	2,0	2	
3	Oravski Podzamok	7,65	-	4	
4	Mokrad	0,9	0,3	-	
5	Dolni Kubin	1,55	-	2	
6	Velicne - Istebna	1,3	-	2	
7	Kralovany	0,6	0,2		
8	W sumie	33,4	2,5	8	

Section Nowy Targ/Czarny Dunajec – Country Border

Line 118 from the Nowy Targ station should be routed along the route of the former line No. 118 but with significant adjustments to the course consisting mainly in changing the horizontal profile of the curve from the bridge over the Czarny Dunajec River to the intersection of Domańska Street in the village of Czarny Dunajec, and then building a bypass around the village of Podczerwone along the eastern bank of the Czarny Dunajec River. This river, together with the provincial road DW 958 running along its bank, will cross between the villages of Podczerwone and Koniówka, returning to the former route of line No. 118. Then, following the former line No. 118 to the border with Slovakia. However, it should be emphasized that the possibility of using the former railway line No. 118 should facilitate the acquisition of land for the investment.

Slovak section: State border - Sucha Hora - Trstena - Kralovany

On the Slovak side, it is necessary to comprehensively modernize the existing SK 150 line from the Trstena station to the Kralovany station, which is a junction station on the main Slovak trunk line - Koszyce - Poprad - Žilina - Bratislava, and to rebuild the border section SK/RP border - Sucha Hora - Trstena.

In addition to the electrification of the entire route, in several places, its deep reconstruction is necessary to eliminate the greatest restrictions resulting from the unfavorable profile of this line. This line was built as a local connection, with a very modest scope of engineering facilities, without which high track speed cannot be achieved in mountainous terrain. Because it is mostly routed in the Orava valley - running along this meandering river, therefore in many places the line has a very unfavorable geometric profile. Adapting it to the requirements of the AGCT network requires the elimination of several sections with curves with low radii, as well as bypassing several towns for which heavy freight transport would be a major nuisance. A favorable circumstance is that the Orava River flows in a relatively wide valley along most of the SK 150 line, which significantly reduces the cost of the necessary investments.

The planned connection requires first opening the track from the city of Trstena to the Polish border in Sucha Hora (from km 56,450 to km 70,410). With the height difference

between the border point (770 m above sea level) and the Trstena station (615 m above sea level), the average slope of the line reaches less than 1.11%, which is a fully satisfactory result. On the 14 km section, only in a few places would it be necessary to consider the advisability of minor corrections of the curves. The most serious investment – apart from the reconstruction of the line itself – would be the construction of a border station. The optimal location would be the area to the east of the Trstena ring road (route R3) through the village of Liesek.

The first section to be completed along the new track is Krasna Horka - Kriva. There are a number of sharp curves on this section of the SK 150 line. In addition, the line runs through the densely built-up area of the towns of Krasna Horka, Nižna, and Podbiel. The new 6.4 km section from the existing line would depart before the curve in Krasna Horka, 750 m before the Krasna Horka stop. After crossing Orava, it would run along the left bank of the Orava, along the slope of the hills (Kovalowo, Gruń, Postredny), then it would run through a tunnel of about 2 km under the Ostrvka and Biela Skala hills, and then it would return to the right bank of the Orava, connecting with the old line behind the curve at 850 m before the Kriva stop.

The next and longest of the new sections would be the ring road of Oravski Podzamku, consisting of two sub-sections with a total length of 7.65 km. This section would start 950 m after the Sedliacka Dubowa stop, on the curve at the foot of Polom hill. Then the new line would cross the Orava River before Horna Lehota; from here, running along the R3 road, crossing Orava again, it reached the Kycera mountain and then along its foot to the place where the R3 road crosses the current SK150 line. From here, for 1,350 m, the line would follow the SK 150 track to the Orava bend before the area where Oravskie Ferozlatinarske Zavody is located, after which - after another change of shore, the line would run to the junction with road 59 along it to the bridge in Orava before the village of Bziny to connect with the SK 150 line 0.5 km before the Bziny stop.

The third section proposed for implementation is the bypass of the village of Mokrad, 0.94 km long, it would start right after the Bziny stop and connect to the current SK150 line at the southern end of the village of Mokrad. Due to the need to cross the ridge of the vast Pastornik hill (which the current course of the SK 150 bypasses in a wide and sharp arc through the village of Mokrad), the route must partly run in a trench, the 300 m section of which should be covered and filled with a short tunnel.

