

C.III. ASSESSMENT OF EXPECTED IMPACTS OF THE PROPOSED ACTIVITY ON THE ENVIRONMENT, INCLUDING HEALTH AND THEIR ESTIMATED RELEVANCE

Assumed impacts direct, indirect, secondary, cumulative, synergic, short-term, temporary, long-term and permanent, induced during the construction and realisation

A seven-digit scale was used to evaluate impacts of the variants under review of the given aim of the D4 highway in the Ivanka North - Záhorská Bystrica section in the individual chapters. The variants were as part of the issue in the individual chapter assigned a value based on the intensity and nature of the impact on individual characteristics. The applied scale is as follows:

- +5 substantially positive impact**
- +3 positive impact**
- +1 slightly positive impact**
- 0 neutral impact**
- 1 slightly negative impact**
- 3 negative impact**
- 5 substantially negative impact**

A brief summary is provided at the end of each chapter as well as variants listed in a table stating the variant with the smallest impact (first from the top) to the variant with the greatest impact (the first from the bottom) including the value pointing at the level of impact of individual variants.

C.III.1 IMPACTS ON POPULATION

The number of population affected by impacts of the activity under review in the affected townships, health risks, social and economic consequences and implications, disruption of comfort and quality of life, acceptability of the activity for the affected townships, other impacts.

The Dispersion Study (ENVICONSULT, 2010) and the Noise Study (ENVICONSULT, 2010) that are a part of this EIA Report as *Separate Annexes* were used to identify impacts on the population.

Since the aim will have a positive impact on the extensive road network, it is not possible to define the traditional Zero Variant from the aspect of the affected population. The evaluation of impacts of the aim on the population is thus focused mainly on the territory newly affected by the aim in all its variants and the Zero Variant is considered in the area of the individual variants.

The source of disadvantageous impacts on the population is mainly the automobile transport in the aim under review. The main factors of the automobile transport potentially threatening health are following:

1. Noise
2. Air pollution
3. Injuries
4. Psychological influences

Influences in form of vibrations or various types of electromagnetic radiation are not expected. Further factors (impact on water, soil etc.) are negligible from the aspect of influencing the health of the population.

The assessed aim in form of active variants does not cross the residential area, however comes close to the residential built-up area in some sections. The following locations can thus be labelled as potentially affected:

In case of variants 2a, 2b, 7a, 7b a 7c

- 1) **MP Vajnory – eastern edge** – distance approximately 300 m from the aim
- 2) **MP Rača – north-eastern edge** – distance approximately 460 m from the aim
- 3) **Marianka – north-western edge** – distance approximately 200 m from the aim

In case of the SPL variant

- 4) **Viničné – southern edge** – distance approximately 420 m from the aim
- 5) **Slovenský Grob – north-western edge** – distance approximately 430 m from the aim
- 6) **Lozorno – southern edge** – southern edge approximately 560 m from the aim

Noise

Noise is one of the typical and seriously negative environmental factors in developed countries. Disturbing effect of noise has difference consequences during the day and at night.

Increased levels of **day noise** affect mainly the nervous system and psychic of people and can this way contribute also to psychosomatic defects in case of intense effects. Increased levels of day noise lead to:

- a) disturbance interfering with an activity or relaxing (intellectual work, oral communication, sleep etc);
- b) annoyance, i.e. the sense of discomfort, resistance, originating in case of forced perception of noise that the individual has a refusing attitude to;
- c) sense of harassment by unacceptable environmental effect and effect on personal or collective rights;
- d) changes in the social behaviour (respectfulness, willingness to provide help and the ability to cooperate decrease in a noisy environment, and overall irritation and aggressiveness increase).

The subjective feeling of irritation due to noise and harassment by noise is given by the emotional element of perception. Irritation originating in this connection leads to the sense of discomfort to aversion, resulting in deteriorated psychological comfort. Emotional survival is not in principle related with the intensity the noise impulse. The feeling of harassment occurs however more frequently in an environment with higher noise levels.

Direct health impacts start only with higher intensities. The equivalent level of 65 dB at daytime represents the extreme limit for the residential environment of a settlement complex from the aspect of health risks. Positive acoustic climate from the aspect of acoustic comfort for regeneration of work abilities is given in the external environment for the stay of people by the equivalent level lower than **50 to 55 dB**. In case of higher values (during the day and at night), the above-described effect on psychological comfort occurs.

Full protection of sensitive people is ensured not even when following the basic limit of 50 dB. 10 % of persons experience the feeling of irritation due to noise anyway.

Increase level of **night noise** affects the exposed population by interfering with the process of falling asleep and disturbing the quality and length of sleep. The effect depends on the individual sensibility of people that is significantly different. Differences in influences by acoustic stimuli are as high as 25 to 30 dB. Apart from the constitutional specific features, age also applies. With increasing age, the perceptiveness of sleep disturbance significantly increases. A certain protection in the old age is on the other way the decreased auditory

acuity. Significant is also the frequency width of the noise, broadband noise has a more intense effect. Growing noise intensity leads to increased percentage of those affected. On the other hand, sensitivity can decrease in case of some people due to gradual habit.

The level of noise in the bedroom which provably does not change the sleep characteristics is 35-37 dB(A), disturbance starts above this limit.

Due to the reasons of stated knowledge from the literature, we base our further evaluation clearly on the basic limits of equivalent noise levels, i.e. 50 dB during the day and 40 dB at night. The correction enabled by current regulations (Decree No. 549/2007 Coll.) has got a legal importance, not physiological. People are bothered by noise of a certain level independently from the fact if correction was allowed at a given place or not.

Effects on the sense of harassment, annoyance and the levels of disturbance in case of the **day-time noise** are described in the literature. The Dutch institute *TBO Prevention and Health* in Leiden developed polynomic equation of the third order based on epidemiological studies from Europe, Northern America and Australia for the relationship of street noise levels and the occurrence of annoyance due to noise in residents during the day and the level of sleep disturbance at night.

The stated Dutch institute set the lowest equivalent level of street noise in dB(A) based on the epidemiological studies below which no direct health effects were observed. In case of the day-time noise, it is 70 dB for higher blood pressure and 65-70 dB for ischemic heart disease. For the night-time noise, this level for good sleep quality is 40 dB, for good mood on the following day less than 60 dB and for performance on the following day equally less than 60 dB.

The Noise Study (ENVICONSULT, November 2010) served as the basis for the evaluation of the exposition and is contained in the Separate annex to this EIA Report. Detailed information on methods and results of the noise assessment can thus be found in the given *Separate annex*.

Results of the Noise Study suggest that the majority of the area with relevant limits valid was not affected by above-limit noise burden and if it happened in some place, anti-noise measures were proposed.

When applying these measures, nowhere, in no variant are the valid limits exceeded and in most cases the above-stated basic limits are not exceeded either.

Based on the analysis of the Noise Study and further data we can come to the following overall conclusions:

- In case of the *Zero Variant*, noise levels during the day and at night shall reach in the north-east of Bratislava limit values (the municipal part of Vajnory, Rača etc.). Active variants 2a, 2b, 7a, 7b a 7c shall improve this state considerably, the SPL variant in only relatively small level.
- Realisation of the active variants 2a, 2b, 7a, 7b a 7c shall increase the level of noise disturbance in the area around the Šúrsky Channel and in the north-western edge of Marianka. Protected areas can however be protected using anti-noise measures.

Note: A potential objection can be raised against the fact that the noise prognosis was developed for the year 2040, thus a time horizon considerably distant, when a lot of conditions can be changed when compared to the presence. If we consider, that the new road is to serve for dozens or hundreds of years, the state approach is acceptable and other justified objections could to the contrary be raised for prognoses that are short-term and thus very tied to the presence.

Air pollution

The *Dispersion Study* (ENVICONSULT, November 2010) served as the basis for the evaluation of the air pollutants affecting the population and is contained in the *Separate annex*

to this EIA Report. Detailed information on the procedure of the calculation is stated in the given study.

The evaluation of effects on the population is based mainly on the cartographic presentation of emission contributions of individual pollutants.

Emission concentrations of individual pollutants in the evaluated area are probably in the interval of values detected at the Bratislava stations of AMS Mamateyova, Jeséniova, Kammenné námestie Square and Trnavské mýto Square and at the station in Malacky (see Chapter C.II.5). The dispersion of this interval has been summed up in the following table. Due to preliminary caution, the upper limit of the measured concentrations was applied in the evaluation.

Table C.III.1: The interval of emission concentration of pollutants [in $\mu\text{g}\cdot\text{m}^{-3}$] in the nearest stations of the emission monitoring, limits for environmental protection pursuant to the **Decree of the Ministry of Environment and Regional Development of the Slovak Republic No. 360/2010 Coll.**

Pollutant	NO ₂		PM ₁₀		CO	C ₆ H ₆	C ₂₀ H ₁₂
	y	1 hour	y	24 hours	8 hours	y	y
Emission concentrations	16.4-33.1	-	21.4-32.6	16 - 40	1553-2419	1.1 – 1.5	-
Limits	40	200	20	50	10,000	5	-

Abbreviations used:

1 hour Maximum 1-hour average

8 hours Maximum daily 8-hour sliding average

24 hours Maximum 24-hour average

y yearly average

Detailed evaluation of impacts of individual pollutants is as follows:

NITROGEN DIOXIDE (NO₂)

Nitrogen dioxide (NO₂) is one of the most significant and most monitored pollutants of exhaust gas emissions. Combustion engines free nitric oxide (NO) that gradually oxidates to NO₂ due to air oxygen. The mixture of these two gases is labelled by a collective name of nitrogen oxides (NO_x). It is not only a part of the exhaust gases, but also of every combustion emissions. Their more harmful part is NO₂, a gas of a more burning, choking smell. In terms of the odour, it starts to be smelled at a concentration of 200 – 400 $\mu\text{g}\cdot\text{m}^{-3}$.

With the presence of hydrocarbons and ultraviolet radiation (summer smog), nitrogen dioxide is the main source of potential toxic tropospheric ozone as well as nitrate aerosols that are a significant fraction of soft suspended particles in the air (PM_{2,5}).

Effects of higher NO₂ concentrations on the human organism are chronic and acute. In case of long-term breathing in, the lower respiratory tract diseases and their symptoms increase. Acute effects can be seen in case of high dosage already after a short exposure to disadvantageous effects on the respiratory functions and eye irritation.

In many epidemiological studies, NO₂ was used as the indicator of the mixture of pollutants from combustion, mainly from road traffic. Health effects in these studies are then linked to the involvement of other products of combustion, their effects are hard to differentiate from the effects of NO₂, such as suspended particles (especially ultra-soft), nitric oxide or benzene.

In case of long-term breathing of increased concentrations of nitrogen dioxide, asthma sufferers respond the worst. Epidemiological studies suggested that bronchitis signs of asthmatic children increase with the growth of the average annual concentrations of the nitrogen dioxide. Even when annual concentrations of NO₂ are increased as is usual in the air of European and North-American cities, a slow-down in the development of pulmonary functions in children was detected.

Test examinations of the effects of nitrogen dioxide repeatedly confirmed that the health of people is not affected in case of a short-term (two-hour) breathing of concentrations under 1 ppm (1,880 $\mu\text{g}\cdot\text{m}^{-3}$). At concentrations of 3000 – 9000 $\mu\text{g}\cdot\text{m}^{-3}$, changes in pulmonary functions (increase in respiratory resistance) start in healthy persons after 10 – 15 minutes. In case of people suffering from bronchitis, the respiratory functions deteriorate at 3000 $\mu\text{g}\cdot\text{m}^{-3}$ already after 5 minutes. Most sensitive are people suffering from asthma. In their case, laboratory tests at two research institutes confirmed identically changes in respiratory functions after 30 – 110 minute expositions to concentrations of 560 $\mu\text{g}\cdot\text{m}^{-3}$. Other laboratories however did not confirm the effect on asthma sufferers at such low concentrations. In case of healthy persons, some responses of respiratory functions were detected after longer expositions at concentrations exceeding 2,000 $\mu\text{g}\cdot\text{m}^{-3}$.

The referential value of WHO¹ for NO₂ is 40 $\mu\text{g}\cdot\text{m}^{-3}$ for the annual average and 200 $\mu\text{g}\cdot\text{m}^{-3}$ for the hourly average. These concentrations were taken over also to the Decree No. 360/2010 Coll., as limits binding in the Slovak Republic while the stated hourly average must not be exceeded by more than 18 times per calendar year.

Contributions of NO₂ of the reviewed variants are according to the results of the Dispersion Study under limit and based on the detected concentrations of NO₂ (of average annual and hourly) in residential zones along the route of the individual variants, we can state that from the aspect of emissions of the nitrogen dioxide NO₂, the situation around the reviewed aim is acceptable in terms of health and that there is no significant difference between variants 2a, 2b, 7a, 7b and 7c. The SPL variant is evaluated best, but only because this variant is going to be used by almost half of the quantity of cars.

SUSPENDED PARTICLES IN THE AIR (PM₁₀)

Apart from the polluting gases, the air usually contains also suspended particles of various type, size and origin. Their health effects depend mainly on their chemical, physical and biological characteristics. Moreover, their size is also important. Particles exceeding 100 μm get almost completely caught in the upper respiratory tract, do not get into the lower respiratory tract and are thus less significant in terms of health. They do not stay in the air for long but are relatively fast sedimented. With the decreasing size, the period of their maintenance in the air increases as well as the share of particles that enter the lungs. In terms of health, so far the most in the praxis monitored particles have a diameter of up to 10 μm . These are further classified during deeper studies to gross particles with the diameter of from 10 to 2.5 μm and soft particles with the diameter of 2.5 μm and less. They are labelled with the abbreviation "PM" (particulate matter) with the index according to the upper limit of their size, thus as PM₁₀ or PM_{2.5}². These can be either solid substances or drops of liquids. Our often used collective label of "solid pollutants" (SP) is thus not exact.

The PM₁₀ fraction usually contains dust, pollen, spores, fly ashes and particles of plants or insects. They originate especially during mechanical processes, such as construction works and during back whirling of dust by transport means and wind. Considering the measurements using filters, this class contains also the category of smaller, softer particles (PM_{2.5}) including apart from others also secondarily created aerosols (conversions of gas to particles). They originate mostly from combustion processes. They may contain heavy metals, carbon substances, including carcinogenic, nitrates, sulphates and others. Particles from the PM_{2.5} fraction, especially in case of sizes below 1 μm get in 90 and more percents to lung lobes and

¹ WHO – World Health Organization

² Specialised literature sometimes differentiates also between ultra-soft particles with the diameter up to 0.1 μm (PM_{0.1})

affect their walls. The contained pollutants easily permeate into the blood circulation. The $PM_{2.5}$ fraction is thus rightfully considered to be more significant in terms of health than PM_{10} . Measurements in the praxis are however mostly based on filters transmitting up to $10\mu m$, so even limits valid in the Slovak Republic have so far been set only for PM_{10} .

The ratio of gross and soft particles can be varied in various places and locations. Usually the $PM_{2.5}/PM_{10}$ ratio is set at 0.5, in cities of developed countries it is in the interval of 0.5 – 0.8.

Studies focusing on short-term (24-hour) as well as long-term (annual) expositions show a negative effect of suspended air particles on the function and health of the respiratory organs and the cardiac and vascular system. At increased expositions, increased mortality was repeatedly determined, as well as increased number of cases of hospitalisations and further consequences. The differences in the sensitivity to negative effects of the suspended particles are great among people. In general, more sensitive are older people and children as well as patients suffering from respiratory and cardiovascular diseases. Asthma sufferers are especially sensitive.

Great variability of the suspended particles in terms of chemical content and size as well as mentioned great differences in sensitivity of people make the scientifically reasoned setting of limits more complicated. In case of both mentioned fractions, it was not easy to determine the limit of particles of urban type below which nobody was affected. In case of soft particles ($PM_{2.5}$), it is note assumed too much above the concentration of $3 - 5 \mu g.m^{-3}$. It is not assumed that any limit could reliable protect every person from all potential negative health effects. We must try to reduce dustiness to the reachable minimum. Limits if they are stated are rather a convention allowing a small degree of negative effects in case of especially sensitive people.

Contributions of PM_{10} of the reviewed variants are according to the results of the Dispersion Study under limit and based on the detected concentrations of PM_{10} (of average annual and maximum short-term 24-hour) in residential zones along the route of the individual variants, we can state that from the aspect of emissions of the suspended particles PM_{10} , the situation around the reviewed aim is acceptable in terms of health and that there is no significant difference between variants 2a, 2b, 7a, 7b and 7c. The SPL variant is evaluated best, but only because this variant is going to be used by almost half of the quantity of cars.

CARBON MONOXIDE (CO)

Carbon monoxide (CO) originate in case of imperfect combustion and is emitted to the air from the combustion processes and from motor exhaust gases. The toxic effect of CO is conditioned by its tie with the molecules of the blood colorant haemoglobin that is then unable to transfer oxygen to the tissues.

Carbon monoxide is lighter than the air and therefore rises relatively quickly from the ground layer of the air up. From the aspect of human health, it is thus little significant in free air. It is risky especially in closed areas and in traffic tunnels, the areas of customs houses or along frequented crossings of narrow urban streets.

It is a pollutant with acute effects and therefore when it comes to the health, it is crucial to assess the maximum short-term concentrations.

Most sensitive to CO are people suffering from heart diseases (ischemic heart disease, angina pectoris). Their conditions worsens when breathing CO in concentrations of around $30 mg.m^{-3}$ (i.e. $30,000 \mu g.m^{-3}$).

The limit for CO is set in Slovakia by the above-stated decree only as the maximum daily eight-hour sliding average, namely $10 mg.m^{-3}$, i.e. $10\,000 \mu g.m^{-3}$ (identically recommended in the WHO Guideline from 2000). The allowed hourly or yearly values are not set by the Decree. The risk coefficients are not set for CO in the literature.

The stated limit is far from being reached in free air in Slovakia, even in cities, the concentrations are usually in hundreds of $\mu\text{g}\cdot\text{m}^{-3}$.

The emission contributions of the reviewed variants of the aim are deeply under limit and cannot have any relevance in terms of health.

BENZENE (C_6H_6)

Another harmful substance emissions of which are usually monitored in areas of automobile traffic roads is benzene (C_6H_6). It is pure, colourless, volatile and combustible liquid of clear aromatic odour with the boiling point of 80.1°C . It is omnipresent in the environment, occurs at each burning of fuel, and is part of the exhaust gases and in relatively significant quantity it is contained in the tobacco smoke (a smoker smoking 20 cigarettes per day breathes in 10x more benzene than the regular inhabitants of urban air). The motor gasoline contains 0.5 to 2 % of it.

Benzene in high concentrations irritates eyes and skin and in acute dosage it is toxic for the central nervous system. Such concentration can however not occur in the reviewed area. At chronic exposures to high dosage, benzene suppresses the creation of blood cell in the bone marrow. The epidemiological studies of staff exposed for the long-term to increased benzene concentrations (in leather industry and rubber industry) suggest that their long-term breathing in has a cumulative effect and increases the risk of acute myeloid leukaemia. The U.S. Environmental Protection Agency (US EPA) and the International Agency for Research on Cancer (IARC) includes benzene among human carcinogens.

The limit for annual average concentrations of benzene in the air valid in Slovakia is $5 \mu\text{g}\cdot\text{m}^{-3}$, i.e. $5000 \text{ ng}\cdot\text{m}^{-3}$.

Contributions of the C_6H_6 aim according to the Dispersion Study is in all variants deep under the limit in all reviewed locations. We can thus assume that the local background, no matter what its level is, will not be significantly changed by the contributions of active variants. The realisation of the aim in all variants does not have a health importance from this aspect and is well acceptable.

FURTHER HARMFUL SUBSTANCES

Nitrogen oxides, dust particles, carbon oxide, benzene are far from being the one harmful substances in the exhaust gases. Approximately parallel with the NO_2 emissions, numerous other NO_x s, mainly from the group of hydrocarbons.

They however occur in only slight traces and are spread more or less parallel with oxides of nitrogen and other NO_x s. In the described situation we can reasonably assume that their impact will not be risky in terms of health.

The above-stated suggests the following facts:

- Contributions of individual variants to air pollution are in the affected residential area low and reliably under limit in terms of the monitored contaminants;
- Active variants will not negatively affect public health in the reviewed area;
- There is no significant difference between the variants 2a, 2b, 7a, 7b and 7c; The SPL variant is evaluated best, but only because this variant is going to be used by almost half of the quantity of cars.

Further impacts

Among other impacts of automobile traffic on the population is **accident rate** and **psychological impacts**.

The automobile traffic of growing density increases the danger of traffic accidents, especially in cities of frequent transit of pedestrians, movement of cyclists etc. From this aspect, the reviewed active variants are advantageous by being led outside of the residential areas.

Dense car traffic has negative impacts on the **psychic of people**. The reasons is not only the intense, irregular and sudden noise and disturbance of focused activities caused by it, but also further responses to dense ground transport, the smell of exhaust gases, stress when crossing the street in places insufficiently secured, mainly for old people, disabled, mothers with baby carriages and small children etc. This is accompanied by some permanently disturbing worries, e.g. about the safety of individually moving children.

Mental tension and stress impact the emotional side of the human psychic and bring the hormone level out of balance, change functional and metabolic conditions in the organism. This opens the way to interventions of psychological conditions into the area of physical health. *Active variants* will significantly reduce these impacts especially in municipal parts of Vajnory, Rača and other parts of Bratislava. The zero variant, apart from constant increase of these influences in the stated locations, will cause traffic collapse of the main traffic arteries in Bratislava with all the negative implications for the people.

Impacts during construction

The construction will include apart from the highway construction itself also significant volumes of ground work and extensive items of the technical infrastructure in the territory for the freeing of the construction area. It will probably be realised gradually in stages, thus shifting the disturbing influences (mainly dustiness, exhaust gases, noise and increase accident rate) in time in the vicinity of the protected areas. They can be present in places near human dwelling directly from the route of the highway, from the nearby places (construction yards). Factors will be visible more intensely also in places of greater concentration of construction works (e.g. around crossings, road shifts etc.).

A significant advantage is the fact that work will mostly take place sufficiently away from the residential area. A significant disturbing element can also be the transport of soil and construction material using trucks.

Closer characteristic and importance of these impacts can be assessed only in further stages of the project preparation when the work procedure, traffic claims and traffic routes are exactly known. It is necessary to require that these questions are resolved so as to minimise the negative impacts on the inhabitants to an achievable degree.

Psycho-social impacts

In terms of psychology, the road can temporarily disturb in individual locations the comfort of inhabitants during the period of construction.

The disturbance of the psychological comfort by noise in the built-up area of the municipal part Vajnory and other municipals parts of Bratislava shall be mitigated after the realisation of the aim.

In terms of social aspects, the aim will contribute to new job opportunities during the construction. Positive will also be the improved transport accessibility between western and eastern part of Small Carpathians (commuting to work etc.).

Exposed population

Considering the nature and scope of the aim we can state that the aim in variants 2a, 2b, 7a, 7b and 7c will lead to an overall improvement of the environment for the population of

Bratislava in terms of thousands or even ten thousands. The most significant improvement will be in the municipal parts of Vajnory, Rača and in the centres of Stupava and Záhorská Bystrica (in terms of hundreds to thousands). Slight improvement of the environment will also be felt locally in the township of Marianka (in terms of units, no more than dozens).

In case of the SPL variant, the improvement in the above-stated areas and municipal parts will not be so visible, because the SPL variant will not contribute to such significant and positive redistribution of traffic than the variants in the southern corridor.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF IMPACTS ON POPULATION

The realisation of active variants 2a, 2b a 7a, 7b and 7c will lead to reduced negative impacts on the population, not only in the directly affected areas where the variants are routed so as to avoid centres, but mainly in a broader area when the aim contributes to a significant improvement of traffic situation in all of Bratislava, thus improving the living conditions of the inhabitants.

All in all, we can state that there is no significant difference between the variants 2a, 2b, 7a, 7b and 7c. Slightly worse are the variants 2a and 2b thanks to their influence in the municipal part of Rača and variant 7a thanks to the sum of noise burden in the area of the municipal part of Vajnory and the township of Marianka. The SPL variant seems to be the worst of the active variants since it does not have such a positive effect on Bratislava and its area. Maintaining the current state – zero variant is the worst option for the people in the future.

Reviewed variant	Number of points
variant 7b	+1
variant 7c	0
variant 7a	-1
variant 2b	-1
variant 2a	-1
SPL variant	-3
zero variant	-5

C.III.2 IMPACTS ON SURROUNDING ROCK, MINERAL DEPOSITS, GEODYNAMIC PHENOMENA AND GEOMORPHOLOGIC CONDITIONS (GEO-FACTORS)

The construction in the peripheral part of the Danubian Lowland is not expected to impact the rock environment and the ground water level through surface highway solution. When building the excavated tunnel in Vajnory, the construction works and the object of the excavated tunnel will be significantly influenced by the ground water collector – gravel sand

sediments. In hilly sections, the hills of cuts will drain the ground water bound to the basis of deluvial sediments and weathered zone of bedrock.

In the Záhorie part of the reviewed sections, the risk will be the long high level of the ground water in sections of alluvial bottom land of Stupavský potok Creek and its tributaries. Since no significant cuts are expected in the section, but rather mounds and deep placement of bridge objects, we do not expect any negative impact on the ground water regime or impact on the rock massif. The risk of construction can also be the unequal consolidation on watered fluvial sediments with slower consolidation of the sub-base.

The Karpaty tunnel – variant 2a, 2b, 7a, 7b, 7c

For variants 2a, 2b, the tunnel and the adjoining section until the eastern portal has a more significant impact and risks especially in the following sections:

- Cuts in the section led parallel with the foothills of slopes above the state road II/502 due to drainage influence on the highest level of ground water with seasonal oscillation;
- Driving of tunnel in defect zones or in the bedrock or in the Mesozoic and in the zone of thrust line of the bedrock due to drainage effect on the ground water tied to collectors of open, defect zones; More significant representation of these open, dilatant zones is in the section of listric fragments in the eastern part of the massif; In defect zones, with degradation of disintegrated minerals to loam, construction will only impact the stability of clearing and deforming of the massif in the immediate vicinity of the clearing;
- The influence on massif stability in the section with low top-base in the western peripheral part of the driven tunnel including the western portal due to low top-base, geo-technical parameters of rocks (weathered, tectonically damaged layers of Mariathal slates, Neogene gravel and sand soils). More significant impact will be brought about by the variant with prolonging the route towards the west in order to change the slope of the height line – variant of the prolonged tunnel 2b; When prolonging the section of driven, portal sections, it will impact massif deformations near excavation works.

For variants 7a, 7b, 7c the tunnel and the adjoining section around the eastern portal has a more significant impact and risks especially in the following sections:

- Eastern portal from the aspect of stability and deformation of the massif of excavated and driven parts of the tunnel in the more significant zone of weathered granitoid massif;
- From the aspect of stability and deformation of cut in direction zones of defects with massif degradation (sections driven in the zone of direction depressions in the eastern part of the section);
- Conditions of tunnel realisations are similar with the variant 2a, 2b towards the western portal;
- In the area of the western portal, the rock massif will be influenced also in the section of the adjoining part of the western portal due to the necessity of reinstating measures (probably excavation in Neogene, gravel soils), this impact will also be in case of prolonged excavation;
- The excavation in the core of Small Carpathians itself, in the massif of crystalline rocks and rocks of the Borinska facies will not have a more significant impact on the rock environment and ground water;

Karpaty tunnel and Katušina tunnel - variant SPL

From the aspect of impacting the rock environment, the Karpaty tunnel shall have a similar scope of impacts than in previous variants. It is mainly the sections of the eastern portal in the slope above the road II/502 (impact on the stability of the portal excavation, impact on the highest level of ground water);

A more significant impact and deterioration of conditions of realisation will be in the western section of the Karpaty tunnel and the whole section of the Katusina tunnel, including both portals. In this sections, digging in Neogene set of strata is expected, with the prevalence of incoherent gravel, locally sand soils. This type of soil, especially in case of loose locations, represents very difficult geo-technical conditions from the aspect of ensuring stability of the clearing. Clearing will require not only horizontal, but also vertical segmentation using ensured calotte with micro-pilot umbrellas. In sections with the greatest top-base the occurrence of ground water tributaries is expected. In sections at the foothills of slopes, ground water will be drained to the level of erosion basis of valleys. The majority of depressions in the corridor is dry.

To eliminate suffosive effects of water, preliminary drills will be necessary to drain the massif of foregrounds. After draining the accumulated ground water, water tributaries will be only dependant on the regime and intensity of climatic precipitation (technical measures). The impact on stability of clearing expected along the whole length of the Katusina tunnel and in the western section of the Karpaty tunnel will require the application of the system of vertical segmentation or the application of injections when using the NRTM method of tunnelling or with the TBM method the system of continuous placement of reinforcement – close type TBM.

Prior to the construction of the tunnel, we recommend to realise a survey tunnel of a certain specified length in order to verify the optimal technology of tunnelling and ensure the future tunnel.

In sections of tunnelling through rocks of the bedrock and Mesozoic, we do not expect a significant impact on the rock environment.

We can assume that the whole massif of the Small Carpathians will be very unequally damaged and loosened with the occurrence of crushed zones several centimetres to several meters thick which may include even relatively large blocks of little damaged rocks. Even significant over-breakages can be expected when driving the tunnel pipe. Some also with the occurrence of tectonic loam. The average scope of free space in clefts and defects is expected to be several tenth of percentage (n.0.1%) of the total volume of the massif filled to the most part with water.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF IMPACTS ON GEO-FACTORS

All the reviewed variants with the exception of the zero variant represent a relatively significant intervention into the rock environment mainly when building the tunnel parts of individual variants. According to geological and hydro-geological assessments we can state that the SPL variant has got the longest tunnel section construction of which would present the greatest risks and complicated interventions with the rock environment. In variants 2a, 2b, 7a, 7b and 7c passing through the massif of the Small Carpathian mountains, the decisive impact of the tunnel construction is on the part of eastern slopes of the Small Carpathians and the impact of excavation near the prolonged section of the Karpaty tunnel. The variants 2b and 7b also consider the intervention with the sub-base due to the driven tunnel of Vajnory.

Based on all determined facts, from the aspect of impacts of active variants on the rock environment, mineral raw materials, geodynamic phenomena and geo-morphological conditions, variant 7a can be evaluated as the most suitable and the SPL variant as the least suitable variant. The zero variant does not represent any intervention with the environment, therefore the level of its influence is zero.

Reviewed variant	Number of points
zero variant	0
variant 7a	-3
variant 7b	-3
variant 7c	-3
variant 2a	-3
variant 2b	-3
SPL variant	-5

C.III.3. IMPACTS ON CLIMATIC CONDITIONS

When evaluating the possible impacts of the considered options on the climate it is necessary to distinguish between macroclimate, mesoclimate, local climate and microclimate.

Macroclimate we can define as a regime of meteorological phenomena developing and forming under the impact of interactions between the atmosphere and active surface conditional on energy balance of the system, large space circulation as well as the prevailing character of the active surface. Whirls with radius of curvature of several tens of kilometres are typical for macroclimate.

Mesoclimate is influenced by macroclimate or it is the result of the impact of human activity, being measured in cities, on ground-level atmosphere and the result of the impact of local climate within the extent of mesoclimate. Whirls with radius of curvature of several units or tens of kilometres are typical for mesoclimate.

Local climate (topoclimate) is created based on the impact of morphology, the prevailing composition and structure of the biotic and abiotic element of the active surface and based on the impact of microclimate within its extent. Typical for local climate are turbulent flows with radius of curvature of several hundreds of metres.

Microclimate is created based on direct impact of climagenetically similar active surface. Its forming is linked to the energy balance of the system active surface – atmosphere. The horizontal dimension of the microclimate depends on the area of the climagenetically homogeneous active surface.³

With respect to the definitions mentioned here above we can state that neither of the evaluated options can have an impact on the factors conditioning the macroclimate, it means neither the atmosphere itself. In case of a construction of this extent we can theoretically consider its impacts on meso-, topo- and microclimate.

From the climate point of view the considered territory creates an interface between the warm climatic area in lowlands and moderately warm climatic area in the Small Carpathians mountain range. From climatic point of view the closeness of the urban habitat of Bratislava is very important with the heat island phenomenon of the city.

The impact of the heat island of the city is demonstrated by increasing air temperature, increasing relative air humidity, by decreasing number of days with snow, i.e. days with snow cover, by changes in the speed and direction of ground-level airflow, by increased frequency of storms and, at the same time, by increased pollution of the ground layer of the atmosphere.

Each of the considered options will bring a new line element in the territory that is oriented from the east to the west. The highway will create a barrier for ground-level airflow and due to changes of the active surface it will contribute to the decrease of the temperature capacity of the surrounding area. Local temperature changes will happen also on overshadowed locations around the highway.

Within the impacts of the construction of the highway in individual considered options we can exclude the impact on the mesoclimate of the considered area. Change of mesoclimate can be caused later by subsequent development of the territory and mass construction of residential

³ definitions are adjusted according to Prošek, P. – Rein, F., 1979

and industrial complexes around options 2a, 2b, 7a, 7b, 7c and, at the same time, in direction south from the SPL option. The change of the character of the active surface on large areas of the planned construction around the highway will lead to deepening and extending the heat island phenomenon of the city further north.

From microclimate point of view, due to shielding of the construction, it is theoretically possible that the temperature will change, the ventilation of the surroundings of the construction will deteriorate and cold air pockets will be created. At the same time slower melting of snow and subsequent change of snow cover height on the overshadowed areas can be presumed.

The implementation of the plan will not cause change in the total rainfall in the territory, however quick water drainage will happen from the reinforced parts of the highway into the rain water sewer system, what can cause a slight decrease of the amount of water vapour in the atmosphere.

The impact of D4 highway will probably be seen and felt the most severely in case of radiation weather due to poor dispersion of air pollutants and subsequent odour from traffic around the body of the highway itself. From this point of view the most critical shall be the situation at the tunnel outlets where the polluted air from the tunnel will be concentrated. During advective (windy) weather the highway will contribute to the increased roughness of the active surface, what will cause an increased incidence of whirls at the ground-level of the atmosphere and transmission of air pollutants into higher layers of the atmosphere.

During winter months with snow it can be assumed that due to increased incidence of whirls spray drifts will occur on both sides of the highway.

However, we can state that by implementation of one of the considered options of the D4 highway the climate of the considered territory shall be affected only on a minimum level. Neither the macroclimate, nor the mesoclimate will be affected. Impacts on the local climate and microclimate are assumed nearby the newly constructed D4 highway.

PARTIAL COMPARISON OF OPTIONS AND SUMMARY OF THE CLIMATIC IMPACTS

The considered options do not mean a potential for climatic changes based on their features and extent. Only impacts on the microclimate of the nearby surroundings of the highway can be expected in sections which are not tunnels. The development of the Bratislava region connected to the construction of the highway can lead to extension of the heat island phenomenon of the city also to locations which haven't been touched by it so far.

Based on the findings and comparison of the extent of impact of each option on the local microclimate the options 7b, 7c can be considered as the most suitable ones and the option SPL can be considered as the worst one. The zero option does not mean a new interference with the environment, for this reason the impact rate can be considered as zero.

Considered option	Number of points
zero option	0
option 7b	-1
option 7c	-1
option 7a	-1
option 2b	-1
option 2a	-1

option SPL

-1

C.III.4. IMPACTS ON AIR

E.g. amount and concentration of emissions and immissions

This chapter has been worked out based on the results of the dispersion study (ENVICONSULT, 2010) that serves as a basis for evaluation of the impacts on population in Chapter C.III.I.

When evaluating the impacts of the considered options the values of valid immission limits set by the Regulation of the Ministry of Agriculture, Environment and Regional Development No. 360/2010 Coll. Acts in valid wording on protection of health of people were decisive and they are summarized in the table below.

Table C.III.2: Limit values for protection of health of people according to Regulation No.360/2010 Coll.Acts

Pollutant	Averaging period	Limit value	Margin of tolerance
NO ₂	1 hour	200 µg/m ³ shall not be exceeded more than 18-times for the calendar year	none
	calendar year	40 µg/m ³	none
CO	8 hours	10 000 µg/m ³	60 %
PM ₁₀ particles	24 hours	50 µg/m ³ shall not be exceeded more than 35-times for the calendar year	50 %
	calendar year	20 µg/m ³	20 %
Benzene	calendar year	5 µg/m ³	none

For hydrocarbons the regulation indicated above does not set any immission limits. This limit is set only for benzene in the amount of 5 µg/m³, for annual average. Benzene in general is considered as carcinogen, however it constitutes only a negligible component of total hydrocarbons – in motor fuels it is contained in the amount of approx. 1 %. This value was used as the conversion factor of the calculated hydrocarbon concentrations to benzene.

For the calculation of average annual pollutants concentrations in the eastern part of the territory the wind rose from Bratislava – airport weather station was considered, in the western part of the considered territory, behind the Karpaty tunnel, the wind rose from Stupava weather station was used. The data from these stations are for the period of years 1990 - 2009 according to observations of SHMÚ (Slovak Hydrometeorological Institute).

A mathematical model of air pollution – pollutants dispersion - has been drawn up with the purpose to evaluate the immission situation around the considered D4 highway. The model has been worked out based on the methodology of SHMÚ and the Geophysical institute of the Slovak Academy of Sciences (Geofyzikálny ústav SAV), with the help of MODIM IT programme. It is a programme for mathematical modelling of pollutants dispersions – immissions in the air. The mathematical model used in the programme is based on the EPA USA - ISC2 methodology.

The following factors were considered in the mathematical model:

- emission factors
- volume of traffic and its composition based on types of vehicles
- longitudinal gradient of the road
- driving speed of the vehicle
- weather conditions.

The calculation was realized for unfavourable dispersion conditions at low wind speed 0-2 m/s (stability class C, speed class 1).

The traffic regime was selected as rural. The driving speed on highway was considered 100 km/hour. The highway in the calculation was considered as a four-lane communication.

The considered territory was in the individual options divided into sections divided by Karpaty tunnel for the purposes of the calculation, while every section was evaluated separately. The sections were as follows:

- | | |
|--------------------------------|--|
| Options 2a, 2b, 7a, 7b and 7c: | - section Vajnory - Rača |
| | - section Marianka - Stupava |
| Option SPL: | - section Chorvátsky Grob - Pezinok |
| | - section Lozorno. |

Except the D4 highway also the cumulative impact of the traffic on other major roads was evaluated. The following were considered in individual sections:

- | | |
|--------------------------------------|---|
| – section Vajnory - Rača: | D1 highway, roads I/61 and II/502 |
| – section Marianka - Stupava: | road I/2 |
| – section Chorvátsky Grob - Pezinok: | D1 highway, road II/502 and relocation II/502 |
| – section Lozorno: | D2 highway, road I/2 |

Within these sections the relevant sections of communications were considered as mobile sources of air pollution and the relevant portal was considered as a stationary source.

The tunnel itself was evaluated separately. Its outlets were modelled as stationary sources of air pollution.

The emissions from traffic on D4 and other indicated roads in the territory were considered in the calculation, the impact of other stationary and mobile sources within the territory is not taken into consideration. The results processed in the dispersion study thus present the contribution of pollution from car traffic on D4 highway to the indicated major roads.

In the following tables we will compare the results of calculation of maximum concentrations of pollutants for the year 2030 in individual modelled sections with limit values set by the Regulation No. 360/2010 Coll. Acts on air quality. We indicate the comparison of the contribution of D4 highway itself with cumulated status, i.e. with traffic on decisive roads on the territory including D4 highway.

Table C.III.3 : Calculated maximum concentrations of pollutants - section Vajnory - Rača

ZL	Averaging period	Option	Maximum concentration in the immediate vicinity of the road $\mu\text{g}/\text{m}^3$		Limit value from health of people point of view $\mu\text{g}/\text{m}^3$
			D4 highway	Cumulated status	
NO ₂	1 hour	2a	123,5	618,4	200
		2b	123,5	618,4	
		7a	124,0	619,3	
		7b	124,0	619,3	
		7c	124,0	619,3	
NO ₂	calendar year	2a	23,3	120,9	40
		2b	23,3	120,9	
		7a	23,4	120,9	
		7b	23,4	120,9	
		7c	23,4	120,9	

ZL	Averaging period	Option	Maximum concentration in the immediate vicinity of the road $\mu\text{g}/\text{m}^3$		Limit value from health of people point of view $\mu\text{g}/\text{m}^3$
			D4 highway	Cumulated status	
CO	8 hours	2a	58,8	281,6	10 000
		2b	58,8	281,6	
		7a	59,5	282,6	
		7b	59,5	282,6	
		7c	59,5	282,6	
PM ₁₀	calendar year	2a	2,6	13,2	20
		2b	2,6	13,2	
		7a	2,7	13,2	
		7b	2,7	13,2	
		7c	2,7	13,2	
Benzene	calendar year	2a	0,085	0,425	5
		2b	0,085	0,425	
		7a	0,086	0,426	
		7b	0,086	0,426	
		7c	0,086	0,426	

Note: The values highlighted in bold represent the exceeding of the limit values set by regulation.

The results presented in the table and in the graphic models in the dispersion study (Text annex No. 3) show that the decisive air pollution source from car traffic in the monitored area is and will be the D1 highway. In case of unfavourable dispersion conditions considered when working out the calculation the NO₂ threshold is exceeded approx. 3-times in the immediate vicinity of the D1 highway. The short term immission limit 200 $\mu\text{g}/\text{m}^3$ is exceeded up to the distance of 350 – 400 m from the D1 highway.

The limits of other pollutants are not reached, in case of CO and benzene they are tenths up to hundredths of the limit value.

Similarly the limits in the surroundings of the D4 highway itself are not exceeded. The calculated NO₂ values reach approx. 60 % of the limit value in its surroundings, in case of other pollutants we can talk about minor significant influence.

As to the comparison of the options, the differences between individual options in this section are marginal and the options can be considered as equivalent.

Table C.III.4: Calculated maximum concentrations of pollutants - section Marianka - Stupava

ZL	Averaging period	Option	Maximum concentration in the immediate vicinity of the road $\mu\text{g}/\text{m}^3$		Limit value from health of people point of view $\mu\text{g}/\text{m}^3$
			D4 highway	Cumulated status	
NO ₂	1 hour	2a	78,2	188,7	200
		2b	73,6	188,8	
		7a	76,2	194,6	
		7b	75,6	188,8	
		7c	75,6	188,8	
NO ₂	calendar year	2a	15,1	37,6	40
		2b	16,6	37,7	
		7a	13,4	37,9	
		7b	16,6	37,7	
		7c	16,6	37,7	

ZL	Averaging period	Option	Maximum concentration in the immediate vicinity of the road $\mu\text{g}/\text{m}^3$		Limit value from health of people point of view $\mu\text{g}/\text{m}^3$
			D4 highway	Cumulated status	
CO	8 hours	2a	37,5	96,2	10 000
		2b	33,9	96,7	
		7a	36,5	101,6	
		7b	37,4	99,2	
		7c	37,4	99,2	
PM ₁₀	calendar year	2a	1,7	5,1	20
		2b	1,8	5,1	
		7a	1,6	5,2	
		7b	1,9	5,1	
		7c	1,9	5,1	
Benzene	calendar year	2a	0,054	0,162	5
		2b	0,059	0,162	
		7a	0,048	0,164	
		7b	0,019	0,051	
		7c	0,019	0,051	

The results presented in the graphic models in the dispersion study (Text annex No. 3) and in the table show that there are 2 shared air pollution sources in the monitored area – D4 highway and the road I/2. The limit values are not exceeded in this area neither in case of unfavourable dispersion conditions. The NO₂ concentrations are getting the closest to the limit values. From the options comparison point of view the option 7a shows slightly less favourable outcomes.