The next proposed section - the ring road of Dolny Kubin, 1.55 km long, is to divert traffic from the town, and at the same time eliminate two sharp curves. The new line would depart from SK 150, 680 m before the Dolni Kubin station and run along the left bank of the Orava (through the area adjacent to Zettransport Slovakia) to the right bank over the bridge located on the bend of this river. Then, leaving the river, crossing the gentle slopes of the Brezovec hill, and avoiding a small housing estate, it reconnects with line Sk 150 in the area of the cemetery in Dolny Kubin at the intersection of SK 150 with road No. 70.

The next section is a simple 1.3 km long slip road located exactly between the Velicna and Istebne stops. It crosses the bend of the river between these towns, eliminating the rather tight curve on which the SK150 line runs today.

The last of the necessary investments - a 0.6 km slip road eliminating the sharp curve of the SK150 line, is located in the area of the Kralovany Zastavka stop, in the area where Orava

flows through the deep valley of the Mala Fatra gorge. It starts 380 m before the stop on the left bank of the Orava River, which it crosses twice, connecting again on the left bank with the current course of the SK150 line 520 m after the Kralovany Zastavka stop. Part of this mountainous section - about 200 meters - has to be covered in a tunnel.

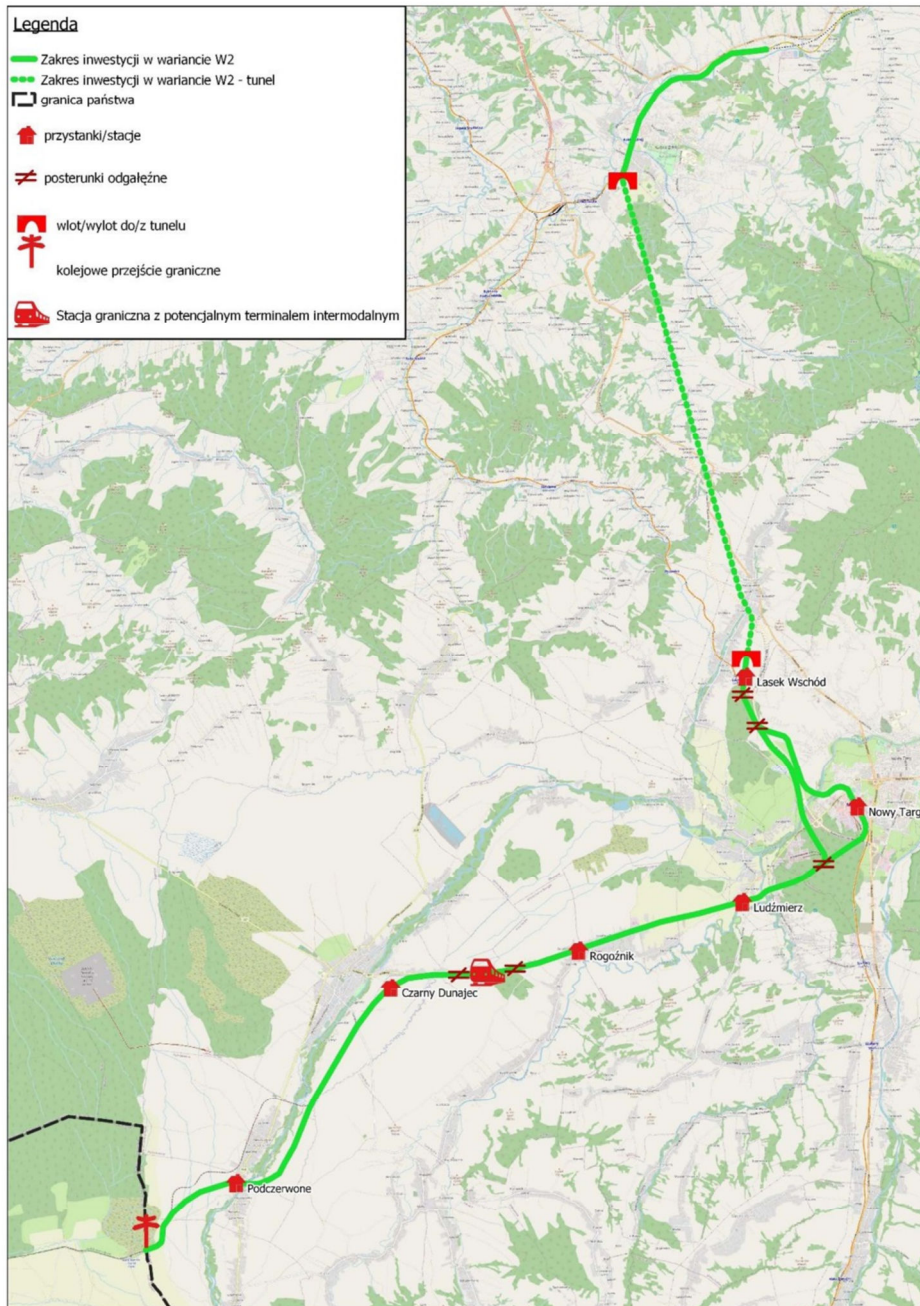
The scope of the investment - a summary of the investment on the Polish side