Table C.III.5: Calculated maximum concentrations of pollutants - section Chorvátsky Grob - Pezinok

ZL	Averaging period	Option	Maximum concentration in the immediate vicinity of the road $\mu\text{g}/\text{m}^3$		Limit value from health of people point of view $\mu\text{g}/\text{m}^3$
			D4 highway	Cumulated status	
NO ₂	1 hour	SPL	38,8	375,9	200
NO ₂	calendar year	SPL	8,6	78,8	40
CO	8 hours	SPL	21,4	169,8	10 000
PM ₁₀	calendar year	SPL	1,1	8,4	20
Benzene	calendar year	SPL	0,036	0,273	5

Note: The values highlighted in bold represent the exceeding of the limit values set by regulation.

Table C.III.6: Calculated maximum concentrations of pollutants - section Lozorno

ZL	Averaging period	Option	Maximum concentration in the immediate vicinity of the road $\mu\text{g}/\text{m}^3$		Limit value from health of people point of view $\mu\text{g}/\text{m}^3$
			D4 highway	Cumulated status	
NO ₂	1 hour	SPL	35,7	305,2	200
NO ₂	calendar year	SPL	7,6	68,6	40
CO	8 hours	SPL	19,8	99,2	10 000
PM ₁₀	calendar year	SPL	1,0	5,3	20
Benzene	calendar year	SPL	0,032	0,177	5

Note: The values highlighted in bold represent the exceeding of the limit values set by regulation.

The distribution of short-term 1 – hour NO₂ concentration shows that the dominant emission source in the section Chorvátsky Grob – Pezinok is the D1 highway and in the section Lozorno it is the D2 highway. The threshold NO₂ concentrations in the surroundings of these roads are in case of unfavourable dispersion conditions exceeded approximately 1,5 up to 2 – times. The impact of the D4 highway itself is relatively small, the NO₂ concentrations from the traffic on it reach max. 20 % of the limits. The other pollutants do not reach the limits.

PARTIAL COMPARISON OF THE OPTIONS AND SUMMARY OF THE IMPACTS ON AIR

The results of the modelled calculations show that during the construction and subsequent management of any of the considered options the emissions will increase in places where the D4 highway will mean a new line source of air pollution. However, by redistributing the traffic the emissions will be reduced on the major roads that have been the busiest so far and particularly on the roads leading through some of the urban areas (city district Vajnory, city district Rača, Stupava, Záhorská Bystrica).

The citizens living in the neighbourhood of the D4 highway route will not be affected by excessive (above limit) immissions from traffic in neither of the considered options including the zero option. The results show that the dominant air pollution sources will be still the D1 and D2 highways in the immediate vicinity of which the limit values will be exceeded further on.

Based on the comparison of individual considered options according to the results of the emission study for the total considered area the options 2a,2b,7a,7b and 7c can be evaluated as the positive options with small differences. The SPL option has a slightly negative impact on the air quality. Although this option avoids any contact with the settlements, it will not help to relieve congestions in the municipalities close to Bratislava neither in Bratislava itself. The zero option can be qualified as the worst one as it keeps the current alarming state on the roads leading through a number of settlements without any change.

Considered option	Number of points
option 2b	+1
option 2a	+1
option 7b	+1
option 7c	+1
option 7a	+1
option SPL	-1
option 0	-3

C.III.5 IMPACTS ON WATER

E.g. quality, regime, discharge, reserves.

Impact on water quality

Water, running from the surface of the road shall comprise numerous contaminants that shall have an impact on the quality of surface water.

It can involve the following contaminating additions:

- Toxic trace elements;

- Oil substances (non-polar extractable substances - NES)
- Residues of spreading materials from winter road maintenance;

The main trace toxic elements source of which is the road transport are mainly lead, cadmium, nickel, chromium and copper. The greatest part of this type of pollution is taken by lead occurrence of which decreases with the growing share of unleaded fuel.

Non-polar extractable substances get into the sink water from the road through leaking of (mainly lubrication oils) onto the surface of the road. The toxicity of these substances is low, their presence in the water however deteriorates its organoleptic characteristics.

The maintenance of roads during the winter period assumes the use of 1 kg of road salt (sodium chloride is most used) per 1 m² of road. This quantity of soil can be reduced by using the technology of salt spray to approximately 70 %. Part of this salt permeates the soil, but the most part will be drained through surface waters. Chloride pervasion into ground water will occur only suddenly in winter periods and in other parts of the year, salts will be gradually washed out by rain water.

In spite of all above-named possibilities of water pollution as a result of the reviewed variants of the D4 highway, we can state already now that while following the standard concept of highway-type road drainage (sewage system, sedimentation and retention tanks, oil substance separators), the pollution of recipients as well as ground water in the reviewed area as a result of the planned D4 highway operation is insignificant.

The influence on ground and surface water when tunnelling of all reviewed variants

The construction of tunnels through the Small Carpathian Mountains assumes zones with ground water inflow. According to the degree of loosening and opening of cracks, breaks, the drainage of rock massif occurs, but only within the reach of the depression curve. The loosening of the Small Carpathian massif is very irregular. The subsidy of water to the tunnel shafts when tunnelling as part of any of the variants will be continuous enough from the intensively weathered surface of the massif to the depth of 1 to 10 m with porosity of more than 30 %, Water from the porous space after its saturation with water runs away softly and supplies the hill-wash springs and crack area also during long periods of drought. In more significant flaws when tunnelling, water can also be drawn from the surface courses and from caught sources mainly under the Saint Hill and from the surface courses, so the richness of the water inflow to tunnelled pipe in the defect zones of the massif can reach even several dozen l per second, especially in the western part of the designed tunnels. Such zones can be expected based on the study and suitably focused research (geo-physical works, drilling works).

Impact on ground water and watering of surface courses can be only assumed in:

- Easter part of the area of the Small Carpathian hills (lightened zone of the massif with an open system of cracks and breaks), in the section inflow into the tunnels is expected, in zones of listric breaks - drainage of the massif;
- In sections with continuous north-west and south-east systems of breaks and accompanying crack systems;
- In the zone of the contact between the bedrock and the cover unit (layer of quartzite and sandstones) as a result of their strong damaging and cracking;
- In the massif of lime stones, the effect on the karst system of ground water, even though no significant karst development is assumed; From potential karst phenomena, we assume only the development of corrosive karst in tectonically damaged zones;
- In group of strata of Neogene sediments by drainage effects of tunnels in central parts of the massif; Peripheral slopes of the massif are drained by erosive basis of valley recipients, if developed; The prevailing part of the valleys are dry;

The SPL variant crosses (16.600 km and 19.400 km) through the zone of hygiene protection of ground water sources of 2nd degree (indistinct) which in case of realisation of this variant means direct threat to ground water reserves under the influence of the tunnel construction.

For more exact evaluation of the development of tunnel structures on the area of the rock massif, we recommend building and operating a monitoring system to assess the 0 condition, natural condition of the hydro-geologic conditions prior to their construction. By monitoring objects during the construction and after the construction, it will be possible to assess the reach and intensity of the effects on hydro-geologic conditions.

The impact on ground and surface water in non-tunnel sections

When building the D4 highway outside of the tunnel sections of the highway, near mounds, bridge objects, foundations of their constructions, pillars or when building shifts of water recipients, no significant changes will occur in the ground water regime. To the contrary, by building new against large water sufficiently dimensioned river beds, more advantageous hydrological conditions will be created.

The alternative construction of the D4 highway in the section with trenched tunnel of Vajnory (section of western edges of fluvial complexes between the crossing of Ivanka North – crossing of Rača) will have a significant impact on ground water, since the natural level in fluvial sediments has a significant seasonal oscillation with the short-term period to the level of the terrain. Building of sunken sections would require high costs of problem-free sealing of objects. The grouting of walls and bottom of trenches of construction ditches and building of long panelling walls would change the natural flow of ground water. Since work would be realised mostly in gravel soils, ensuring stability of excavation all the way under the HPV level would have high requirements. Potential influx of water to the trench would mean a negative change in the geo-technical conditions caused by suffosion of fluvial, incohesive sediments.

In case of realising any of the reviewed variants, it is necessary to realise switches of one or several water courses. In case of realising the variant 2a,2b,7a,7b,7c, it is necessary to change the water course of Strúha in the length of approximately 380 m (it collides with the D4 highway in the 3.000 km to 3.500 km). When realising the variants 7a, 7b and 7c it is necessary to modify not only the Strúha creek, but also the Javorník creek in the place of elevated crossing (EC) Rača in the length of approximately 420 m (will partly needed to be covered). In case of realising the variant 7c, considering the other form of the crossing, modification of the nameless water course in the northern part of the elevated crossing Rača will be necessary. The course coverage in the section of approximately 100 m will be needed.

In case of the SPL variant, switches of courses will be needed in the place of the elevated crossing Pezinok. It involves switches in the length of around 1,950 m on the course of Viničniansky channel, Mahulianka.

The effect on the anti-flood protection of the Municipal Part Vajnory

The area near the municipal part Bratislava– Vajnory as well as its whole cadastre together with the cadastre of the municipal part Bratislava – Rača required considering the hydro-geologic and geo-morphological conditions complex solution of draining and realisation of anti-flood protection in form of channels and collecting or accumulation tanks already in the past.

The situation is currently in fact in a balanced stated in this area considering the hydrological balance. Storm rainfall water is drained within basins using water management measures to

local sewage system. A substantial part of the rainfall water from the built-up part of the Municipal Part of Vajnory naturally soaks into the sub-base.

By the realisation of further residential and industrial construction (CEPIT) together with planned roads and D4 highway, this balanced state will be damaged and rainfall water from roofs, reinforced areas and roads will accumulate. It will not immediately (due to the capacity possibilities of the Šúr channel and especially the Čierna voda channel) be drained from the area or naturally soaked to the sub-base in the remaining not built-up areas.

The solution to the problem of territory drainage became a necessity in connection with the residential construction in Čierna voda. In 2006, the project "Possibilities of draining storm rainfall water from the territory of Čierna voda" was developed dealing also with the area around the municipal part of Vajnory and the D4 highway in our reviewed section of the 2a, 2b, 7a, 7b, 7c variants. The proposed project deals in terms of rainfall water drainage and accumulation near the municipal part of Vajnory with three separate sites and namely the area of CEPIT (business areas with the built-up area of 23.4 ha), the former airport (built-up areas of family houses on an area of 27.8 ha) and new family houses around the municipal part of Vajnory (newly built-up area is estimated at 15.1 ha).

When developing this study, the maximum aggregate amount of continual rain with the periodicity of once in 50 years was considered based on the observations of the Slovak Hydrometeorological Institute in the area of Bratislava, representing 38.2 mm of rainfall in 120 minutes. Calculations of this study suggest that in case of realising all prepared construction projects in the territory, in case of a two-hour rain, the 100-year flow rate in Čierna voda would be exceeded which would lead to negative flood consequences in our studied area near the municipal part of Vajnory.

Thus, if the proposed construction is to be realised it is necessary to build such protective elements prior to the realisation of these projects –including the D4 highway in the section from the crossing Ivanka North to the crossing Rača that would be able to retain a substantial part of rainfall water so that this area is not endangered.

The following measures have been proposed for the three locations near the municipal part of Vajnory:

Construction zone Vajnory - CEPIT

Considering the negative hydrogeological conditions, unsuitable configuration of the terrain, damming of the Račiansky potok Creek, two dry polders are proposed to be created in this area that would correspond with their form to the contour line in the altitude of 130.75 m above sea level. The lowest situated parts in two created polders will need to be deepened by approximately 0.5 m. At an area of 0.49 and 1.47 ha and the average depth of 0.7 m, an accumulation volume of 13,000 m³ will be created. The discharge would be enabled through the damming object of the Vajnorský potok Creek. The capacity of a dry polder can take also water from that part of this area which belongs to the Račiansky potok Creek basin (an aqueduct through the Račiansky potok Creek needs to be built).

The total volume of the storm rainfall from this construction zone is estimated to 9,700 m³, dry polders can hold as many as 13,000 m³. The reserve is thus **3,300 m³**.

Construction zone Vajnory - Airport

Unlike the previous area, this has got advantageous geological and hydrogeological conditions enabling to apply several ways of rainfall water accumulation (soaking of trenches, underground soaking tanks, accumulation sewage network or lake). From the economic and landscape aspect, the best solution seems to be the accumulation lake.

The total volume of the storm rainfall from this construction zone is estimated to 12,200 m³, the accumulation lake would be able to hold as many as 15,000 m³. The reserve is **2,800 m³**.

Construction area Vajnory - township

This construction zone consists of three smaller parts situated in the township's residential area. Storm rainfall from these areas can direct through the Vajnorský potok Creek and a separating object on it to the lake in Lysy with sufficient retention capacity.

The total volume of rainfall water from the newly built-up areas is estimated at 6,600 m³. The accumulation potential of the lake in Lysy is 9,500 m³. The reserve is **2,900 m³**.

In case of realising one of the variants 2a, 2b, 7a, 7b, 7c of the D4 highway, it will be necessary to count in this area with further increase in the volume of storm rainfall abducted from the part of the D4 highway between the elevated crossing Ivanka North and elevated crossing Rača. These volumes are described in detail in the following table:

Table C.III.7: Contributions of considered storm rainfall water to individual recipients

variant	channelled section	recipient	Quantity of storm rainfall water	total
2a	0.500 - 1.500 km	Struha (Čierna voda)	735 m ³	5,039 m ³
	0.500 - 1.500 km	Šúrsky channel	735 m ³	
	1.500 - 2.500 km	Račiansky potok Creek	1,470 m ³	
	2.500 - 4.300 km	Šúrsky channel	2,099 m ³	
2b	0.600 - 2.200 km	Struha (Čierna voda)	1,177 m ³	4,894 m ³
	0.600 - 2.200 km	Šúrsky channel	1,177 m ³	
	2.200 - 4.300 km	Šúrsky channel	2,540 m ³	
7a	0.500 - 1.500 km	Struha (Čierna voda)	735 m ³	5,154 m ³
	0.500 - 1.500 km	Šúrsky channel	735 m ³	
	1.500 - 2.500 km	Račiansky potok Creek	1,470 m ³	
	2.500 - 4.400 km	Šúrsky channel	2,214 m ³	
7b	0.600 - 2.200 km	Struha (Čierna voda)	1,177 m ³	5,008 m ³
	0.600 - 2.200 km	Šúrsky channel	1,177 m ³	
	2.200 - 4.400 km	Šúrsky channel	2,654 m ³	
7c	0.500 - 1.500 km	Struha (Čierna voda)	735 m ³	4,925 m ³
	0.500 - 1.500 km	Šúrsky channel	735 m ³	
	1.500 - 2.500 km	Račiansky potok Creek	1,470 m ³	
	2.500 - 4.200 km	Šúrsky channel	1,985 m ³	

In case of identical meteorological conditions (two-hour rain, 38.2 mm of precipitation) as in case of the above-named planned construction area, the contribution represents approximately 5,000 m³ of water in two hours. This includes a maximum of 1,177 m³ mouthed to the problematic Čierna voda basin through the Struha Creek (Vajnorský potok Creek). The rest of the anticipated storm rainfall water from the highway is mouthed to the Šúrsky channel. The contribution of storm rainfall from the D4 highway to the problematic basin of Čierna voda can be accumulated in the lake in Lysy with sufficient capacity reserve which is closest to the D4 highway section channelled to the Struha Creek.

The above-stated suggests that the remaining approximately 4,000 m³ of water from the D4 highway section between the elevated crossing Ivanka North and elevated crossing of Rača would be drained to the Šúrsky channel. The volume of water flowing from the tunnel tube when driving the Karpaty tunnel must also be added. According to the currently available hydrogeological data about the Small Carpathian massif, in case of the Karpaty tunnel, the volume of water flowing out is expected to be at 20 l per second during the tunnel

construction which represents 144 m³ in two hours. In case of an extreme (ten times the estimated volume of water flowing from the tunnel) discharge from the tunnel, the volume of water from the tunnel would be around 1,500 m³ in two hours.

We can thus state that in case of extreme precipitation in the territory and in case of an extremely large discharge of water from the tunnel, the volume of water that will need to be mouthed to the Šúrsky channel will be around 5,500 m³ of water in two hours. Since the situation in the Šúrsky channel basin is similarly dense (its flow volume is quickly filled) than in case of the Čierna voda channel, the above-stated volume of water could mean in the period of extreme precipitation the threat of flood mainly for the area of the municipal part of Vajnory. The condition can be documented at the situation from 17 May 2010 and 18 May 2010 when the day precipitation exceeded the limit of 35 mm. This led to increased level of the Šúrsky channel exceeding 280 mm and the declaration of the third degree flood activity on the water course.

Based on the above stated we must consider creation of another retention area for water accumulation where a certain volume of water could be retained during extremely high flow volumes in the Šúrsky channel in order to prevent its overflowing from the dam area.

In case of realising the D4 highway in variants 2a,2b,7a,7b,7c, an area will originate between the body of the D4 highway itself (from 2.524 km to 3.600 km) and the right-bank dam of the Šúrsky channel that will be hard to use for other than agricultural purposes and will be able to be used as a dry polder. After small terrain modifications and water management equipment installation, this polder could retain as much as 30,000 m³ of water at a water level of up to 1 m. This measure would eventually completely eliminate the flood risk around the municipal part of Vajnory originated due to the construction and operation of the D4 highway.

When building the D4 highway in one of the 2a,2b,7a,7b,7c variants, part of the lake in Lysy will be taken by an object of the highway near its southern edge. It is thus necessary to preserve its accumulation capacity (or increase it) through potential modifications as an important part of anti-flood measures of the municipal part of Vajnory and the whole Čierna voda basin.

Based on the above stated, we can say that the realisation of the D4 highway in the section between the elevated crossing of Ivanka North and elevated crossing of Rača will not endanger the anti-flood protection of the municipal part in Vajnory or the realisation of the needed anti-flood measures in the reviewed area.

PARTIAL COMPARISON OF THE OPTIONS AND SUMMARY OF THE IMPACTS ON WATER CONDITIONS

All the considered options represent, with the exception of the impacts on the water regime and surface water quality, also significant effects on the hydrological regime of the Small Carpathians mountain range when drilling the Karpaty tunnel as well as effects on the hydrological regime of the groundwater in case of excavated parts of the tunnels.

The zero status represents a situation in the territory of continuously increasing demands for the current road network (increasing risk of traffic accidents occurring), which is not secured in relation to groundwater and surface water protection at all (oil trap, sewer system, retention tanks, etc.). Thus, as time will lapse, the zero option represents a growing risk of water contamination due to any accident or natural drainage of contaminated water from the reinforced part of the road into groundwater or surface water. At the end of the day the zero status represents a high risk of direct water contamination.

Based on the findings the impact on groundwater regime during drilling and excavation of the tunnels can be designated as the most sensitive and the biggest one. For this reason the option 2b represents the worst impact on water conditions and option 7a represents the relatively smallest impact. In case of zero option minimum impact on surface water and groundwater can be qualified.

Considered option	Number of points
zero option	-1
option 7a	-3
option 7c	-3
option 2a	-3
option SPL	-3
option 7b	-5
option 2b	-5

C.III.6. IMPACTS ON LAND

E.g. way of usage, contamination, soil erosion.

According to Act No. 220/2004 Coll. in valid wording all the agricultural land is classified in 9 classes of soil quality according to belonging to VSEU (valuated soil-ecological units). The highest quality soil belongs to the 1st class and the lowest quality soil belongs to the 9th class. The classes one to four are protected according to section 12 of the Act on agricultural land protection and they can be temporarily or permanently used for non-agricultural purposes only in case of necessity, if no alternative solution is possible.

Class 1 to 4 (high quality soil) – those VSEUs that have favourable physical-chemical features and site conditions for effective growing of field crops. They are usually medium hard and light soils and also hard soils, deep to medium deep soils. In the top soil maximum slightly skeletal soils, without significant degree of wetness, without water and wind erosion as well as other limiting elements.

Class 5 to 7 (medium quality soil) – soils with medium land suitability (soil quality). Light, medium skeletal and medium deep soils belong here, shallow soils on loose substrate in dry climatic regions, waterlogged land in wet climatic regions, clayey soils in depression areas, light regosols on blown sands and significantly gley sub-types in deep and lightly skeletal soils in cold climatic region.

Class 8 and 9 (low quality soil) – soils with low land suitability. Soils on more than 12° slopes belong here, shallow, significantly skeletal soils on 7-12° slopes, waterlogged peatlands, saline soils, soils of northern exposition on more than 7° slopes in cold climatic region, soils which are not suitable for agricultural production (on more than 25° slopes, extremely shallow and undeveloped).

Use of agricultural land

In case of temporary land use the soils will be reclaimed and depending on the quality of execution it will have a rather positive effect on the soil. The most significant effect of the planned construction on the soil will be the permanent use, particularly permanent use of the agricultural land, including the vineyard area. The total use of land is demonstrated in Chapter B.I.1.

The total use of land for individual levels of soil quality according to options is represented by the following table:

Table C.III.8: Preliminary assessment of the total use of agricultural land for individual options

soil quality	option 2a		option 2b		option 7a		option 7b		option 7c		option SPL	
	ha	%	ha	%								
high	31,45	36	26,56	34	31,47	40	25,96	37	27,4	44	58,3	68
medium	44,48	51	39,04	51	45,54	58	42,33	61	33,46	54	24,18	28

low	11,80	13	11,8	15	1,6	2	1,6	2	0,9	2	3,74	4
total	87,73	100	77,4	100	78,61	100	69,89	100	61,76	100	86,22	100

Use of forestry land

Industrial forests and special purpose forests are located in the considered area. Prevailing part of the forests is part of Small Carpathians Protected Landscape Area. We do not assume any significant interference to the forestland, neither do we assume any impact on the forest management in the monitored area in relation to the tunnel construction through protected area.

Table C.III.9: Preliminary assessment of forestry land use for individual options

	<i>forestland (ha)</i>	
	<i>special purpose forests</i>	<i>industrial forests</i>
<i>option 2a</i>	1,37	0,00
<i>option 2b</i>	0,00	0,00
<i>option 7a</i>	1,67	0,00
<i>option 7b</i>	1,56	0,00
<i>option 7c</i>	0,00	0,00
<i>option SPL</i>	0,00	3,28

Soil contamination

Any possible dripping of hazardous substances from construction equipment during the term of construction, accidents and immissions caused by traffic of the highway and dispersion of materials poured on the road during winter maintenance of the roads can be the source of direct soil contamination.

On condition that all the standard security measures are kept, the risk of soil contamination during the term of construction and as an effect of accidents can be completely minimized.

The immissions polluting the soil especially with their toxic effects or change of soil reaction lead to indirect soil contamination.

The outcome of study „Evaluation of ecological risk of traffic on D1 highway“ („Zhodnocení ekologického rizika provozu dálnice D1“) that was worked out in the Czech Republic by companies EVERNIA and TOCOEN in 2000 proved surprisingly, based on the results of chemical analysis and biological tests, that cumulating the contaminants from the management of highway does not represent any significant ecological risk for the surrounding ecosystems. It was demonstrated that the soil contamination with matters from traffic decreases by geometric rate with increasing distance from the highway.

A separate element that plays a significant role in soil contamination are inorganic road salts. The content of sodium chloride is the biggest in these mixtures. Its increased concentration is demonstrated by a move of soil pH to alkaline area, as Na⁺ are by sorption tight to soil particles and hydrolysis goes on in the suspension. On contrary, Cl⁻ makes sorption in a far lesser extent, so diffusion in the surroundings happens easier and also migration with the penetrating rain water. The contents of Na⁺ effects also the heavy metals migration that is further decreasing with increased pH.

When traffic on D4 highway starts, the facts explained above will occur during winter maintenance when using chemical road materials.

During realization of construction works in areas of temporary land use the soil will be mechanically downgraded by its compression (compaction) with heavy machinery, the soil structure will be devalued. The impact on the soil structure in the areas of temporary use will depend also on the quality of the executed reclamation after completion of construction.

PARTIAL COMPARISON OF THE OPTIONS AND SUMMARY OF THE IMPACTS ON SOIL

All the considered options, with the exception of the zero option, represent with their extent a significantly large use particularly of agricultural land. The total land use together with its classification is considered as the decisive impact, thus the use of high quality soil, then use of medium quality soil and as the smallest impact the use of low quality soil is evaluated.

The zero state represents a situation in the area when the demands towards the current road network are constantly increasing with all their negative impacts (increasing risk of traffic accidents, congestions). For this reason, as time goes by, the zero option represents an increasing risk of soil contamination due to accidents or possible contamination due to increased immission load on the area during congestions.

Based on all the findings and comparisons of soil use as to the considered options the SPL option is the least suitable and the most suitable option according to set criteria is the 7c option. The zero option represents only a slightly negative impact, as it does not mean a new land use.

Considered option	Number of points
zero option	-1
option 7c	-3
option 7b	-3
option 2b	-3
option 7a	-3
option 2a	-3
option SPL	-5

C.III.7. IMPACTS ON FAUNA, FLORA AND THEIR HABITATS

For example protected, rare, endangered species and their habitats, migratory corridors for animals, health of vegetation and animals, etc.

IMPACTS ON FAUNA AND FLORA

The impact of the construction and operation of D4 Highway on the biotic elements of the environment could be referred to as a synergic influence of a set of civilization stressing factors with different times of duration, intensity and with different consequences from the point of view of space as well as time.

Generally, we can define these impacts on fauna and flora in the following way:

1. During construction of a highway, these events occur
 - during earthwork, the ground is exposed and ruderal and unoriginal species show up
 - interference, elimination or interruption of linear and global biocenosis, close to the nature
 - pollution of watercourses by deposits with influence on water fauna and flora
 - contamination of environmental parts by foreign elements, there is a hazard of oil substances leakage from heavy construction and transportation machinery
 - increase in the levels of noise with a stressing influence on fauna

2. During highway operation, the following events are predominant
 - contamination of environmental elements by pollutants emerging in burning fuel (heavy metal, carbon monoxide, nitrogen oxide, sulphur dioxide, persistent organic pollutants, solid elements and others)
 - local contaminations by a wide spectrum of organic as well as inorganic pollutants, by means of abrasion and abrading of tyres, braking segments as well as the road itself (paints used directly on the road or in its surroundings), gritting material used in winter seasons, car accidents etc.
 - increase in the level of noise around the highway

3. As a result of those events mentioned above the following do or may occur
 - direct elimination of habitats which are more or less environmentally significant
 - creation of an environmental barrier by the body of the highway which limits or prevents migration of life forms
 - direct deaths of animals on the highway
 - increase in the level of noise which leads to limitation of functions close to animal refugium (limits in the possibilities of communication, hunting etc.)
 - changes in environmental conditions in the surrounding environment as well as changes in the species composition of biocenosis
 - endangering significant landscape segments (endangering their functions as sub-protective, microclimatic, homeostatic etc.) which create the frame of environmental stability of the landscape

Impact on fauna

Versions 2a, 2b

Invertebrates - there are several significant insect refugia on the highway route. Already at the head of the MÚK Ivanka North there is a valuable locality in a delimited forest (remains of bottomland forest) in the neighbourhood of a little lake on Lys. This locality represents a highly valuable refugium of receding bottomland forest habitat with occurrences of significant European xylophagous and mycophagous species. The locality will be relatively greatly affected by construction in these versions. A great part of the remaining bottomland forest will be eliminated and a part of the body of water will be taken.

Another important locality for invertebrates are the vineyards on the border of the forest complex and cottage area on 4.500th to 6.000th km. Here, despite the progressive degradation of the habitat, there are thermophilic insect communities bound to the border of the forest as

well as the non-forest part of the landscape. Significant species in Europe, e. g. *Lucanus cervus*, were found here by research. The highway runs across this area by its groove as well as embankment, which leads to extinction of a part of valuable habitats which are in collision with the body of D4 Highway.

The construction of D4 Highway behind the western tunnel Karpaty portal may paradoxically help by creating early successive habitats and by increasing diversification of the invertebrates species as a consequence.

The influence of D4 Highway on invertebrates could be assessed as acceptable due to the fact that there will be no removal of the affected habitats within the assessed area, but only reduction in size.

Hydrobiology – all watercourses within this area are affected by water management modifications in their flat parts. From the natural point of view of watercourse morphology and water purity, the upper parts of watercourses on the slopes of Lesser Carpathians are especially valuable. Interferences with the watercourses will be significant when diverting the watercourse Struha (Vajnorský stream) and constructing at the lake on Lys. After completing the construction work, the hydrofauna will be restored and therefore it is possible to assess this impact as temporary. The risk of endangering the stream bed of watercourses in other parts could be minimised with sensitive realisation of construction work. The risk of influence of diverting waste water from the highway will be eliminated by technical measurements.

The impact of D4 Highway on hydrofauna might be assessed as of little significance due to the time limit of this impact during the construction and to the minimisation of negative impacts during operation.

Amphibians and reptiles – for the species of reptiles, mainly xerothermic localities which are found along the southern slopes and peaks of embankment of the Šúr channel are suitable, and these will not be affected by the construction. Xerothermic localities on the eastern slopes of Lesser Carpathians will be affected by construction in these versions to a relatively large extent, but the newly-created body of the highway will create a new suitable substitutive habitat for reptiles. We can presuppose attacks of the popular locations by reptiles by building a highway behind the western portal of tunnel Karpaty. The new highway will create new suitable xerothermic habitats here as well.

Amphibians especially use the space between embankments of watercourses for their life and migration. These embankments will be affected by the construction, in particular in the area in the north of MČ Vajnory. The construction will also affect the lake on Lys which serves mainly as an area for amphibian reproduction. This function will remain even after the building interference with the water body.

For this species, mainly temporariness of the affected area is important; it should not be limited by the highway construction.

The impact on amphibian and reptile species is expected only to a minimal extent: old habitats will cease to exist and new ones will be created, their migration might be partially limited, but it is important to say that migration will not be made impossible by realisation of suitable measurements.

Mammals – their occurrence is limited by the character of the landscape to species typical for agricultural landscape and species bound to water around Šúr channel, or those staying in NPR Šúr. In the eastern part of the segment along MČ Vajnory, no large habitats of all-day residence of game are found which would be limited or eliminated by the construction of D4 Highway. Due to great mobility of mammals, there is in particular a risk of collision of game and motor vehicles when migrating locally for food. The issue of migration is dealt with independently in a sub-chapter *Impact on migration within the area*.

In this area, there is a common occurrence of several species of bats which live not far away from NPR Šúr. Assessing D4 Highway in these versions does not cross significant migratory bat corridors. Therefore we do not even expect a significant impact on the bat population living in NPR Šúr.

The greatest limitation within the constructions in these versions might be the interference with the border part of the forest complex in the north of Marianka municipality and on the eastern slopes of Lesser Carpathians where game migrate locally, mainly for food. The location behind Marianka municipality will be affected by the construction as well as the loss of permanently camping positions, however, no great loss will be brought about for the game as there are several similar locations nearby.

The impact could be therefore assessed as minimal with the interference only with the border parts of mammal population occurrence, without impact on the accessibility of food sources and possibilities for reproduction.

Birds – by interfering with the location around the lake on Lys, there will be a significant habitat interference with regard to the water birds as well as birds living nearby, and also interference with a habitat suitable for cavity nesters which use the rests of the bottomland forest. By locating the routes in versions 2a, 2b in concourse of watercourses, there will be an interference with the locations of habitats along watercourses and on the borders of fields which are largely used as a nesting habitat as well as food habitat for birds nesting in vicinity of NPR Šúr. The area of the eastern slopes of Lesser Carpathians affected by the route in versions 2a, 2b all the way to the forest complex, is on the same level of significance for birds in the wilderness by its richness, however, there are more similar locations within this area. Therefore we do not expect any negative impacts on species living in these locations.

The significance of the area behind the western portal of tunnel Karpaty for birds was not shown during the research and the richness of this area significantly increases the potential of this location as a nesting habitat. The highway will, in this case, work as a repulsive element decreasing the attractions of this area for nesting birds.

With regard to the outcomes of the all-year biota research, the impact of 2a version, or 2b version, on the quantitative or qualitative composition of fauna in the assessed area could be expected on no more than the level of decreasing the number of individuals of the affected populations, and in many cases this reduction will only be temporary. Extinction of some species is not expected because no unique habitat, where specific species are bound, will be destroyed or damaged, and within the area, there is a sufficient number of other substitutive habitats for the affected fauna species.

Versions 7a, 7b, 7c

Invertebrates - the impact of the construction in these versions is similar to versions 2a, 2b with the difference being only in the parts between Rača crossroads and the eastern portal of Karpaty tunnel. As well as in versions 2a, 2b, the significant location at the lake on Lys will be affected in the same way. The transition of the highway through the vineyards all the way to the eastern portal of Karpaty tunnel is of little significance from the entomology point of view apart from the previous versions, and the impact of the construction and operation of the highway on the insect population is insignificant.

Also in these versions, the construction of D4 Highway behind the western tunnel Karpaty portal may paradoxically help by creating early successive habitats and by increasing diversification and distribution of populations of the invertebrates species as a consequence.

The impact of the invertebrates species could be assessed in a similar way as in versions 2a, 2b. It is important to point out that in versions 7a, 7b, 7c, there is a smaller number of affected valuable locations than in versions 2a, 2b.

Hydrobiology – all watercourses within this area are affected by water management modifications in their flat parts. From the natural point of view of watercourse morphology and water purity, the upper parts of watercourses on the slopes of Lesser Carpathians are especially valuable. Interferences with the watercourses will be significant when diverting the watercourse Struha (Vajnoský stream) and constructing at the lake on Lys. After completing the construction work, the hydrofauna will be restored and therefore it is possible to assess this impact as temporary. Diverting the watercourse Javorník (Račí stream) will be necessary between MÚK Rača and the eastern portal of Karpaty tunnel; there will be an interference with the natural character of this watercourse and a temporary elimination of the organisms bound to this area. The risk of endangering the stream bed of watercourses in other parts could be minimised with sensitive realisation of construction work. The risk of influence of diverting waste water from the highway will be eliminated by technical measurements.

On most affected watercourses, the impact of D4 Highway on hydrofauna might be assessed as of little significance due to the time limit of this impact during the construction and to the minimisation of negative impacts during operation. The impact on the diverted and covered part of the watercourse (Javorník) will be more significant (its length will be known only on the next level of project documentation). Due to the current character of the watercourse and the area around it, it is possible to consider this impact as acceptable.

Amphibians and reptiles – for the species of reptiles, mainly xerothermic localities which are found along the southern slopes and peaks of embankment of the Šúr channel within the assessed area are suitable, and these will not be affected by the construction. Xerothermic locations on the eastern slopes of Lesser Carpathians will be affected by construction in these versions only on the borders of a valley of Javorník stream. We can expect attacks of the popular locations by reptiles by building a D4 Highway behind the western portal of tunnel Karpaty. On the southern slopes of the D4 Highway itself, there will be new xerothermic locations which will replace the ceased xerothermic habitats.

Amphibians especially use the space between embankments of watercourses for their life and migration. These embankments will be affected by the construction, in particular in the area of the reduced watercourses in the north of MČ Vajnory. The construction will also affect the lake on Lys which serves mainly as an area for amphibian reproduction, however this function will remain even after the construction interference with the water body.

For this group of species, mainly temporariness of the affected area is important; it will not be limited by the highway construction in the great part of the area. The change in character of the diverted and covered Javorník stream will represent a change and limitation to the migratory possibilities along this diversion.

On a major part of the area, the impact on amphibian and reptile species is expected only to a minimal extent: old habitats will cease to exist and new ones will be created, their migration might be partially limited, but it is important to say that migration will not be made impossible by realisation of suitable measurements. As a result of diverting and covering the watercourse Javorník, there will be a permanent limitation in occurrence of amphibians and their migration. Due to the current character of the watercourse and the area around it, it is however possible to consider this impact as acceptable.

Mammals – their occurrence is limited by the character of the landscape to species typical for agricultural landscape and species bound to water around Šúr channel, or those staying in NPR Šúr. In the eastern part of the segment along MČ Vajnory, no large habitats of all-day residence of game are found which would be limited or eliminated by the construction of D4

Highway. Due to great mobility of mammals, there is in particular a risk of collision of game and motor vehicles when migrating locally for food. The issue of migration is dealt with independently in a sub-chapter *Impact on migration within the area*.

In this area, there is a common occurrence of several species of bats which live not far away from NPR Šúr. Assessing D4 Highway in these versions does not cross significant migratory bat corridors. Therefore we do not even expect a significant impact on the bat population living in NPR Šúr.

The greatest impact could be the interference with the border part of the forest complex in the north of Marianka municipality. This location will be affected by the construction, however, no great loss will be brought about for the game as there are several similar locations nearby. The impact could be therefore assessed as minimal with the interference only with the border parts of mammal population occurrence, without impact on the accessibility of food sources and possibilities for reproduction.

Birds – by interfering with the location at the lake on Lys, there will be a significant habitat interference with regard to the water birds as well as birds living nearby, and also interference with a habitat suitable for cavity nesters which use the rests of the bottomland forest. By the construction in versions 7a, 7b, 7c in concourse of watercourses, there will be an interference with the locations of habitats along watercourses and on the borders of fields which are largely used as a nesting habitat as well as food habitat for birds nesting in vicinity of NPR Šúr. The area of the eastern slopes of Lesser Carpathians affected by versions 7a, 7b, 7c all the way from road II/502 to the forest complex, is on the same level of significance for birds in the wilderness by its richness, however, there are more similar locations within this area. Therefore we do not presuppose any negative impacts on species living in these locations.

The significance of the area behind the western portal of tunnel Karpaty for birds was not shown during the research and the richness of this area significantly increases the potential of this location as a nesting habitat. D4 Highway would work repulsively in this location for some species of birds and would reduce the attractions of this area for nesting of birds.

With regard to the outcomes of the all-year biota research, the impact of 7a, 7b, or 7c version, on the quantitative or qualitative composition of fauna in the assessed area could be expected on no more than the level of decreasing the number of individuals of the affected populations, and in many cases this reduction will only be temporary. We do not expect extinction of any species. It is noteworthy that the impact on individual species and their habitats is expected to be lower in these versions (as far as the number of affected individuals as well as the scope of impact are concerned) than in versions 2a or 2b.

Version SPL

Invertebrates - the impact of the construction on this species could be expected in the area of Šalaperska hora which is highly significant for insects by its richness as well as its potential of occurrence of rare species. The highway would take a significant portion of the location and there would probably be a change in the use of the whole location as well as extinction of a great part of refugium significant for insects.

A second location significant for insects is the affected segment between the two portals which the highway crosses. The area is rich with regard to habitats and there are species of xylophagous, saproxylic and mycophagous beetles bound to this area. The radical change after construction of D4 Highway would lead to an inevitable reduction in valuable habitats necessary for life of significant species in Europe which have their habitat here.

Other parts of the area affected by a possible construction of the highway do not represent any danger for significant insect species or extinction of valuable habitats for invertebrate species.

With regard to the value of the affected habitats and the size of the interference, especially in the segment between the two portals, we could assess the impact of version SPL on this group of species as relatively significant.

Hydrobiology – the construction in the version SPL will affect the confluence of watercourses on the Pezinok crossroad and also the non-regulated and naturally meandered watercourse in the segment between the two portals, without any pollution. The above mentioned regulated watercourses on the route of the highway are used also as sewers that is why they get highly polluted in the course of the whole year.

By construction of D4 Highway, it will be necessary to divert all watercourses on the Pezinok crossroads, which will practically interfere with 2.5 km of regulated watercourses and limit the possibility of organism occurrence bound to this water environment. With regard to the water quality in these watercourses, the impact will be insignificant. When bridging the watercourse on 23.500th km in version SPL, the construction will interfere with approx. 150m of the most valuable portion of the watercourse with potential consequences for the biota bound in the free environment and in the lower parts of the watercourse all the way to the water dam Lozorno. In the location of the Šúr channel bridging on 10.321th km, it is possible to minimise the risk of damaging the water bed by sensitive realisation of the construction work.

The impact on hydrofauna on the affected watercourses could be assessed as relatively significant, but limited only to the period of construction, therefore a temporary impact. From the scope point of view, the impact of all the assessed active versions is clearly the largest.

Amphibians and reptiles – during the construction, there will be an interference with several locations significant for amphibians which are bound to the watercourses, from the perspective of migration as well as all-year-round occurrence. By building the highway in the SPL version along MÚK Pezinok, the migratory routes along watercourses will be interfered with, and the habitat, inhabited by this group of species all-year-round, will be eliminated relatively to a large extent. When bridging Šúr channel, there will be influence on the amphibian population, especially during the construction, after putting the highway in operation the migration along the channel might start working again, despite the limited conditions. The D4 Highway will be critical in the segment between the two portals where the habitat will be eliminated and migration of amphibians will be limited due to the interference with the natural habitat of the stream. Behind the western portal of Katušiná tunnel, there will be a local impact on amphibian migration, mainly on the spot of the local biocorridor (MBK3, see the graphic attachment 3) between the wetlands, or the local gene pool location, and the nearby forest in the area of Rakytov stream.

With regard to the above mentioned facts, the impact on amphibians could be assessed as significant but temporary, related only to the period of construction.

Xerothermic locations suitable for reptiles and affected by the construction in version SPL are located on Šalaperská hora and on the eastern slopes of Lesser Carpathians (the eastern portal of Karpaty tunnel) as well as between the western portal of Katušiná tunnel and Lozorno crossroads. The construction of the highway will lead to elimination of these locations popular among reptiles. However, the new highway will create a suitable replacement for these posts. The impact on reptiles will be acceptable within the assessed area.

Mammals – in locations in the corridor in version SPL, there are species typical for agricultural landscape and borders of forest complex of the massif of Lesser Carpathians. Due to great mobility of mammals, there is in particular a risk of collision with motor

vehicles. The highway in this version will also affect the camping positions of the all-day occurrence of game, e. g. on Šalapérska hora, a highly valuable in-between-portal segment with the highest numbers of occurrences of game at all, as well as the segment between the western portal of Katušiná tunnel where the mammal populations are concentrated (especially hunting animals) which migrate across D2 highway in the western direction as well as along D2 highway. In the non-tunnel segments, a local migration for food was observed; this will be limited to a large extent by the construction. The impact on the above mentioned species could be assessed as of less significance and acceptable. It is noteworthy that due to the size of the affected area, this is the greatest impact on this group of species of all the assessed active versions.

The issue of migration is dealt with independently in a sub-chapter *Impact on migration within the area*.

Birds – in this version, we can expect a more significant impact on avifauna in the location of Šalapérska hora where there are particularly endangered species of birds bound to extensively used gardens, wastelands and other landscape structures. Another significantly impacted location is the segment between portals where there would be a permanent damage to the forest habitats directly in CHVÚ Lesser Carpathians. This location is specifically significant for cavity nesters. The whole location from the western portal of Katušiná tunnel to the Lozorno crossroads represents a good potential for species which are subjected to protection within CHVÚ Lesser Carpathians. When realising the SPL version, there would be a direct elimination of habitats as well as negative changes in the attractions of this location for birds.

Despite the crossing of SPL version directly through the area of CHVÚ Lesser Carpathians and influence on the significant habitats for local birds, we can assess the impact of this version as of little significance and acceptable due to the fact that the affected habitats are not unique within the area.