In the first variant, approx. 24.5 km of the new railway line is to be built, including 10 km in the tunnel, approx. 10 km of a slip road for freight trains bypassing Nowy Targ and a section of 4.5 km from the Rabka Zaryte station to the tunnel entrance. In addition, 6.7 km of line No. 99 from the junction with the newly built line to the Nowy Targ station, and about one kilometer of line 104 from the Rabka station in the direction of Chabówka should be modernized to various extents.

In the second variant, approximately 24.2 kilometers of the new railway line are to be built, including 11.7 kilometers in the tunnel, 4.5 km of track from the tunnel exit to the Nowy Targ station, 3.5 km of a slip road for freight trains bypassing Nowy Targ, and a 4.5 km section of the line from the Rabka Zaryte station to the tunnel entrance. As in the first variant, about one kilometer of line 104 from the Rabka station towards Chabówka should be modernized. Regardless of the above variants of the section to Nowy Targ/Czarny Dunajec, the entire former line No. 118, approximately 21 km long, is to be revitalized, but both the length of this section and its final course depend on the results of detailed analyzes and the choice of route variant. Stops in Ludźmierz, Rogoźnik, Czarny Dunajec, and a station in Inframed should be built on the reconstructed line. The latter would not only be a terminus for regional connections but would also allow international long-distance trains to stop. In this way, the accessibility of places in the Western Tatras, such as Witów, Chochółów, or the western part of Kościelisko, would significantly improve. In the area between the villages of Rogoźnik and Czarny Dunajec, on the DW 957 road, south of the former line 118 running along this road, a border station for freight trains should be built, as well as an additional passing track to reduce the succession times of trains passing the section Nowy Targ - Podczerwone - State Border, and thus increase its capacity. In turn, in the same area, but on the northern side of the DW 957 road, there is an area where an intermodal terminal can be built, primarily dedicated to reloading semi-trailers. Attention should be paid to the natural advantages of this area of the Nowotarska Valley, which are flat and create good conditions for the location of both a large station and a border intermodal terminal.



17. Rail route Rabka Zaryte - Nowy Targ - Podczerwone - State border - first variant (W1)



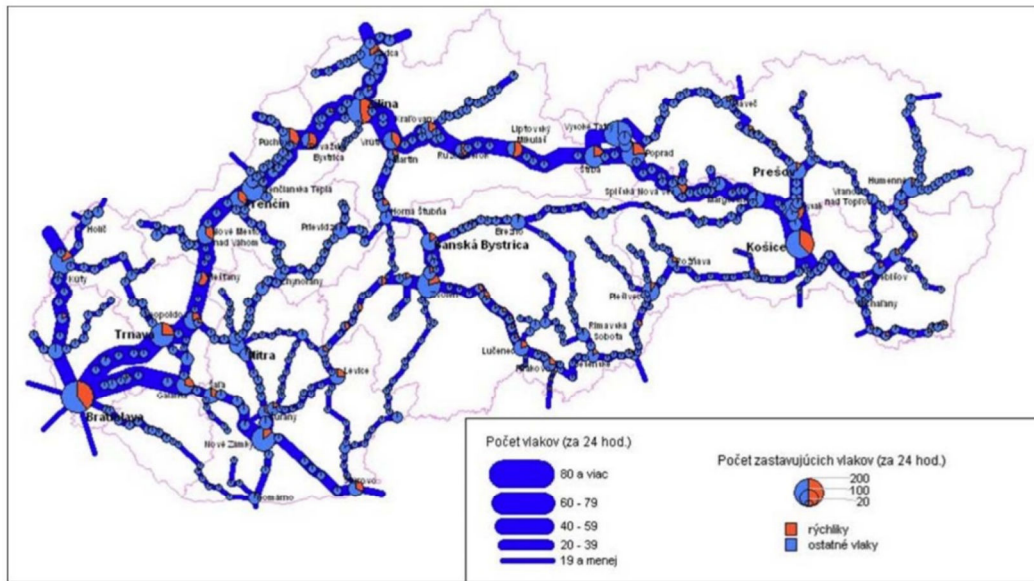
18. Railway route Rabka Zaryte - Nowy Targ - Podczerwone - State border - variant two (W2)