With regard to the outcomes of the all-year biota research, the impact of SPL version, on the quantitative or qualitative composition of fauna in the assessed area could be expected on no more than the level of decreasing the number of individuals of the affected populations, and in many cases this reduction will only be temporary. We do not expect extinction of any species.

The impacts of the tunnel output flues in all versions (2a, 2b, 7a, 7b, 7c and SPL) will be acceptable for all groups of species because there will be only a small consumption of the forest vegetation on the venting device and accessibility of all these devices will be secured by using the existing forest roads (with the exception being versions 2a and 2b where it is necessary to build a short final segment anew). The greatest impacts will be during the realisation of the intention, and after building of the device, the impacts on environment and the fauna in the area will be minimal (the device will be noiseless, with emissions emitted above the tree crowns and with maintenance requiring only a minimal frequency of visits).

Also thanks to the existence of a great portion in the tunnel in the individual assessed versions, habitats valuable for fauna in the affected area will be affected only marginally by construction of D4 Highway. The central part of the Lesser Carpathians will be affected only in SPL version in the segment between the portals. Based on the assessment of impacts

on individual groups of fauna in individual assessed versions stated above and on comparing the sizes of affected areas (more or less valuable for the fauna representatives), versions 7b or 7c appear to be the most suitable ones.

Impact on flora

Versions 2a, 2b

The building of D4 Highway in concurrence with Šúr channel in the north of MČ Vajnory goes through the border of a valuable location along the water body of the lake on Lys. This location is significant from the perspective of valuable vegetative species occurrence as well as from the perspective of the value of the habitat. On the embankments of Šúr as well as other regulated channels within the area, an occurrence of valuable vegetative species was observed, e. g. *Botanus umbellatus* and *Thalictrum lucidum*, however, the botanical significance of these locations from the point of view of value of the habitats is insignificant. The eastern slopes of Lesser Carpathians are interesting from the botanical point of view only due to the richness of the habitats, however, without any greater occurrence of significant vegetative species. The D4 Highway construction will not fully endanger or devalue this broad zone of vineyards and the forest border.

The western part of the building in the version behind the portal of Karpaty tunnel goes through the botanically strongly ruderalized area of little significance and with a great occurrence of invasive and non-original species. The border of the valuable forest complex could be defined as more significant in the part of the highway that goes deep in the massif of the Lesser Carpathians nearby the western portal of Karpaty tunnel.

In case of impact on flora in versions 2a, 2b, it is mostly an interference with the common ruderal communities and a marginal interference with the more valuable habitats. Based on the outcomes of the all-year monitoring, it is clear that none of the affected locations shows any signs of botanically extraordinary or more valuable area. Therefore, no greater negative impacts on vegetative communities are expected.

Versions 7a, 7b, 7c

The impact on the botanic part of the biotic component could be compared to previous versions 2a, 2b. Their impact differs only in the segment of the eastern slopes of Lesser Carpathians where the versions 7a, 7b, 7c interfere with a significantly smaller part of rich habitats of terraced vineyards in terms of botany, which leads to narrowing of the construction impact and D4 Highway operation from interference with approx. 1,500m in versions 2a, 2b to approx. 450m. The impacts in other parts of the versions are considered the same with versions 2a, 2b.

Version SPL

One of the most significant botanic locations on the route in SPL version is Šalaperska hora. The value of this location lies especially in its rich habitat components and potential to create a habitat of a good quality in the future as a refugium for many organisms. At present, it is a young habitat being developed in the place of deserted orchards, vineyards and wastelands. Running the highway through this potentially significant location will mean partitioning and extinction of a part of the location. It is noteworthy that the location is not unique within this area, however, it is highly valuable for the structure of the landscape matrix.

For the eastern part of the area in version SPL, strong ruderalized locations of lower value in the field landscape in terms of botany are less typical, and they are simple replaceable by applying of suitable measurements.

A location which is valuable from the perspective of botany is the segment between the two portals; it is not only for the occurrence of the species composition but also from the habitat

perspective as a whole. The construction of the highway will not lead to a large reduction in the habitat area, however, the complexity of the forest vegetation in a wider area and the botanic value of this location will be interfered with.

Running the D4 Highway in the north of the Katusiná tunnel goes through the vicinity of botanically valuable borders of forest complexes of Lesser Carpathians as well as non-forest habitats of little significance which are strongly ruderalized with the dominance of invasive vegetative species.

The impact of SPL version on flora could be defined in a similar way to other versions. It is mostly an interference with ruderal communities of vegetation, with the valuable habitat locations being affected only marginally. Therefore, not even with the realisation of SPL version, no significant negative impacts on vegetative communities affected by this version are expected.

The impacts of the tunnel output flues in all versions (2a, 2b, 7a, 7b, 7c and SPL) will be acceptable for flora in the assessed area because there will be only a small consumption of the forest vegetation on the venting device and accessibility of all these devices will be secured by using the existing forest roads (with the exception being versions 2a and 2b where it is necessary to build a short final segment anew). The greatest impacts will be during the realisation of the intention, and after building of the device, the impacts on environment and the flora in the area will be minimal (the emissions from the tunnel will be emitted above the tree crowns and with maintenance requiring only a minimal frequency of visits).

Thanks to running a great portion inside a tunnel in all the individual versions, no botanically or biologically significant areas on the route of D4 in the segment Ivanka North – Z. Bystrica will be affected in a destructive way. The botanical value of the affected locations lies in particular in their habitat significance as a whole within a strongly anthropical landscape. Based on the completed researches and comparisons in terms of the scope of valuable and less valuable habitats, the most suitable version, from the point of view of impact on flora, seems to be version 7b, or 7c.

Impact on the most ecologically important sites based on results of year-round biota monitoring

Construction of roads would directly liquidate part of valuable sites. The functioning of various environmental components would be disrupted and thus the overall stability of these locations.

In the case of Šalapérska Hora - **Lk I** (Year-round Monitoring Site No. 3), the SPL variant for constructing the D4 Highway would split the site into two parts and reduce the area's heterogeneity, thereby limiting conditions for maintaining current biodiversity. Reducing the diversity of plant communities would automatically lower diversity for the animal species linked to them. However, appropriate measures can partially replace the area that would be occupied by the highway.

The interportal section described in the SPL Variant - **Lk II** (Year-round Monitoring Site No. 5) is a valuable location which would be significantly disrupted by construction. The integrity of the surrounding forest complex would be disrupted and many distortive effects would be added (noise, emissions, invasive plants, highway maintenance) related to construction and operation of the highway. In addition, this site is part of the Malé Karpaty (Little Carpathians) SCI and Malé Karpaty SPA. These protected areas would be adversely impacted by construction and operation.

The ecotone location in the SPL variant south of Lozorno - **Lk III** (Year-round Monitoring Sites No. 6) would be fragmented by construction and its current use would be affected to a

large degree. The newly-built highways would cause increased background noise and the spread of other invasive plant species. The high potential for enhancing the environmental importance of the site would be eliminated, as it would cease to be attractive to birds and other animal species.

The impact on the site at Lysy lake - **Lk IV** (*Year-round Monitoring Site No. 10*) will be relatively significant if the D4 is constructed using Variants 2a, 2b, 7a, 7b and 7c. The lake's water area would be reduced by intervention in its southern part and part of its bank vegetation would be destroyed. Several plant and animal habitats would be directly liquidated and the site's importance as a refuge for eco-stabilising elements in the landscape would be reduced.

The impact on the ecotone site at the border of the forest and vineyards - **Lk V** (*Year-round Monitoring Site No. 13*) will be relatively significant in the case of construction. A broad strip of valuable habitats would be taken where insect species of Community importance are present and there would be an overall reduction in habitat diversity (forest habitats, garden habitats, so-called "runs", vineyards, groves, water flow, riparian vegetation and others). Ultimately, the construction of the highway would mean a reduction in biodiversity at the site and the retreat of different species to similar nearby locations in the vicinity.

Impact on habitats

They will be affected by the implementation of different variants, in addition to common ruderal habitats (X), and also valuable habitats of national and Community importance.

Corridor - Variants 2a, 2b, 7a, 7b, 7c

The following valuable *habitats of national importance* would be stricken: LS2 - Oak-hornbeam forests; K10-tall sedge vegetation, and in the case of Variants 2a and 2b also Tr6-Thermophilous edge communities. *Habitats of Community importance* that would be affected include Ls1 - Floodplain forests; Ls5- Beech and mixed beech forests; Vo2 - Natural eutrophic and mesotrophic slack waters with vegetation of floating and/or submerged vascular plants of type Magnopotamion or Hydrocharition and Br4 - Mountain waterways and ligneous vegetation with grey willow.

The impact on all habitats would be acceptable, in any case the entire habitat would not be liquidated and additionally the status of some habitats can improve with appropriate landscaping.

Corridor - SPL Variants

Affected would be *habitats of national importance*: Ls2 - oak-hornbeam forests, Ls6- Natural dry pine and mixed pine forests, Kr9- Willow shrubs on flooded river banks and *habitats of Community importance*: Ls5 Beech and mixed beech forests and Lk1-Lowland and submountain hay meadows.

The impact on most habitats would be acceptable. In any case the entire habitat would not be liquidated, although mitigation of adverse effects cannot always be achieved with appropriate landscaping. Especially at Site 5 (interportal section).

When comparing the different variants in terms of diversity and quality of the affected habitats, Variants 2a and 2b are comparable with each other and at the same level, while Variants 7a, 7b and 7c are the most negative in terms of impact on habitats.

Impact on migration in the area

This section aims to evaluate the barrier effect of the road based on how it is routed on the terrain, design categories and bridge dimensions. The assessment refers to individual animal groups whose migration or occurrence has been detected in the area.

In order to trace migration in the area, the animals are divided into categories (species expected or observed at the site) with similar claims to environmental quality, capacity of the landscape for migration and parameters of migrating animals.

Overall of animal categories:

- A - red deer, lynx, brown bear, grey wolf, European moose, wildcat
- B - roe deer, wild boar, fallow deer, mouflon
- C - red fox, badger, hare, small polecat, beaver, otter
- D - amphibians and reptiles
- E - fish and other aquatic animals
- F - birds and bats
- G - communities of invertebrates and small vertebrates at specific habitats (wetlands, steppes, peat bogs xerothermic habitats and the like)

Variant Senec - Pezinok - Lozorno

Km	Technical Solution for Structure	Cat.	Impact
0.0 - 1.5	0.0 - 0.75 embankment 0.750 - 1.5 notch, section with no bridges	(A), B, C, D, F, G	distorts local and regional migratory routes, highway would divide habitat
1.5 - 5.0	km 1.5 - 2.0 at about ground level; 2.0 to 3.5 embankment; 3.5 to 4.0 notch; 4.0 to 4.75 embankment; 4.75 to 5.0 at about ground level; 2.675 km bridge at dirt road relocation	(A), B, C, D	restricts free movement of animals, fragments landscape
6.5 - 7.5	highway grade is at ground level, Pezinok interchange located here	B, C, D!, F	liquidates habitats along the water channel, interchange distorts local migration routes
10.3	highway grade is situated here on embankment, viaduct over the waterway, a railway line and Route II/502	C, D, F	distorts regional migratory route along the waterway, liquidates nearby stand
10.7	highway grade in notch, eastern portal of Carpathian tunnel	B, C, D, G	distorts local migratory routes (between forest and vineyards), highway would divide habitat
22.5 - 24.0	highway grade on embankment, interportal section between Carpathian tunnel and Katusiná	A, B, C	tunnel portals, bridge pillars and flyover would liquidate habitat - limits natural migratory routes, critical meeting point of animal species; construction and operation would distort inner forest environment
25.0 - 26.5	highway grade at either ground level or on a low embankment	A, B, C	restricts free movement of animals, fragments landscape
26.5 - 27.0	highway grade on low embankment, bridge across D4 at relocated II/502 at km 27.068	B, C, D, F	restricts free movement of animals, fragments landscape

27.5	highway grade on an embankment continuing on a bridge over Highway D2, bridge crossing the D2 at relocated I/2 approx. km 28.000; passage below D2 approx. at level of small forest	B, C	restricts free movement of animals, fragments landscape
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Variant 7a,7b,7c

Km	Technical Solution for Structure	Cat.	Impact
0.25 – 3.5	in Variants 7a, 7c, highway grade is on an embankment, in Variant 7b, an overlapping tunnel at km 0.900 to 1.600 there is a bridge over the Struha stream situated at km 0.480 and another bridge over the Račiansky potok stream at km 2.520	C, D, F	indirect impact by operations due to distortions (noise, emissions, light) to the Šúr Canal (Šúrský kanál) biocorridor, limits local migratory route at waterway crossings
3.7 - 4.0	highway grade on embankment, rising above railway, km 2.520 a bridge over a branch of the Rača interchange and Rači potok stream	C, D, F	indirect impact by operations due to distortions (noise, emissions, light) to Šúr Canal (Šúrský kanál) biocorridor, limits local migratory route
4.0 - 4.7	highway located partially on an embankment, partially in a notch past the Carpathian tunnel portal	B, C, D, (E), G	intervenes directly, liquidates ecotone site and central part of Rači potok, at present a non-functioning water migratory route (level to stream, canalisation shaft below route II/502)
14.0 - 16.5	Carpathian tunnel opens in Variants 2a, 2b, 7a, 7b and 7c and afterward the highway grade is predominately on an embankment; bridge through a relocated meadow road at km 15.775	B, C, D	restricts free movement of animals, fragments landscape

Variant 2a,2b

Km	Technical Solution for Structure	Cat.	Impact
4.0 - 6.5	highway located partially in a notch and partially on an embankment past the Carpathian tunnel's east portal	B, C, D, G	distorts local migratory routes to food sources (between forest and vineyards), highway would divide habitat

Note: other sites that Variant 2a, 2b crosses are included in sites mentioned in Variants 7a, 7b, 7c

Explanatory notes:

(A) - animal category only estimated for the section under consideration and has not been confirmed

D! - animal category is the most abundant at the section under consideration and the intention will have the greatest impact on it

SUMMARY OF IMPACTS ON AREA MIGRATION

The corridor for **Variants 2a, 2b, 7a, 7b and 7c**, (except the tunnel section, which is not problematic in terms of migration) runs closer to urbanised landscape and the distortion of migratory routes is not significant, it mainly concerns migration of a local scope to food depending on the season and condition of the countryside (e.g. type of agricultural crops grown). The local animal population (mainly Cat. B - roe deer, wild boar, fallow deer, mouflon and C - fox, badger, polecat, beaver, otter) have adapted themselves to live near humans, are able to quickly adapt to a new condition in the landscape and can change their existing migration habits.

The corridor for the **SPL Variant** runs northward from Bratislava through a less disturbed area, so the adverse impact on animal migration and further fragmentation of the area is greater. The eastern part not tunnelled would cause complete isolation of the space between Highway D1, unbroken built-up Bratislava and the almost unbroken built-up area along Route II/502 between Rača and Pezinok. The western part not tunnelled of the variant would distort migratory routes of animals between the forest and a half-cultivated landscape, where they migrate to food.

The barrier effect and adverse effect on the migratory routes of animals can be mitigated by appropriately modifying bridges to allow migration of selected animal groups, possibly by constructing special migration underpasses (culverts for small animals, construction of special migration structures - underpasses (culverts for small animals, passages for frogs and otters).

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF BIOTA IMPACTS

To evaluate and compare the impact of the assessed alternatives on animals, plants and their habitats, a year-long survey of biotas was prepared for the area covering all variants considered. The site of the one-year survey conducted at the routes of each variant showed varying quality in each individual sub-communities, based on which a value was determined for them and subsequently the value of the entire corridor for all individual variants.

The above facts imply biodiversity would not be impacted by completion of any of the considered variants and at most we can consider a decline in the number of some species in the area, of which most would recover after construction is completed to the original quantitative status of the species. The area has appropriate substitute habitats for all affected species where all affected animal and plant species can be preserved.

Based on the above partial evaluations, the variant evaluated with the greatest impact on the biota would be the SPL Variant, which intervenes in the most valuable part of the area under observation, while Variants 7b and 7c can be evaluated as having the least impact. The baseline variant does not present any new intervention in the existing state of biota, although despite its impact we evaluate it as slightly negative due to the increasing risk of conflicts between animals and growing traffic on the current road network (migration barrier).

Variants considered	Number of points
Baseline variant	-1
Variant 7b	-1
Variant 7c	-1
Variant 7a	-1
Variant 2b	-1
Variant 2a	-1
SPL Variant	-3

C.III.8. IMPACT ON LANDSCAPE

Structure and land use, land image

The proposed D4 highway passes through the Danubian Lowland, a flat landscape with a slightly rugged to slightly undulating relief through the core Little Carpathian mountain range created by a domed horst until the flat relief of the Záhorská lowland is reached with its sharply rising highlands.

Starting at the D4-D1 interchange, the overlapping routes in Variants 2a, 2b, 7a, 7b and 7c run through flat terrain near the urbanised Vajnory district, through intensively farmed meadows. The D4 Highway then runs practically to the linear Šúr Canal with a view toward the city neighbourhood of Vajnory. The highway is situated in front of the canal, limiting its visibility from the countryside. There would be no significant impact on any long-distance view of the landscape in the Vajnory neighborhood since the highway would be obscured by the Šúr Canal, which creates a visual barrier in the area and no perception of a new element in the landscape would be created. The highway would cause the most pronounced impact on views from the hillside vineyards above Rača and from locations situated higher, below the forest line the corridor lanes will be able to be perceived. In the case of Variants 2a and 2b, remote views would be impacted because the vineyards at the foot of the slopes would be removed along the wider corridor of the highway and the remaining vineyard landscape would be disturbed. Variants 2a and 2b will cause a significant impact on the countryside and interfere with the typical features of the landscape. The least impact on the landscape will come from Variant 7c, which would run above ground level in the Vajnory neighbourhood, with direct access to the Little Carpathians massif and minimal encroachment on vineyard growth.

The Rača interchange will interfere significantly with the scenery in Variants 2a, 2b, 7a, 7b and 7c. A negative factor is caused by its incompatibility with the surrounding area (distorting the harmony of the landscape) because significant visual disturbance would be caused by the large amount of land taken.

At Marianka, highway variants 2a, 2b, 7a, 7b and 7c run from the western slope of the Little Carpathians eastward toward Záhorská Bystrica. In the cadastral district of Marianka, the route runs behind a rounded peak separating the built-up area from the highway corridor. In terms of impact, Variant 2 will markedly intervene in the landscape at the western portal opening due to disruption of stands skirting the edge of the forest, the largest intervention into forest cover and its routing directly on the surface. The least impact in terms of assessing the landscape will come from Variant 7, where the highway is recessed and covered from the western portal. In long-distance views, Variant 7c will be hidden and will be incorporated the most appropriately into the landscape. The variant will be reflected in close-up views only from an immediately close distance.

In the case of the SPL variant, the impact is the most significant of all the considered variants, due to being the longest D4 variant, taking the most agricultural land compromising the concept of intensively farmed land in the area east of the Little Carpathians, the tunnel portals opening in forest growth, disrupting forest unit homogeneity and disturbing the landscape of the cadastral district of Lozorno, where the portal opens at the foot of the Little Carpathians massif, distorts the harmony of the landscape and will disturb the image of the landscape both in both long distance and close up views.

Impact of construction on the vineyards, changes in the vineyard landscape

The vineyard region is linked to the historical development of the country. It has a specific, irreplaceable character, so it is necessary to meaningfully conserve its appearance and take steps to avoid any intervention that liquidates it. In this respect, the landscape through which Variants 2a, 2b, 7a, 7b, 7c and part of the SPL Variant will run is unique. The landscape unit in which the variants run is incorporated into the Little Carpathians SCI, which was declared as a large-scale protected area with a vineyard character. The landscape mosaic of the area that marks the border of an urban environment and forest cover is composed of typical small-scale vineyard structures that merge at the foothills of the Little Carpathians into units of deciduous forests. In Variants 7a, 7b, 7c, the impact can be said to be in the smallest scope in terms of intervention into the vineyard area due to its direct route and the shortest possible route of all the variants along the surface.

Implementation of Variants 2a and 2b would fundamentally disrupt the area and intervene into specific symbols, forming a peculiar landscape in the neighbourhoods of Rača and Vajnory. The variants traverse current vineyards and as a consequence their completion would eliminate up to one-third of total vegetation. Such encroachment into an area vulnerable in terms of view, where vineyards are visible above the built-up part of Rača, means the loss of one of its symbolic features.

At Marianka, the representative features are reflected to a great degree by the natural character created by the vineyards and it would not significantly intervene directly into these parts of the landscape because the D4 would run on flat terrain after it exits the tunnel, outside of the exposed landscape views. In the case of Variant 2b, 7b and 7c, which are recessed and partially covered, any adverse visual impact is eliminated. The least intervention is in Variant 7c, with an extended tunnel and recessed past the village of Marianka.

In the cadastral district of Lozorno, there is no direct impact on the vineyards, but there would be an indirectly visually adverse impact on the harmony of the landscape in both long-distance and close-up views from the countryside. Partially liquidated valuable areas at the exit from the western tunnel would be directly impacted and direct effects would be visible. This intervention would negatively affect the overall layout of the landscape.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF LANDSCAPE IMPACTS

Impacts on the landscape were assessed comprehensively as required by law, using the new Ministry of Environment methodology for assessing impact on the characteristic appearance of the countryside. All variants pass across flat or slightly rugged areas that are divided by the ridge of the Little Carpathians. This massif is overcome in all variants by long tunnels. The landscape and its structure and image are impacted mainly in flat areas due to interchanges and at spaces where the tunnel portals are located. This is most noticeable in the SPL Variant, which does not correspond to the structure of the landscape and in the area of Pezinok and Lozorno disrupts the harmony of the landscape.