Tab. 2. The scope of the investment in the first variant (W1)

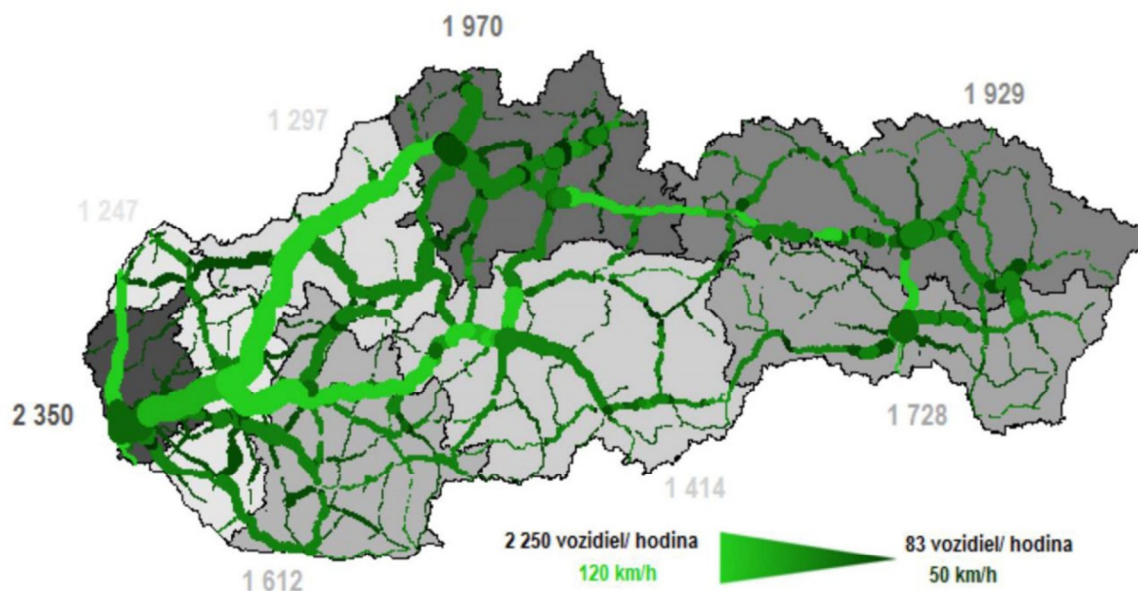
Kilometr osi (km)		obiekt	Wysokość n.p.m.	punkt	Numer linii
osobowy	towarowy				
0,000	0,000	stacja	452	Rabka Zaryte (RZ)	104/W1
3,690	3,690	stacja	482	Rabka Zdrój	W1
4,690	4,690	wlot tunelu	499	tunel portal północny	W1
14,290	14,290	wlot tunelu	674	tunel portal południowy	W1
14,490	14,490	p.o.	671	Lasek Tunel Północ	W1
14,620	14,620	p.o.	670	Lasek Tunel Południe	W1
16,460		stacja	643	Lasek	W1
20,960		stacja	602	Nowy Targ	W1os./L118
24,960		przystanek	603	Ludźmierz	L118
27,060	22,190	p.o.	624	Śmietany	W1tow./L118
28,660	23,790	przystanek	644	Rogoźnik	L118
30,160	25,290	p.o.	655	stacja graniczna (wschodni)	L118
31,460	26,590	p.o.	656	stacja graniczna (zachodni)	L118
32,060	28,190	przystanek	670	Czarny Dunajec	L118
39,060	34,190	przystanek	742	Podczerwone	L118
41,760	36,890	g.p.	768	granica państwa	L118

Tab. 3. The scope of investments in the second variant (W2)