Variants 2a and 2b (both excluding the section between the Rača interchange and the eastern Carpathian tunnel portal) and Variants 7a, 7b and 7c on the other hand are appropriately incorporated into the landscape, respect its current lines and harmony and are mainly recessed, and these variants are a suitable solution. In particular, the recessed grade is sensitively incorporated into the landscape in Variants 7b and 7c at the western side of the Little Carpathians. In terms of intervention into the landscape, the recessed grade at Vajnory (2b and 7b) has insofar much positive impact because the Čierna Voda interchange and collector roads along the highway assert themselves into the landscape scenery along with the noise barrier (see Annex 9 - Visualisation).

The vineyard character is affected by all the variants, but the most marked would be the intervention by Variants 2a and 2b, which run along the eastern slopes of the Little Carpathians. It would significantly intervene into the vineyards themselves.

In terms of comparing the different options and their impact on the landscape, the landscape image, the characteristic appearance of the landscape and the vineyard character of the area, the worst for the considered Highway D4 would be the SPL Variant, then Variants 2a and 2b are at a comparable level, then Variants 7a and 7b, and the best in terms of full impact on the countryside would be Variant 7c

Variants considered	Number of points
Baseline variant	0
Variant 7c	-1
Variant 7b	-1
Variant 7a	-1
Variant 2b	-3
Variant 2a	-3
SPL Variant	-3

C.III.9. IMPACTS ON PROTECTED AREAS AND THEIR PROTECTIVE ZONES

E.g. proposed protected bird areas, areas of European importance NATURA 2000 National Parks, Protected Land Areas, protected water management areas.

All the assessed variants, to a varying degree, affect the **Small Carpathians PLA** (Level II of protection). Their main contact with this protected area is solved by placing the route into a tunnel, so the negative impact of the highway on the territory is minimized. In the case of Variants 2a, 2b, 7a, 7b, 7c, this consists of one long tunnel through the entire territory of the PLA touching only the peripheral border zones of the protected area. Structurally, these variants also consider the construction of one tunnel air outlet, which will exit in the central part of the PLA. The construction and operation of the air outlet will have a minimal impact on the surrounding flora and fauna, will not interfere with any valuable habitats and will have no bearing on the subject of protection of the PLA.

In the case of the SPL variant, there is envisaged the construction of two tunnels, which means the highway directly crossing an area of about 600m of the protected area, which ultimately means destroying the integrity of the PLA by directly taking part of its land, deforestation, adjusting water flows and modification of the forest roads in the area. It also leads to affecting the peripheral border zones at the western portal of the Katušiná tunnel.

There is peripheral contact with **NPR Šúr**, or rather its protective zone (Level IV of protection) under variants 2a, 2b, 7a, 7b, 7c, namely by the Ivanka North junction (a small stretch alongside the western edge of the D1 Highway, to the north of the junction). At the point of contact and the main route of the D4 by NPR Šúr towards MÚK Rača does not result in direct contact or significant adverse effects on this protected area or its buffer zone because its connection with the territory is only marginal (these are mostly agricultural areas). The rare central part of the reservation will not be affected and there will be no taking of habitats of the

rare wetland ecosystems. Effects on the water regime of this site are not expected. The noise impact of traffic on the D4 highway will be partially lessened by noise barriers and partly by the proposed concrete barrier at a height of 1.2 metres along the entire length of the D4 highway by NPR Šúr.

The other small protected areas located in the assessed area, NR (natural reservation) **Jurské lake, NR Pod Pajštúnom, NR Strmina, NR Zlatá Spring, PLA Svätojurské hradisko and Limbašská vyvieracia**, will not be impact by any of the assessed variants either directly (felling of trees, takes up space, etc.) or indirectly (effects of air pollution, noise, etc.). Their protective zones will also not be affected.

There is a minimal effect on protected areas due to routing with options 7b, 7c. On the eastern side the portal is located outside the protected land area, as is the case with the western side. The worst solution is the SPL variant, which impacts the central part of the Small Carpathians PLA for a section of 600m.

In the assessed area, within the network of protected areas NATURA 2000 there is the Small Carpathians protected bird area, the Homolské Karpaty Area of European Importance and the Šúr Area of European Importance. The most serious impacts of the different variants on these protected areas are again solved by placing the route into the tunnel or the sufficient distance of the routes of individual variants from those territories. Variants 2a, 2b, 7a, 7b, 7c extend into the peripheral border of the Small Carpathians Protected Bird Area, due to the location of the tunnel air outlet for these variants. Variant SPL, in it's between portal section, destroys the integrity of the central part of the Small Carpathians PBA. The tunnel vents are located in the Small Carpathians PBA and Homolské Carpathians AEI. Šúr AEI is not directly impacted by any of the assessed alternatives.

The effect on the protected areas of the **NATURA 2000 system (SKCHVU014 Small Carpathians, SKUEV0104 Homol'ské Carpathians, SKUEV0279 Šúr, SKUEV0388 Vydrica, SKUEV0089 Martinský les)** is developed in Text Appendix 4, from where the conclusions considered in comparing and evaluating the impact of variants are also taken.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF IMPACTS ON PROTECTED AREAS AND THEIR PROTECTIVE ZONES

All variants under consideration with the exception of the null variant have a direct marginal impact on protected areas registered in the assessed area. The null variant affects the protected areas only indirectly. The worst impact is from the SPL variant, which directly affects the central part of a protected area of Slovak and European importance, which speaks strongly against it. In the area there are several small protected areas, which are not directly affected by any of the variants.

Based on all of the findings in terms of possible effects of the active variants of the protected areas and their buffer zones we evaluate most favourably variants 7b, 7c, and as the worst variant we can classify variant SPL.

Assessed variant	Number of points
null variant	-1
variant 7b	-1
variant 7c	-1
variant 7a	-1
variant 2b	-1

variant 2a	-1
variant SPL	-5

C.III.10. IMPACTS ON TERRITORIAL SYSTEM OF ECOLOGICAL STABILITY

The plan of D4 highway construction in all assessed variants is a new line element in the territory that comes into conflict with a number of elements of the ecological stability territorial system /TSES/. In all considered variants the tunnel line through the Little Carpathians mountain range reduces the degree of impact on the number of contacts with TSES elements.

The impact on the territorial system of ecological stability will be the same in case of 2a, 2b variants implementation. The same impact will be on TSES when comparing variants 7a, 7b, 7c. The impact on TSES in the SPL variant will be described separately.

To assess the degree of TSES elements distortion, the following scale was used:

1 – marginal impact, the plan passes close to or marginally affects the TSES individual elements, or crosses a valley on a capacitive bridge structure, through which valley a bio corridor is led. The functionality of such affected elements is not limited.

2 – moderate impact, it is relatively simple to change the layout/route of affected TSES elements or design them in a close and functional form with a partially limited function. The continuity of TSES elements is retained.

3 – strong impact, the affected TSES elements will lose their function and it is difficult to replace them. In case of crossed bio-corridors it will be difficult to ensure their continuity.

The concurrences/clashes of individual variants in the D4 highway in the section Ivanka north - Záhorská Bystrica with individual TSES elements are summarized in the following tables.

Table C.III.10: Concurrences of variants 2a, 2b with TSES elements

<i>km</i>	<i>cadastre</i>	<i>name</i>	<i>nature of concurrence/range of distortion</i>
MÚK Ivanka north	Ivanka pri Dunaji	NRBK-H 23	crossing/ 1
MÚK Ivanka north	Ivanka pri Dunaji	RBK Šúrský channel	crossing / 1
MÚK Ivanka north	Chorvátsky Grob	NRBC 116 Šúr	interference with edge/ 1
0,484	Svätý Jur	RBK Struha creek	crossing / 2
0,500	Svätý Jur	MBC Háj	interference with marginal part/ 2
MÚK Čierna voda	Svätý Jur	RBK Šúrský channel	contact/ 1
2,400 – 2,900	Svätý Jur, MČ Vajnory	RBK Struha creek	relocation of creek/ 2
2,524	Svätý Jur	RBK Račiansky creek with tributaries	crossing / 2
3,366	Svätý Jur	RBK Šúrský channel	crossing / 1
6,100	MČ Vajnory	RBK Ecotone bio-corridor	crossing / 2
8,680 – 10,200	MČ Rača/Záhorská Bystrica I	NRBK-T 82	route in tunnel
10,080	MČ Rača	RBK Vydrica with tributaries	route in tunnel
13,210 – 13,535	Marianka	MBC Nad kameňolomom	route in tunnel
MÚK Záhorská Bystrica – relocation/shifting I/2	Záhorská Bystrica I	RBK Stará Mláka	crossing/ 1

In case of variants **2a** and **2b** and when building interchanges, also the elements of supra-regional TSES will be partially marginally affected, the interference with these elements does not jeopardize their integrity or functionality.

The clash with a local bio-centre Háj may be considered most significant, in case of D4 highway construction in these variants, the direct interference with the bio-centre will occur, and its revitalization for recovering its actual function will be required. Also the bio-corridor of Struha flow (Vajnorský creek) will be significantly affected, it will be once crossed, and on the section of approximately 380 m its relocation will be required, which for a long time will limit its functionality of regional bio-corridor (especially during the highway construction).

Crossing with the bio-corridor of Račiansky creek will mean a temporary limitation of the functionality during the construction and permanent restriction of transit for deer due to the insufficient underpass height of bridge over the creek.

The tunnel air outlet on the Karpaty tunnel is located on the route of supra-regional bio-corridor, passing through the ridge of the Little Carpathians. Regarding the width of ecological corridor and nature of the vegetation in the area, the impact of tunnel air outlet on the bio-corridor's functionality will be minimal.

Table C.III.11.: Concurrences of variants 7a, 7b, 7c with TSES elements

<i>km</i>	<i>cadastre</i>	<i>name</i>	<i>nature of concurrence/range of distortion</i>
MÚK Ivanka north	Ivanka pri Dunaji	NRBK-H 23	crossing /1
MÚK Ivanka north	Ivanka pri Dunaji	RBK Šúrský channel	crossing /1
MÚK Ivanka north	Chorvátsky Grob	NRBC 116 Šúr	interference with edge/1
0,484	Svätý Jur	RBK Struha creek	crossing /2
0,500	Svätý Jur	MBC Háj	interference with marginal part /2
MÚK Čierna voda	Svätý Jur	RBK Šúrský channel	contact/ 1
2,400 – 2,900	Svätý Jur, MČ Vajnory	RBK Struha creek	relocation of creek /2
2,524	Svätý Jur	RBK Račiansky potok with inflows	crossing /2
4,600 – 4,700	Svätý Jur, MČ Vajnory	RBK Ecotone bio-corridor	contact/ 1
5,280 – 6,190	MČ Vajnory, Svätý Jur, MČ Rača	RBC Vajnorská valley	route in tunnel
8,070 – 10,100	MČ Rača/Záhorská Bystrica I	NRBK-T 82	route in tunnel
10,300	MČ Rača	RBK Vydríca with tributaries	route in tunnel
MÚK Záhorská Bystrica – relocation/shifting I/2	Záhorská Bystrica I	RBK Stará Mláka	crossing /1

In variants **7a, 7b, 7c** the impact on the TSES elements will be- with minor variations- almost identical with the 2a, 2b variants' impact, described in the previous paragraph, except for the impact of tunnel Karpaty air outlet, which in these variants does not have any impact on the TSES elements.

Table C.III.12.: Concurrences of SPL variant with TSES elements

<i>km</i>	<i>cadastral area</i>	<i>name</i>	<i>nature of concurrence/disruption range</i>
MÚK Pezinok	Viničné, Pezinok	MBK Viničiansky channel	crossing /2
MÚK Pezinok	Viničné, Pezinok	MBK Mahulianka	crossing /3
7,350	Pezinok	MBK Viničiansky channel	crossing /2
10,150	Svätý Jur	RBK Šúrský channel	crossing /1
15,500 – 19,100	Svätý Jur, Lozorno	NRBK-T 82	contact/ /1
16,500	Svätý Jur	RBC Zlatá studnička	route in tunnel
26,550	Lozorno	MBK 3	crossing 3
MÚK Lozorno, relocation/shifting I/2	Lozorno	MBK 2	crossing /1

The impact of SPL variation on the TSES elements can be characterized by a smaller number of clashes, but with more significant consequences in case of the D4 highway construction in this variant.

Near MÚK Pezinok there will occur the multiple crossing of Viničniansky channel bio-corridor and permanent restriction of its functionality because of the low underpass height at the bridge bodies. The construction of this intersection will likely permanently disable the bio-corridor of Mahulianka channel. It will disable also the MBK 3 bio-corridor in the cadastre of village Lozorno, which connects the local gene pool habitat and forest unit at Rakytov creek.

At app.19.000 km the tunnel air outlet touches the western edge of supra-regional bio-corridor NRBK Nová hora – Ostrý vrch.

Other contacts of SPL variant with TSES elements are insignificant with a marginal impact.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF IMPACTS ON THE TERRITORIAL SYSTEM OF ENVIRONMENTAL STABILITY (USES)

When comparing the impact of variants assessed on elements of USES, the procedure was based on the frequency and nature of encounters, that is the impact of the highway D4 on bio centre or bio corridor with potential limitations of these features and even disabling the passability of bio corridor or functioning of the bio centre.

The assessment of number and nature of encounters within the variants assessed has revealed the variants 7a,7b,7c as the most convenient, while the impact of variant SPL seems the least convenient, despite the lower number of encounters with USES elements. Those will be totally disabled in two cases actually. The zero variant can be considered as a variant with no impact on USES elements with preservation of impassability of certain elements.

Variant assessed	Point score
zero variant	-1
variant 7a	-1
variant 7b	-1
variant 7c	-1
variant 2a	-1
variant 2b	-1
variant SPL	-5

C.III.11. IMPACTS ON URBAN COMPLEX AND GROUND UTILISATION

Construction of the highway D4 will not bring any direct significant change to the ground in its vicinity in any of the variants subject to assessment. Most of the land along the routes of particular variants is used for arming purposes, viticulture and forestry. However, construction of the highway D4 represents an indirect aid to the urban development within the adjacent locations and finally a change in utilisation of the existing farming land.

As far as the impact on urbanism and land utilisation, the impact of variants 2a, 2b, 7a, 7b, 7c will be very similar. The said variants have been elaborated in compliance with local land use plans and no demolitions of occupied or industrial properties will be required.

All the 5 variants are passing mostly across farming land within the section between Ivanka-North Flyover and the Raca Flyover. Construction of the highway D4 in this section will result in permanent land rush with simultaneous reduction of the farming land and vineyards. That will obviously result in decline of farming production and impair accessibility of the adjacent fields, especially during the construction process (access to the affected plots is ensured by means of relocation of existing roads). The highway D4 bisects the dam of local pond at 0.500 km resulting in reduction of its area (by 10 to 20%) and its yield capacity as well as the ability to hold storm water. The Raca Flyover will take up a large area and reduce the local grape production significantly. The largest annexation of vineyards is presented by variants 2a, 2b, while the drop in grape production at this location will also rise.

The eastern portal of Carpathians Tunnel shown in variants 2b is situated in allotments and its construction would then require demolition of almost 25 garden chalets, dividing these allotments into two sections and bringing a substantial change to this relax and leisure area.

Construction of one of the variants 7a, 7b, 7c would require removal of a small area of vineyards and demolition of just one garden chalet behind the Raca Flyover only.

Construction of the variant 2a will lead to permanent annexation of forest land, farming land as well as the old fruit orchard behind the western portal of the Carpathians Tunnel. The structure will therefore reduce the farming production and change in access to the farming land, especially during the highway construction process. It will also require demolition of approximately 10 garden chalets within the allotments area north of the Marianka village. The construction and subsequent operation of the highway D4 will result in restriction of the farming and even certain leisure activities in the location from the western portal of the Carpathians Tunnel up to the Zahorsky Bystrica Flyover.

The rate of impact will rise with construction of the variant 2b thanks to elongation of the Carpathians Tunnel by 0.993 km (design as trenched tunnel in this section). The trenched tunnel will be partially covered with soil to enable further utilisation of this land up to the 15.268 km. Pursuant to covering the trenched part of the tunnel with soil and its reclamation, the permanent impacts on this land will change, as far as utilisation of the location is concerned.

The variant 7a will not require any interference with the forest land adjacent to the western portal, that will reduce the scope of impact on utilisation of the area along the highway D4 (farming and leisure purposes) behind the western portal of the Carpathians Tunnel when compared to construction of variant 2a.

Variants 7b a 7c with tunnel elongation up to 15.200 km will have the greatest impact on utilisation of the land and the local urban conditions, since there will be 500 m of the tunnel designed as poured tunnel with further options to utilise the covered part to minimise its impact on the farming operations and leisure in the area.

The SPL variant is passing through the farming land basically from the beginning of Chorvatsky Grob Flyover up to the 10.321 km. The impact of construction and operation of the highway D4 can be then assumed with potential decrease of farming production within the area and change to accessibility of individual fields. There will be an change in use of the farming land intended for allotments between the Sur Channel and the railway track to an inevitable extent (during the bridge construction). The section of highway D4 between road II/502 and the eastern portal of the Carpathians Tunnel passes through vineyards (approx. 200 m) the annexation of which will result in reduced grape production in this area. The area between portals of the Carpathians Tunnel and the Katusina Tunnel will be also struck by annexation of forest land and change to their use for transport purposes. The highway behind the western portal of Katusina Tunnel passes through the farming land only, so the limits and changes in utilisation of the land will affect farming production only.

As far as the SPL variant is concerned, the relocation of road I/2 will affect the industrial zone situated south-west of the Lozorno Flyover (passing through a newly built hall), so its route has to be changed or several newly built properties would have to be demolished. Keeping the existing route of the relocation of the road I/2 would divide the industrial zone into two areas.

Since the SPL variant is not indicated in any zoning plan (UP), its further project preparation and integration into zoning plans would result in annexation currently intended for farming activities, fruit orchards and vineyards.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF IMPACTS ON URBANISM

The comparison of variants and their impact on utilisation of the land have been based on the extent of annexation inherent to each variant, the impact on farming activities and leisure in the area, as well as the impact on farming activities, both existing and planned, with attention to benefit brought by individual variants for development of the said area.

Following the facts established and comparison of land annexation scope with respect to the variants assessed, the assumed least impact on the local economic activities is seen in variant 7c, while the SPL poses the greatest impact. The zero variant does not represent any change to the existing utilisation of the area subject to assessment, it does not even help or deal with its further development, which is why it has been evaluated as the worst one.

Variant assessed	Point score
variant 7c	+3
variant 7b	+3
variant 7a	+3
variant 2a	+1
variant 2b	+1
variant SPL	-1
variant 0	-3

C.III.12. IMPACTS ON CULTURAL AND HISTORIC MONUMENTS

None of the variants subject assessment actually passes through any built-up areas of municipalities or conservation areas within the area assessed. It neither affects nor jeopardizes any of the cultural monuments included in the central list held by the Monuments Fund.

Construction of variants 2a, 2b, 7a, 7b, 7c of the highway D4 will require removal or demolition of two stone crosses and one chapel close to the village of Marianka (for location details refer to Chapter C.II.12).

Construction of the eastern portal of the Carpathians Tunnel in each of the variants assessed will require interference with the stone embankments, the so called runes, which have been constructed on eastward slopes of the Little Carpathians during terrace vineyard construction over centuries.

There are no further impacts on cultural and historical monuments assumed with respect to construction of any of the variants assessed.

PARTIAL COMPARISON OF VARIANTS AND SUMMARY OF IMPACTS ON CULTURAL AND HISTORICAL MONUMENTS

Our comparison of variants was based on the frequency of interferences with crosses and chapels at the existing field roads and the scope of interference with the so called runes on the eastward slopes of Little Carpathians forming a historical sight of the viticulture land.

Following the evaluation of facts discovered, the SPL variant has the least impact on monuments, besides the zero variant with no impact on the cultural and historical monuments described herein. The variants posing greatest impact are 2a,2b, these also represent the most significant interference with elements of the viticulture land.

Variant assessed	Point score
zero variant	0
variant SPL	-1
variant 7a	-1
variant 7b	-1
variant 7c	-1
variant 2a	-3
variant 2b	-3

C.III.13. IMPACTS TO ARCHAEOLOGICAL SITES

Archaeological sites, being legitimately protected by a historical monuments act, are often damaged or totally destroyed by various construction activities. To avoid their liquidation resulting in a loss of national cultural heritage, it is necessary to examine the locations by a systematic archaeological survey prior any construction activity. The increased residential density proves traces of settlement in at least 23 registered locations on the route of all assessed variants, either directly in the proposed corridor of the construction site or in its vicinity. Further archaeological survey of these sites shall be topical should the construction activity be directly involved with them (premises designed for the site or places being adjusted for service roads, and locations designed for extraction or material storing). Despite the fact that a surface archaeological survey of the existing land registries of towns and villages (listed as known archaeological location) was performed both in the past and present, the possibility that during the construction other than by now known archaeological sites may be damaged, cannot be ruled out.

It is clear from the presentation of variants of the highway object D4 that the greater part of the highway (with all variants) shall pass through a tunnel, deeply under the present ground surface. Such construction depth of the tunnel should not by principle directly intervene or damage any archaeological objects being present in relatively shallow depths from the ground (mostly between 40/50 cm and 150/200 up to 250 cm from the ground, of course, out of continual municipal built-up area). Secondly, the portal parts of the tunnel have to be considered, when during vast construction activities (ground work) significant ground adjustments may be done resulting in eventual damage to registered or by now unknown archaeological sites. Last but not least, one has to consider construction of a construction base

of the tunnel (premises designed for the site or places being adjusted for service roads and locations designed for extraction or material storing), which can also significantly intervene with archaeological sites. The lower probability of damage in given mountain parts of individual variants of the object D4 is connected also with relatively low density of prehistoric and historic settlement of the hilly terrain of the Little Carpathians.