Kilometr osi (km)		obiekt	Wysokość n.p.m.	punkt	Numer linii
osobowy	towarowy				
0,000	0,000	stacja	452	Rabka Zaryte (RZ)	104/W2
3,690	3,690	stacja	482	Rabka Zdrój	W2
4,690	4,690	wlot tunelu	496,5	tunel portal północny	W2
15,990	15,990	wlot tunelu	660	tunel portal południowy	W2
16,380	16,380	przystanek	653	Lasek Wschód	W2
16,790	16,790	p.o.	640	Lasek	W2
17,570	17,570	p.o.	624	Grel	W2
20,950		stacja	602	Nowy Targ	W2os./L118
22,780	21,170	p.o.	610	Nowy Targ Bór	W2tow./L118
24,950	23,270	przystanek	603	Ludźmierz	L118
27,020	25,370	przystanek	644	Rogoźnik	L118
30,050	28,470	p.o.	655	stacja graniczna (wschodni)	L118
31,390	29,770	p.o.	656	stacja graniczna (zachodni)	L118
33,050	31,370	przystanek	670	Czarny Dunajec	L118
39,050	37,370	stacja	742	Podczerwone	L118
41,690	40,070	g.p.	768	granica państwa	L118



19. Size of railway flows on the Slovak railway network



20. Car traffic intensity and speed on Slovak roads

Benefits from the implementation of the investment - passenger transport

The investment should significantly increase the benefit indicator from the construction of the connection Węgrzce Wielkie - Szczyrzyc - Mszana Dolna - Chabówka, increasing the volume of freight traffic on its western branch, and to a lesser extent passenger traffic. Taking into account the assumed parameters of this line on the Rabka Zdrój - Nowy Targ section, passenger trains could cover a distance of 16.3 km in 8 minutes, assuming the tunnel speed of $v=160$ km/h and the improvement of the section of line 99 to at least 120 km/h. This would result in a real shortening of the journey from Rabka to Nowy Targ by 20 minutes, as the assumed travel time of trains on the Chabówka - Nowy Targ route after modernization is 25

minutes, plus a 2-minute stop at the Chabówka station and a minute to cover the last kilometer of line 104 from Rabka to the Chabówka station, which gives a total of 28 minutes. It should be noted that this significantly reduces the assumed travel time on the Kraków Główny Zakopane route - from 1.40 minutes to 1.20 minutes. In this sense, the proposed line complements the "Podłęże - Piekiełko" line, which is in the process of advanced design work.

Benefits from the implementation of the investment - freight transport

This investment is necessary for the launch of any freight transport via Nowy Targ to Slovakia. Freight trains should not be routed to the line through the Sieniawska Pass due to the very unfavorable profile of this line and its low capacity. Launching these transports along the proposed line significantly increases the currently very limited possibilities of rail freight transit to the south of Europe, the Danube Basin, and further to Adriatic ports and the northern (heavily industrialized) part of Italy.

Such an investment would be of paramount importance from the point of view of the turnover and business prospects of the planned PKP intermodal terminal in Kraków. In cooperation with the PKP Group's border terminals in Małaszewicze, Medyka, and the planned terminal in Chełm, the Polish railway could increase its share in the transit of cargo from across the eastern border - including cargo from China, the Danube Basin, and Northern Italy, effectively competing with Hungarian railways. The aforementioned construction of an intermodal terminal should be considered - in the first place, for the transshipment of car semi-trailers in the area south of the rebuilt line 118 and provincial road No. 957. This road would provide good communication with the high-performance Nowy Targ Bypass under construction (a dual carriageway in the GP standard) - to the NOWY TARG ZACHÓD junction from the junction of the Nowy Targ Railway Bypass and line 118, it would be about 5 km. Such a terminal would be designed to reduce the flow of heavy freight traffic on the E77 road to Slovakia.

Benefits from the implementation of the investment - the Slovak side

For years, the Slovak side has had a huge problem with the growing heavy freight traffic along the corridor of the European route E77, on the Polish side running by road No. 7 (ultimately S7) to the border in Chyżne, and on the Slovak side by the road from the former border crossing with Poland in Orawa through Ružomberok to Banská Bystrica.

The continuation of this road leads towards Budapest, which is the economic and industrial center of Hungary, generating large cargo flows. Road 59 on the Ružomberok - Banská Bystrica section runs through the Donovaly pass at an altitude of 950 meters. The village of Donovaly itself is located in the protection zone of the Low Tatras National Park and is a great ski resort, the center of which - Park Snow Donovaly - is probably the largest center of this type in Slovakia. Due to its route in difficult mountainous terrain, the S59 road is suitable only for spot modernization, which slightly improves its operational properties. On the other hand, the construction of a new S or A category road along road 59 would be extremely expensive and, according to the available information, is not currently being considered. Therefore, the aim of the long-term activities of the Slovak government is to radically reduce the traffic of heavy goods vehicles using this road, especially on the section

Ružomberok Donovaly Pass - Banská Bystrica. As a result, the offer of undertaking a joint railway investment with Poland should arouse the interest of Slovak partners.