Much higher probability of damage to archaeological sites may be expected in areas of the headland of the Little Carpathians (both in the western and southern part of the Little Carpathians), in individual river terraces and river gravel and sand dunes, i.e., in the Záhorská nížina lowlands and the Podunajská nížina lowlands. It is assumed due to relatively dense settlement of geographical locations being suitable for housing structures. The density of population of the region is based on concrete development particularities, described in Chapter C.II.13 Archaeological Sites. Again, the principle of primary threat applies here regarding to damage to archaeological sites in connection with the construction of the highway object. However, even here one has to consider construction of a construction base of the highway object construction (premises designed for the site or places being adjusted for service roads and locations designed for extraction or material storing), which again can significantly intervene with archaeological sites.

The given number of archaeological sites being directly in the object of individual variants of the highway D4 has not be final. Many locations are not cultivated and thus unavailable and unknown to archaeologists. It cannot be ruled out that during implementation of the project new archaeological sites apart from those marked in the graphical annex No. 3 will appear.

In terms of assessment of impacts of individual variants to already registered archaeological sites, in course of the construction of any of variants 2a, 2b, 7a, 7b, or 7c, 17 known archaeological sites will be concerned. Out of which 7 sites are directly on the route of the mentioned variants, 8 sites are in the vicinity of the object of future highway D4 and it is probable that the construction of the highway will affect two sites located above the driven tunnel "Karpaty", however, their destruction by the construction or operation of the highway D4 is not expected.

In case of implementation of the SPL variant, 6 known archaeological sites will be concerned. Out of which 5 archaeological sites are located directly on the route of the SPL variant and one site is located above the driven tunnel "Karpaty" while its destruction is not expected.

PARTIAL COMPARISON OF THE VARIANTS AND SUMMARY OF THE IMPACTS ON ARCHAEOLOGICAL EXCAVATIONS

Comparison of the variants is based on the number of direct contacts with the confirmed archaeological sites as well as the contact with possible archaeological discoveries.

Based on the list of archaeological sites elaborated by the Archaeological Institute of SAS in Nitra for the purposes of processing of the EIA Report, SPL may be considered the variant with the smallest impact, moreover, the 2a and 2b variant are considered to be the ones with potentially the worst impact on archaeological excavations. Zero variant represents no new interference with the archaeological sites, therefore its impact is classified as a zero one.

Variant under assessment	Number of points
variant zero	0
variant SPL	-1
variant 7a	-1

variant 7b	-1
variant 7c	-1
variant 2a	-1
variant 2b	-1

C.III.14. IMPACTS ON PALAEOANTHROPOLOGICAL EXCAVATIONS AND SIGNIFICANT GEOLOGICAL SITES

Since all palaeontological and significant geological sites on the assessed territory are located outside the route of the individual variants assessed, their deterioration or destruction due to construction and operation of the highway D4 may be practically excluded.

The impact of the highway D4 on these sites is therefore not expected.

PARTIAL COMPARISON OF THE VARIANTS AND SUMMARY OF THE IMPACTS ON ARCHAEOLOGICAL EXCAVATIONS

Based on the findings, the impact of variants under assessment as the impact of zero variant is none.

Variant under assessment	Number of points
variant 2a	0
variant 2b	0
variant 7a	0
variant 7b	0
variant 7c	0
variant SPL	0
zero variant	0

C.III.15. IMPACTS ON CULTURAL VALUES OF INTANGIBLE NATURE

E.g. local traditions.

In the monitored region, the tradition of Marian pilgrimages in Marianka village as well as traditions associated with wine-growing in the whole Little Carpathians Region may be considered the cultural values of intangible nature.

Marianka is the oldest place of pilgrimage in Slovakia located on the international Marian tourist route Mariaszell – Czestochowa. Thousands of believers from Slovakia as well as

from abroad travel here, especially during the Marian pilgrimage in September. The history of the village dates back to 1377 when the Hungarian king Louis the Great laid the cornerstone of the Church and entrusted the Order of Saint Paul the First Hermit with the administration of the place of pilgrimage. Pilgrimage area is the memorial site consisting of fifteen national cultural heritage monuments – pilgrimage Church of Nativity of Mary (Slovak: *Kostol Narodenia Panny Márie*) from the 14th century, monastery from the 16th century reconstructed in the 19th century to a manor house, spring of wonders, Lurdská jaskyňa cave and the Stations of the Cross.

Marianka became famous for its “spring of wonders” the water of which healed a blind beggar who saved the statuette of Virgin Mary. There is a baroque Chapel of the Saint Well (Slovak: *Kaplnka Svätej studne*) located above the spring.

Little Carpathians vinicultural region spreads on the south-eastern hillsides of the Little Carpathians in the region of Hlohovec and Skalica. According to the vinicultural register of the SR, there are 5 359.2 ha of vineyards registered in the Little Carpathians vinicultural region. Little Carpathians vinicultural region is further divided into 12 vinicultural districts and 119 vinicultural localities.

The tradition of viticulture in the region is currently represented by the civic association called Little Carpathians Wine Route (Slovak: *Malokarpatská vínná cesta, MVC*). Little Carpathians Wine Route is a marketing product of this association. MVC association was founded based on the initiative of wine fans and enthusiasts as well as wine producers and wine growers in 1995 in order to support all the activities beneficial to wine growers and wine producers. MVC association organizes several events associated with wine every year which are becoming more and more popular each time they are held.

The impact on cultural values of intangible nature is not expected when carrying out any of the variants assessed.

PARTIAL COMPARISON OF THE VARIANTS AND SUMMARY OF THE IMPACTS ON CULTURAL VALUES

All the assessed variants represent no impact on the cultural values of intangible nature.

Variant under assessment	Number of points
2a variant	0
2b variant	0
7a variant	0
7b variant	0
7c variant	0
SPL variant	0
zero variant	0

C.III.16. OTHER IMPACTS

The chapter describes and assesses impacts on areas that could not be included in any of the previous chapters. These relate mostly to specific areas listed in the Assessment Scope.

Impact on Possibility of Pedestrian Passage and Passage by Agricultural Machinery

For line structures of this kind, passability of the territory is always somehow limited. Despite that, it can be concluded that the technical measures provide for passability of the territory in a scope identical to that prior to construction, both for agricultural machinery and for pedestrians. Technical measures are, identically, also in this case for all assessed variants solved by bridges and relocations of field roads, mostly in the routing of their current trajectories. These relocations are described in detail in chapter A.II.8.

Preservation of passability of the territory is also related to another active recreation area. Variants 2a, 2b, 7a, 7b, 7c, and SPL do not directly cross trails for winter and summer tourism; from this aspect, these will remain in their original form drawn in tourist maps and marked in the terrain. The only crossing occurs in the territory of tunnels, with no impacts on the tourist trails in the territory. The intention of the D4 highway will not influence the routing of cross-country skiing tracks and jogging and trekking tracks marked in the terrain.

Impact on Existing and Planned Cyclist Routes

The intention of the D4 highway in its variants 2a, 2b, 7a, 7b, 7c, and SPL will have not direct impacts on the proposed functional areas of recreation in natural environment and the access to these locations in the territory will not be limited.

From the viewpoint of active recreation, the proposed solution of the routing of the D4 highway directly intervenes with cyclist routes. The main cyclist route in the Bratislava region is the international cyclist route from Germany – Passau – Vienna – Hainburg – Bratislava, with extension alongside the Danube through Gabčíkovo all the way to Komárno – Štúrovo – Budapest. Also, regional demanding cross cycling routes through the body of the Lesser Carpathians exist, partially led jointly with the variants of the D4 highway proposed in the valleys and slips on the route – Rača – Kačín – Marianka – Záhorská Bystrica – Devínska Nová Ves. This cyclist route will be directly influenced, however, the route itself will not be affected as passability through the territory will be provided by a bridge in the territory of Marianka. The cross cycling route through the Lesser Carpathians from Svätý Jur – Medené hámre - Stupava - Vysoká - Záhorská Ves, will not be directly affected and no impacts on its routing and functionality will occur.

Direct crossings with cyclist routes will appear in the following specific locations:

Lozorno – The SPL variant crosses the pedestrian and cyclist route proposed by the zone plan, routed from Austria and connecting to the cyclist route from the municipality of Zohor in parallel to road III/00237 and continuing in parallel to the railway track all the way to Lozorno. Then, it is led to the south of Lozorno on a field and forest road to Stupava, Marianka, and then Bratislava. The zoning plan proposes to solve the development of marked tourist and cyclist trails in the connection to the Lesser Carpathians and the Záhorie region by a new marked tourist trail and a cyclist trail directed to the municipality of Stupava, with start from the entry junction in the municipality from the west, then on a field road and alongside the edge of a forest, to a rest location at the I/2 road, and alongside the edge of a forest and on field roads to the municipality.

Mariánka – In the zoning plan of the municipality, cyclist routes are proposed that connect to the routes coming from Austria through Lozorno, Stupava, all the way to Bratislava. This

route is led in an alternate trajectory and will be crossed by the D4 highway in variants 2a, 2b, 7a, 7b, and 7c. Walkways are proposed in parallel to the cyclist route. The routes are proposed in several alternatives in the zoning plan:

Stupava cyclist route (Morava cyclist route + Záhorie main cyclist route – Stupava – Marianka, Stupavská Street – Marianka, Karpatská Street – Marianka, Square)

Stupava cyclist route – alternative routing of a part of route (Morava cyclist route + Záhorie main cyclist route – Stupava – Záhorská Bystrica north – Lamač cyclist radial – Marianka, Karpatská Street – Marianka, Stupavská Street)

Marianka cyclist route (Morava cyclist route + Záhorie main cyclist route – Záhorská Bystrica – Marianka Square)

Cyclist route – unnamed (Marianka Square – Marianka Športová Street – Marianka Panský Les – Carpathian cyclist route)

Cyclist route – unnamed (Marianka Square – cyclist route across the Carpathians + Borinka – Pajštún ...)

Cyclist route – unnamed (Marianka, Budovateľská Street – Marianka, Štúrova Street – Lesser Carpathians – Železná studienka)

Vajnory municipal district (Bratislava) – according to the development document “Cyclist Transport in Bratislava”, cyclist routes are divided, from the aspect of importance and competences when providing for their development, into three categories – main (complex system connecting individual parts of the city, connecting to supra-city and international cyclist routes outside urbanized area), secondary (connecting to main routes and creating a full network in individual municipal districts), and supplementary routes (providing access to buildings, recreation areas, etc.). The following cyclist routes are proposed in the valid zoning plan:

Vajnory route – begins on the river bank under the New Bridge and leading alongside the internal traffic circuit, alongside Vajnorská Street, continues through the Vajnory municipal district up to the border of the municipality; a connection of municipal districts of Vajnory and Rača is added to the route.

Rača route – from the Old Bridge via Špitálska, Blumentálska, and Kukučínova streets, towards Krasňany and Rača; the route is extended behind the border of the city.

The proposed D4 highway crosses, in variants 2a, 2b, 7a, 7b, and 7c, the above cyclist routes in line with the zoning plan and already in the proposal of the zoning plan and incorporation of the D4 intention the crossing with the cyclist routes occurring at the border of the cadastral area was solved.

Another cyclist route crossing the territory is a regional one, running in parallel to road II/502; this will be crossed by all variants (2a, 2b, 7a, 7b, 7cm and SLP), yet in different sections. The impact on territory will be eliminated by the proposed bridges above the current road network. The cyclist route will be fully preserved, without functional changes, even if a part of the cyclist route needs to be relocated and built anew.

In the territory of the SPL variant, there is the *Little Danube Route*, following the attractive touristic environment from the Danube through Dunajská Lužná, Malinovo, Ivanka pri Dunaji, Šúr, Svätý Jur up to the Lesser Carpathians, suitable mostly for suburban tourism. The D4 highway will not directly influence the routing thereof. Impacts will be eliminated by making the territory passable, or by relocating the cyclist route in the necessary length.

The SPL variant crosses the cyclist route leading from the Radničné Square in Pezinok alongside the channel to the Galbov Mill in Viničné, then from Viničné to the border of the Šenkvice Grove and to Senec (to the fuel station at its beginning). At the Mahulianky interchange with a cross channel, it is possible to turn towards Slovenský Grob, in the

Šenkvice Grove it is possible to continue straight towards Šenkvice. The impact will be eliminated by building a bridge that will provide for the passability of the territory.

Cyclist routes located on local roads in direct crossing with the D4 highway in all variants (2a, 2b, 7a, 7b, 7c, and SLP) will be preserved also in the case of direct crossing as the passability of the territory will be ensured, thereby preserving the function of the cyclist routes.

Impact on "Bratislava Green Lungs"

Based on the specific requirement set out in paragraph 9 of the Scope of Assessment for "D4 highway Bratislava, Ivanka North interchange - Stupava" plan issued by the Ministry of Environment in Bratislava on 18 July 2008, the impact of the activity on the "Bratislava Green Lungs" project was evaluated and subsequently some elimination or mitigation measures have been proposed.

The "Bratislava Green Lungs" project was established in the 90's of the 20th century with the main supporting idea of *"Improving the lack of quality vegetation areas ("the green") in certain districts and surroundings, completion of the protected areas network, completion of the ecological network (territorial systems of ecological stability) and also increase in interest of city residents on environmental issues focused on increasing willingness to participate in their solution"*, reflecting the environmental problems arising in the territory of Bratislava and its surroundings.

In June 1999, the program's authors were RNDr. Helga Kothajová, Ing. Tamara Reháčková, RNDr. Jana Růžičková, RNDr. Jaromír Šíbl, who formed the exact wording of the program defining key and specific objectives and individual activities to support the fulfillment of the objectives. The authors, together with several non-governmental organizations, submitted a comprehensive public program **"Bratislava Green Lungs"**, which does not attempt to solve all environmental problems in Bratislava, but to contribute to addressing at least some of them.

Objectives of the Programme:

The main objective of the programme is to achieve a gradual **improvement of the environment** in Bratislava and its surroundings, especially by means of widespread and systematic "greening" of all the available surfaces, especially in parts with the most damaged environment and the lowest share of vegetation.

This primary objective fully corresponds to the partial objectives:

- increasing the ecological stability by completing ecological network (territorial system of ecological stability) in the city in terms of approved documents (Regional TSES of Bratislava, local TSESs)
- biodiversity protection - improving conditions for conserving the populations of rare and endangered plant and animal species in the city
- improving mesoclimate in Bratislava region and improving microclimate in urban area (by planting wood vegetation especially in young neighbourhoods, by vertical greening, completing the "green areas" and the construction of green roofs will decrease dust, increase air humidity, reduce thermal amplitudes, which will contribute to improving the health of the population)
- improving the aesthetic appearance of the city (urban areas)
- increasing the interest of citizens in environmental issues and achieving active public participation in addressing them and cooperating with competent authorities of the city (a special attention will be paid to children and young people, but also pensioners)

The programme has been developing spontaneously since its launch, the media publish information about achieving some of its specific objectives. Its topicality and the achievement, however, can not be reliably proved, as free media do not inform about the results and status of project objectives and activities.

Impact of D4 construction on the main objective and partial objectives of the programme:

The proposed activity of the submitted plan of the D4 highway in considered options does not come into direct conflict with the programme in terms of meeting the **main objective** of the "Bratislava Green Lungs" project, by activities aimed to achieve gradual improvement of environmental quality in Bratislava. The main goal is primarily the systematic "greening" of available surfaces in parts of the most damaged environment and the lowest share of vegetation. In terms of current vegetation and disturbance of natural vegetation there will be just minimal interventions in the territory, since options 2a, 2b, 7a, 7b, 7c and SPL are routed largely through intensively farmed agricultural area. The prerequisite for afforestation of free agricultural land is minimal, without substantial landscape and territorial sense.

Partial objectives of the programme in **options 2a, 2b, 7a, 7b, 7c** of the D4 highway pass from east to west near the SNR Šúr, partially disrupting the corridor RBK Potoka Struha thereby affecting the second subprogramme - Ecological network of Bratislava, whose main activities are passportization of ecologically significant landscape segments, defining the skeleton of ecological stability, clarification of borders of RTSES elements and identification of features of local TSES (bio-centres, bio-corridors, interactive elements), processing joint general plan of local TSES for certain districts, processing TSES projects for selected RTSES elements of Bratislava, the provision of suitable planting stock, gradual implementation of the projects. However, the disturbed RBK Potok Struha is not a priority bio-corridor allocated under the programme.

Partial disturbance of the corridor, conducted in parallel with options 2a, 2b, 7a, 7b, 7c can be eliminated and bio-corridor can be shifted slightly south off the route of options by planting suitable barrier landscape greenery in the area. This elimination measures will positively fill a part of the main objective of the programme concerning the "greening" of available spaces.

Other sub-objectives concerning in particular the urban area of Bratislava districts will not be directly disturbed. Indirect impact to be recorded after implementation of D4 highway in the area will increase the dust from the highway operation. By suitable landscaping of the highway and its immediate surrounding areas, this effect can be eliminated as much as possible. By means of the proposed elimination measures, in contrary, a partial objective of improving mesoclimate of Bratislava region can be achieved and suitable tree planting along the highway in the route of RBK Potoka Struha will support effect of reducing dust.

In the area of the Little Carpathians there are options 2a, 2b, 7a, 7b, 7c led via tunnel. Thus avoiding any conflicts with the objectives of the "Bratislava Green Lungs."

The western section of options 2a, 2b, 7a, 7b, 7c does not come into collision with RBK or MBK in the area of Marianka. There will occur a partial tree felling outside the forest in the form of an old orchard, which is locally a natural refuge for birds and small animals. The unaffected area of the old orchard will continue to perform its function.

As a mitigating measure it is appropriate to propose a new area, which will take over a partial function of the old orchard and shortly replace this refuge. The proposed mitigating measure will support the implementation of intermediate targets in terms of biodiversity protection and developing new areas of landscape green, so-called "greening".

Like with the west sections of options 2a, 2b, 7a, 7b, 7c, further achievement of the main objective and partial objectives will not be threatened by the implementation of the plan.

Option SPL is conducted outside the immediate proximity of Bratislava, and is extended to the territory that can be seen as wider vicinity of Bratislava. For these reasons no direct impacts on the "Bratislava Green Lungs" project will occur. For a comprehensive assessment, it is necessary to deal with sections of the structure, especially in conflict areas with significant natural parts of local to regional importance. At the beginning of the section connecting to the D1 highway, it passes through the centre of old orchards and vineyards, which will be removed, if necessary. In terms of impacts on **partial objectives** and their achievement, it will undermine the ecological stability of the area, create a barrier effect, thereby worsening conditions for the preservation of plant and animal species in the area, seeking to protect biodiversity.

The eliminating measures designed to improve the situation arising from the construction of option SPL aim to examine and propose a technical solution so as bridges connecting the D4 to D1 highway are extended in the next project documentation, which will ensure the area throughput.

Other directional routing of option SPL disrupts partial objectives of the programme by direct transit through NPR Šúr bio-centre, disrupts MBK corridor thereby affecting the second sub-programme - Ecological Network of Bratislava.

Proposing eliminating measures in accordance with the programme is impossible in this case. If option SPL is implemented, it is necessary to examine the new routing of MBK and reinforce the effect of its transfer by suitable planting of landscape greenery.

In the area of the Little Carpathians the option is routed via two tunnels, thus avoiding any conflict with objectives of the "Bratislava Green Lungs."

The land routing of the western section of option SPL will not limit achievement of partial objectives, as the route passes through an intensively farmed field area. By placing the tunnel portal outside the forest, there is no limitation to the permeability of the area.

Globally, when evaluating impacts of the D4 highway construction on the "Bratislava Green Lungs" and proposing eliminating measures, it can state a mild to moderate impact on the main and sub-objectives of the project. Opportunities for developing other activities in the project will not be disturbed by the territory as it will ensure total throughput of the area. With respect for the main programme activities, if necessary, in accordance with the proposed eliminating measures, some new areas of ecological stability can be designed near the D4 highway.

Impacts on the hills Vrchná hora and Vajnorská hora.

"Vajnorská hora" is the local name for the site of SPA Small Carpathians, the impact on the protected Natura 2000 site is described separately in Annex 4.

"Vrchná hora" is a site of cottage recreation area that stretches around the hill with an altitude of 280 m with the same name north of the village of Marianka. Recreation area is situated between the southwest-facing slopes of the old vineyards and forests of the Small Carpathians. D4 is not directly touching this site and passes about 300-500 m away from it in options 2a, 2b and 7a, 7b, 7c. In the case of the D4 impact assessment on this site it may only consider an increase in noise. The noise study has not showed a negative overflow impact of traffic noise on this site. Therefore it can be concluded only a slightly negative impact on the recreational area.

Impact on the transport system and transport infrastructure

Following the recommended phasing, the construction is to have the following impacts on the already existing road network:

Construction phase I should constitute a continuation of D4 from Ivanka north interchange (D1) until Rača interchange (II/502). This section could be put into operation independently and it would significantly improve the traffic in the area between the road II/502 and D1. The positive impact would be mainly shown in reducing traffic of:

- Rybničná street, relief in Rybničná street would represent in 2020 5,608 vehicles/24h in profile and in 2030 6,708 vehicles/24h in profile;
- in the urban area of CD Vajnory, about 49% less traffic would pass through CD Vajnory;
- it would allow the connecting Čierna Voda and Chorvátsky Grob to the highway network;
- it should also speed up urbanization development in CD Vajnory (CEPIT, planned new urbanization at the former airport in Vajnory);

Construction phase II

- the completion of the entire II. section, along with Stupava south interchange (III. section) will interconnect D1 and D2, which will have a positive impact on busy local roads Račianska, Šancová and Pražská, which can then serve primarily to inner-city transport,

The construction of the entire D4 ring is also very important because of the connection to the road and highway network in Austria and subsequently to other international routes.

It is therefore necessary to put the entire D4 route into operation by 2020 so as to allow the transport distribution of Vienna region (and of course also from more distant distances) in two transport corridors by closing the circuit and two highway crossings of SR/Austria. Transport to the northwestern parts of Bratislava, to Malacky and east of Slovakia would be routed through the S8 expressway and D4 highway (border crossing of DNV/Marchegg), and transport to the southern locations of Bratislava and south of Slovakia via the A6 highway and D4 highway (border crossing of Jarovce/Kittsee).