21. Rabka Zaryte station - view towards Chabowka. The beginning of the planned investment



22. Stop Rabka Zdrój - view towards the east



23. Rabka Zdroj. On the right, the plot at 48 Zakopiańska Street – the area of the tunnel inlet; railway line No. 104 in the distance



24. Rabka Zdroj. On the left, the property at Zakopiańska 48 - the site of the planned entrance to the tunnel



25. The Laski-Pyzówka trail. View from the Lasek side towards the planned exit of the tunnel in the W1 variant. On the left, the place where the line in variant W1 joins line No. 99



26. Lasek village - on the right side behind the village towards the Tatra Mountains, the area of the planned tunnel exit in the W2 variant



27. The area of the Spizgany Las (na pewno?? :P) junction post. On the left, a fragment of the Lasek station in the distance - in front of the buildings of the Lasek village, the area of the tunnel exit in the W2 variant



28. Nowy Targ bypass along DK 47 on the right line No. 99 in the area of the planned Grel branch post

Project history

In the summer of 2007, at a meeting held by Minister Mirosław Chaberek with the participation of Senator Kogut, devoted to accelerating the implementation of the "Podłęże-Piekiełko" investment and improving the flow of rail transport with Slovakia, Krzysztof Celiński, the then president of PKP PLK, proposed to expand this investment in the next stage with a connection from Rabka through Nowy Targ to the border with Slovakia, pointing to the benefits of supplementing the original scope of the "Podłęże-Piekiełko" project. This project returned at the beginning of 2016 to informal meetings at the Railway Institute with the participation of Dr. Andrzej Massel, Krzysztof Celiński, Jan Raczyński, Jarosław Wielopolski (president of Multiconsult Polska, who was then carrying out the feasibility study of the "Podłęże-Piekiełko" connection), and the author of this material. As a result of these meetings, their participants assessed the proposed project as valuable, recognizing that it should be subjected to standard evaluation procedures in the form of pre-project studies.



29. Nowy Targ station, view towards Zakopane



30. bicycle path, so-called Velo Dunajec running along the route of the former line No. 118 in Nowy Targ under the WD-121 structure of the Nowy Targ Bypass



31. Former line 118 in the area of the planned Nowy Targ Bór branch post



32. Former line 118 in the area of the former Nowy Targ Fabryczny stop



33. The railway lane of the former line No. 118 in the Ludźmierz region; view towards Rogoźnik.



34. The area of the former Rogoźnik Podhalański station on line No. 118



35. Former Czarny Dunajec railway station on line 118. View towards Nowy Targ; on the left the former station building



36. Infrared area of the planned bridge over the Czarny Dunajec River and the DW958 road



37. Infrared area of the former Podczerwone-Sycha Hora border crossing. On the left, there is a bicycle path along the route of the former line No. 118



38. The former Infrared border crossing - Sucha Hora - view towards the Slovak side

Summary

An obvious - although far from sufficient - condition for good preparation and implementation of the described concept is the involvement of the Slovak side in it. Participation of other Hungarian, Slovenian, Croatian, and Italian participants is also needed in developing a comprehensive concept of the Rail Adriatica route. Only then will the concept of building the connection Rabka Zdrój - Nowy Targ - Podczerwone - State Border - Trstena - Kralovany be fully mature: embedded in the right - broad perspective, consistent and uniform with the strategy of the emerging Three Seas Initiative, with broadly outlined and fully identified benefits from its implementation. Speaking about the potential profits of the investment, one must not forget about the benefits also for international passenger transport.

It is worth considering including the project in the national transport policy of the state and its implementation in the proposed form. Such a move should precede the launch of formal contacts and cooperation with other countries that are worth involving in the implementation of the project.

In the near future, it is worth considering presenting the concept of the planned route to the Slovak partner, and then, through talks, establishing a common position and further steps and actions. This requires undertaking technical and operational analyses, and then carrying out a preliminary technical and economic study verifying the legitimacy of building a railway line.

Subsequently, based on the knowledge obtained and the results of the aforementioned study, a dialogue should be initiated with the Slovak side in order to identify and agree on the next steps of the project implementation. Only joint action in this matter - proper coordination, guarantees success for the preparation of this project. The crowning achievement of these preparations could be joint actions by the Polish and Slovak parties to develop appropriate feasibility studies, and in the longer term jointly apply for assistance from the European Union for its implementation. Taking into account the assumed very high level of costs of the entire investment, it is necessary to identify and obtain all possible sources of its financing.