Construction and operation of the D4 highway will have a positive impact on:

- improving transport operation service of the affected area,
- increasing traffic flow and safety,
- relief to the road system of Bratislava,
- improving the quality of life of the residents,
- the overall increase in the value and development potential of the area,
- improving the delivery of functional levels of individual sections of the road system,
- increase in economic efficiency of the transit and partly source - target traffic to Bratislava

Impact on hunting grounds

The direct impact is represented by routing through inner part of the hunting grounds, which will cause its significant distribution and disruption of continuity. The indirect impact is evaluated for routing along the border or nearby and spatial isolation of hunting grounds with the different nature of habitats (field - forest). Impacts on hunting grounds were not evaluated in the tunnel part of all options.

Directly or indirectly affected grounds are mostly farmlands (outside Lozorno grounds, which is of a forest type). This corresponds to game composition: deer, rabbit, pheasant, partridge; near watercourses and areas there is the muskrat, mallard, geese; in hunting grounds in the

vicinity of larger forests and vineyards there is fox, badger, wild boar, marten, wood pigeon, fallow deer.

The affected hunting grounds include the following areas⁴:

Deer doe areas

S I Záhorie: Podhorie seated in Lozorno

S II Small Carpathians: Lozorno, Jablonka

Small game areas

M I Záhorská lowland: Záhorská Bystrica

M III Rye Island: Ivanka pri Dunaji, Nová Dedinka

M IV Trnava-Piešťany: Podkarpatské Pole, Viničné, Podhradie Svätý Júr, Slovenský Grob, Veľký Biel, Jablonka, Šúr, Bernolákovo, CD Vajnory,

Fallow deer areas

D I: Lozorno, Jablonka

Evaluation of the impact on individual hunting grounds are in the following table.

Table C.III.13.: Impact on hunting grounds affected by option 2a, 2b, 7a, 7b, 7c

Hunting grounds	km of the plan	Impacts of the plan
Ivanka pri Dunaji	0.0 – 1.4	indirect impact, restricting the free movement of animals between surrounding hunting grounds
CD Vajnory	0.0 – 4.0	the implementation will cause complete isolation of most hunting grounds from the surroundings, game populations will not be revived by new individuals from the environment, the increased development of built-up areas will cause a gradual degradation of game populations, probably also their extinction
Šúr	0.0 – 4.0	restricting free movement of animals, disrupting migration routes in local to regional scale
Podhradie Svätý Júr	4.0 – 5.0	marginal intervention of Rača interchange, restraining animal movement for food resources, increased mortality of game
Jablonka	4.0 – 5.0	restraining animal movement for food resources (forest - vineyard)
Stupava - Mást	13.0 – 16.5	restraining animal movement for food resources (local migration routes forest - field), increased mortality of game, increased fragmentation of the already fragmented hunting grounds (due to D2 highway)
Záhorská Bystrica		

⁴ according to Decree no.344/2009 Coll. implementing the Act on Hunting

Table C.III.14.: Impact on hunting grounds affected by option Senec - Pezinok - Lozorno

Hunting grounds	km of the plan	Impact of the plan
Bernolákovo	0.0 - 2.7	marginal intervention in the hunting grounds, distribution of old orchards and vineyards as an important refuge of the game, increasing the already fragmented hunting grounds by another barrier, restricting the free movement of animals, increasing mortality of the game
Veľký Biel	0.0 – 2.7	indirect impact, restricting the free movement of animals between hunting grounds of Bernolákovo and Veľký Biel
Slovenský Grob	2.7 – 5.5	road leads near the centre of the hunting grounds on agricultural lands, restricting the free movement of animals, increasing mortality of the game
Viničné	5.5 – 7.0	marginal intervention in the hunting grounds, to create more isolated areas between the highway and the built-up area of Slovenský Grob; restriction of the free movement of animals, increasing mortality of the game
Podkarpatské Pole	7.0 – 9.4	marginal intervention in the hunting grounds, restricting the free movement of animals, increasing mortality of the game
Podhradie Svätý Júr	9.4 – 10.7	marginal intervention of non-tunnel section in the hunting grounds, restricting the free movement of animals, increasing mortality of the game
Šúr	0.0 – 10.0	restricting free movement of animals, disrupting migration routes in regional scale
Lozorno	23.1 – 23.6	distortion of the internal environment of the hunting grounds (resting zone) by disturbing influences during construction and operation, restricting natural migration route and food resource
Podhorie seated in Lozorno	25.0 – 28.0	increasing fragmentation of already fragmented hunting grounds by another barrier, restricting the free movement of animals for food resources (local migration routes forest - field), increasing mortality of the game

C.III.17. SPATIAL SYNTHESIS OF THE IMPACTS OF ACTIVITIES IN THE AREA

E.g. assumed anthropogenic load of the area, spatial synthesis of negative impacts on the population, natural environment, landscape, urban area and land use, spatial distribution of predicted congested sites, spatial synthesis of the positive impacts of activities.

Spatial synthesis of negative impacts

The sum of negative impacts associated with the construction of the D4 highway will largely be notable for the population and will be reflected on every part of the environment, more or less. Shortening the construction period to minimum will reduce the negative anthropogenic load of the area by construction to a minimum. After the construction phase, the new anthropogenic stress on many components of the environment and the population will practically reduce on the impact of increased noise level in the vicinity of the newly built highway and the impact of increased emissions from transport around the road.

During construction the most burdened localities are construction site near bridges as well as the tunnel portals, which assume the greatest building activity. During operation, in options 2a, 2b, 7a, 7b, 7c the noise below the limit and air pollution will affect marginal areas of CD Vajnory, Rača, Marianka as well as the recreational area at Vajnorský pond. In option SPL it will also be marginal areas of Slovenský Grob, Viničné, Lozorno in parts closer to the highway.

The activity of each option is placed in such a distance that the effects of its impacts will be minimum on the edge of the said municipalities. This was confirmed by the noise and dispersion studies.

D4 construction in the section Ivanka north - Záhorská Bystrica will not support formation of new sites expected, that could be qualified as overloaded by anthropogenic activity.

Spatial synthesis of the positive impacts

Construction of D4 in its entirety will improve the quality of the transport network with all positive impacts (reduction of accidents, increase in traffic flow, redistribution of noise and air pollution in the area), especially in respect to diversion of transit traffic from congested roads (passing even through the built-up area of settlements), improving the overall condition of the road transport in Bratislava and the entire D4 circuit will have an undeniable positive impact as alternative transport route in the event of the collapse on D1 highway section through Bratislava.

C.III.18. COMPREHENSIVE ASSESSMENT OF THE EXPECTED IMPACTS IN TERMS OF THEIR SIGNIFICANCE AND THEIR COMPARISON WITH THE VALID LEGISLATION

A specific description of the impacts on individual components of the environment is described in the relevant sections of Part C.III. EIA Report. This chapter only indicates a summary of the impacts in terms of the affected area and population, as well as in relation to the legislation in force to their limits.

To describe the range of impacts on individual components it can be scaled - local (approx. cadastral area), regional (several cadasters - district) and supra-regional (several districts - region).

Population

The current traffic on the supra-regional, regional and local road network in the territory has a significant negative impact on a series of specific communities. Construction of road so-called Zero circuit of Bratislava will cause a redistribution of traffic and thus expanding transport of directly affected area. Nevertheless, reduction of extreme values of negative impacts from transport will be strongly positive result at the local level.

Selecting transport corridor will be well beyond the borders of the region concerned, as it will have an impact on stabilization and transport development of the wide region around Bratislava, as whole circuit of the D4 highway.

Positive impact on improving the transport network in the area can be evaluated as **very significant**. In terms of current standards for performance calculation of roads TP 01/2006 "Calculation of road capacities and their equipment", which is transferred to STN 73 6101 "Designing roads and highways," the D4 highway helps to maintain a state where the capacity of roads in the area will not be exceeded.

Noise

Implementation of the D4 highway will affect the new territory by noise. Extreme noise levels need to be locally minimized by designed noise control measures in the form of noise barriers.

At the regional level, there is an overall increase in noise near the corridor around the selected option (predicted sound pressure levels L_{Aeq}). That will not exceed the hygiene limits set by law, defined in an annex to the Regulation of the Ministry of Health of the Slovak Republic no. 549/2007 Coll. (that apart from other things defines details on permissible noise levels), yet in many locations it will be perceived negatively. After taking the necessary noise control measures for selected option, the noise impact can be considered **insignificant**.

Geological environment

Impact on geological environment will occur locally in the areas of building the groves, but at a regional scale geological environment will be affected at the bored and excavated parts of the tunnel. Intervention in the rock environment when tunnel boring is often subject to legislative rules of Act no. 44/1988 Coll. on the Protection and Use of Mineral Resources (Mining Act), as amended, and Act No.51/1988 Coll., on Mining activities, explosives and State Mining Administration, as amended.

Impact on the geological environment is **significant** in implementing any active option.

Climate

Potential impact on basic climatic features is intended only locally, where it will primarily be a change in the nature of the active surface, which may be reflected in small microcirculatory changes. Furthermore, in specific situations, lowered positions can be influenced due to the dam effect forming closed lakes of cold air.

Climate impact in the implementation of the plan can be evaluated as **less important**.

Immissions

Due to operation on the newly built D4 highway there will be a slight increase in total emissions in the affected area. In contrast, however, due to a redistribution of traffic, it will cause decrease in high levels of concentrations of air pollutants from road transport on roads of some municipalities.

The overall slight increase in emissions shall not exceed the limit values laid down by decree of the Ministry of Agriculture, Environment and Regional Development no. 360/2010 Coll. on air quality, as amended. The impact will be noticeable at regional level. Locally, there is a substantial reduction in high values that is a positive contribution of the new structure.

D4 impact on the emission situation in the assessed area is different. Locally, it will be very important, especially in CD Vajnory and Rača, with reduction in emissions in the area. In total, however, a slight increase in pollutant emissions and air pollutants redistribution in the area will have a moderate impact.

Water

For surface waters there will be no fundamental interference with the drainage of the area by the assessed plan, but in concurrence with other plans, planned in the area, it will require a comprehensive solution to the flood protection issue.

Potential changes to the groundwater and the surface water regime in the Small Carpathian Mountains can be brought by construction of bored and excavated tunnel. The next stages will require to conduct the detailed hydrogeological survey to specify possible impacts on water conditions due to the construction of one of the options.

Impact on groundwater and surface water quality, after letting the water out of the road drains will be eliminated by cleaning in ORL and then pumped from the retention tanks to recipients. Waste water limits are legally guaranteed by Government Ordinance no. 296/2005 Coll. laying down quality requirements and qualitative targets for surface water and limit values for waste water and special water indicators.

In terms of impact on the groundwater regime mainly the impacts of the activity may be evaluated as **significant**, impact on the groundwater and surface water quality can be assessed as **insignificant**.

Soil

In this regard, particularly extensive agricultural land use will have the greatest impact. This decline will, despite its considerable extent, be local. The agricultural land use was evaluated according to the listing of the BPEJ in the soil quality group and in further proceedings will be subject to the provisions of Act no. 220/2004 Coll. on the protection and use of agricultural land, as amended. The forest land use is subject to the particulars of Act no. 220/2004 Coll. on forests, as amended.

Impact on soil contamination in wider surroundings by emissions from transport should be avoided, since there is evidence that soil contamination decreases exponentially at a distance of 10 m from the edge of the highway.

Impact on the soil, apart from different agricultural land use, in assessed options can be evaluated as **less significant** in options 2a, 2b, 7a, 7b, 7c and **significant** in option SPL.

Fauna, flora and habitats

There are territories and species protected by institutes of protection valid in the Slovak Republic and the institutes of European legislation. Conditions of protection are set out in Act No. 543/2002 Coll., on Protection of Nature and Landscape, as amended. The importance and value of occurrence of these species and their habitats is beyond regional borders. The species and habitats observed were compared with the list of protected species and habitats in the Decree of Ministry of the Environment no. 24/2003 Coll., as amended, implementing the Act on nature and landscape protection. The impacts on protected species will occur due to marginal interference in their habitats **without significant interference** and impact on their populations.

Landscape

Given the scope and linear nature of the activity, the impact on the landscape can be seen regionally. The strongest manifestation of the new road will be in partial areas, often in enclosed landscape areas (local impact).

Overall it can be said that due to the nature of the area and the fact that the most valuable parts of the territory in terms of landscape are overcome by tunnel, the impact can be defined as **less significant** in all assessed options.

Protected areas

There are territories protected by institutes of protection valid in the Slovak Republic as well as the EU. Conditions of protection are set out by Act No. 543/2002 Coll., on Protection of Nature and Landscape, as amended. PLA, SNR, NR or areas of the Natura 2000 network are certainly beyond regional borders by their significance and values. Impacts were assessed by protection degree of affected sites and subject of protection of the affected areas set by acquisition documents.

The threat to these areas is not to happen, they will be affected only marginally or not at all. Also the subject matter of protection of these areas will not be threatened. Therefore, we can evaluate the impact on protected areas as **less significant**.

Cultural and historical monuments, archaeology

The termination or damage to historical monuments is not to happen. Archaeological sites, either confirmed or newly discovered may be locally affected. It is therefore necessary to conduct a preservation research before construction within the meaning of Section 37 of Act no. 49/2002 Coll. Heritage Protection, as amended. Due to the anticipated extent of the

intervention of archaeological sites the influence of the construction can be assessed as **less significant**.

Transboundary impacts

The assessed activity is located about 2 km from the Austrian border. The actual section II of the D4 highway will constitute a transboundary impact. The transboundary impact in Slovakia, however, needs to be discussed in the context of the entire D4 highway ring, which will be connected to the expressway and highway network of Austria.

Overall, it can be stated there are significant positive impacts mainly caused by the redistribution of transport in the region of Bratislava.

C.III.19. OPERATIONAL RISKS AND THEIR POSSIBLE IMPACT ON THE AREA

The possibility of accidents.

Operational risks associated with bad weather, human error or equipment failure, or a collision with migrating animals can never be excluded in such a construction scope. In standard security measures, these are to be minimized. Their scope is therefore not regarded as significant.

In terms of possible accidents there is, mainly in road structures, a risk of oil leakage or other chemicals that could adversely affect:

- rock environment, quality and quantity hydrological conditions in the area
- valuable habitats in the area
- air quality and possible excess of emissions
- health of road users and residents of nearby populated localities

The biggest environmental threat to the territory by the operation of the highway will be leakage of oil or other chemicals and their potential infiltration into the groundwater in the event of not being trapped by road drainage. These situations can occur both in normal traffic on the roads, but especially during accidents of vehicles carrying these substances.

From geological point of view, the western part of the territory on drifting sand is especially sensitive, which is known for its excellent properties of water infiltration. Therefore, the leakage of oil and other hazardous substances can be associated with a high risk of contamination of a large amount of soil, groundwater and surface water flows.

The risk may appear in the event of an accident in locations crossing the highway with Šúrsky channel (option SPL), Račiansky stream and the pond in the immediate vicinity of the D4 highway at Ivanka north elevated interchange.

C.IV. MEASURES FOR PREVENTION, ELIMINATION, MINIMISATION AND COMPENSATION OF IMPACTS OF THE PROPOSED ACTIVITY ON ENVIRONMENT AND HEALTH

Separately state measures during the construction, operation of the activity and measures for emergency cases.

Besides standard requirements resulting from the valid legislation and technical regulations technical conditions and guidelines of the Ministry of Transport, standards and other) we propose the following measures.

C.IV.1. LAND USE PLANNING MEASURES

E. g. the need of harmonisation with the valid land use planning documentation, recommendation of a change and amendments to the valid land use planning documentation, etc.

- In land use plans of affected municipalities, capital city and self-governing region, the corridor of the highway D4 in the section assessed by us is plotted (with minor inaccuracies) in the form of the variants 2a,2b. In case of selection of another variant it is necessary to detail location of the corridor of the prospective highway D4 in the section Ivanka north – Záhorská Bystrica via amendments to the land use plans
- In land use plans of affected municipalities it is necessary to consider in further changes the incorporation of areas impacted by noise and emissions from the highway D4 in assessed section among areas dedicated for living.

C.IV.2. TECHNICAL MEASURES

E. g. changes in technology, raw materials, schedule of construction, reinstating of the area, rescue surveys.

- According to the results of the noise study noise barriers were designed for each of the assessed variants with the following parameters:

Variant 2a

Order	Stationing in km	Position	Length in m	Height in m
PH1	0,6 – 1,7	Left	1100	3,0 – 4,0 – 3,0
PH2	0,85 – 1,6	Right	750	3,0
PH3	2,9 – 3,4	Right	500	3,0
PH4	5,8 – 6,2	Right	400	2,0-2,5-3,0-2,5-2,0
PH5	6,0 – 6,2	Left	200	3,0
PH6	14,35 – 14,7	Right	350	2,0 - 2,5 – 2,0
PH7	14,8 – 15,9	Left	1100	3,0
Total			4400 (P 2000 / L 2400)	

Variant 2b

Order	Stationing in km	Position	Length in m	Height in m
PH1	0,6 – 1,7	Left	1100	3,0
PH2	1,6 – 2,2	Left	600	3,0
PH3	2,85 – 3,3	Right	450	3,0
PH4	5,8 – 6,2	Right	400	2,0-2,5-3,0-2,5-2,0
PH5	6,0 – 6,2	Left	200	3,0
PH6	15,25 – 16,2	Left	950	3,0
Total			3700 (P 850 / L 2850)	

Variant 7a

Order	Stationing in km	Position	Length in m	Height in m
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PH1	0,65 – 1,7	Left	1050	3,0 – 4,0 – 3,0
PH2	0,85 – 1,6	Right	750	3,0
PH3	2,9 – 3,4	Right	500	3,0
PH4	15,1 – 15,9	Left	800	3,0
Total			3100 (P 1250 / L 1850)	

Variant 7b

Order	Stationing in km	Position	Length in m	Height in m
PH1	0,6 – 0,9	Left	300	3,0
PH2	1,6 – 2,2	Left	600	3,0
PH3	2,9 – 3,4	Right	500	3,0
PH4	15,2 – 16,2	Left	1000	3,0
Total			2400 (P 500 / L 1900)	

Variant 7c

Order	Stationing in km	Position	Length in m	Height in m
PH1	0,65 – 1,7	Left	1050	3,0 – 4,0 – 3,0
PH2	0,85 – 1,6	Right	750	3,0
PH3	2,9 – 3,4	Right	500	3,0
PH4	15,2 – 15,9	Left	700	3,0
Total			3000 (P 1250 / L 1750)	

Variant SPL

Order	Stationing in km	Position	Length in m	Height in m
PH1	6,1 – 6,5	right	400	3,0
PH2	6,3 – 8,4	left	2100	3,0
PH3	10,05 – 10,5	bilateral	450	3,0 – 2,7
Total			3400 (P 850 / L 2550)	

- Slope cuts shall be planted with suitable greenery, which would work as a noise barrier near the tunnel portals; respecting technical conditions for road safety and conditions for protection of birds (i. e. not to plant bushes or any other similar vegetation, which could be attractive mainly for bush species).
- Contemplate coverage of big surfaces of retaining walls with tiles from absorbing materials, in order to eliminate noise reflections to the environment near the tunnel portals (Karpaty or Katušiná) in such a way that the reflections from the concrete constructions and walls at the tunnel mouth are eliminated and in the next stage of project documentation and a final variant to prepare a detailed noise study (dimensional model) for the interchange Ivanka north and its close surroundings, for a complex provision of noise protection of the city district Vajnory in relation to the highways D1 and D4.
- All soil landfills created for the purpose of the construction of the highway D4 shall be situated in sufficient distance from waterways in order to prevent their alluviation.
- Drainage of the selected variant of the highway D4 shall be provided at least to such an extent as proposed in the 'Feasibility and Effectiveness Study for the backbone route of D4, i. e. with the use of oil separators, retention tanks and pumping stations, to prevent contamination of recipients.

- Drainage of bridge constructions between the tunnels Karpaty and Katušiná shall be done with sewerage with leading to sufficiently dimensioned security elements for water protection (able to retain also a volume of dangerous substances, in order of dozens of cubic metres), free-fall drainage in this case is insufficient
- We recommend considering the possibility of lowering speed on the bridge between the tunnels Karpaty and Katušiná for vehicles carrying dangerous cargo; further we recommend considering installation of transverse embossed colour strips in the right lane (prevention of micro sleep) and the possibility of installation of reinforced safety fences, which would prevent e. g. fall of a vehicle with dangerous cargo right into the waterway.
- To prevent soil pollution it is important to deploy in the construction only such machines and vehicles, which are in satisfactory technical condition.
- In all variants it is necessary to stabilise the wall of trench excavation of the Eastern portal of the tunnel Karpaty (realisation of anchored slopes in a massif block type of disintegration of the massive with a substantial presence of risky surfaces of discontinuities sloped towards the excavation).
- In the tunnel it shall be provided for the boring stability of excavation works in strongly weathered zones, weathered and intensively disintegrated rock massifs of rocks and semi-rocks (granitoid rocks, shales and carbonates), incohesive Neogene rocks (grouting, micropile umbrellas),
- In the boring of the tunnel Karpaty drainage drills shall be done in wet parts of the strata of Neogene gravel soils, excavated parts of the tunnel and Western portal, implemented in non-cohesive Quarternary, deluvial soils with the implementation of minimum nailed or anchored slopes.
- In the implementation of the bored tunnel Vajnory it is necessary to sufficiently dimension the construction for the underground water pressure, in particular with regard to the high levels of underground water in the area.
- In the implementation of the bored tunnel Vajnory it is necessary to prevent inflow of underground water to the construction excavation.
- In the implementation of the bored tunnel Vajnory to apply a long-term efficient insulation of joints and expansion joints against groundwater seepage.
- In the further stage of project documentation it is necessary to separately check the impact on stability of the dams of the Šúrsky canal in the section of the concurrence of the highway D4 and the canal Šúr (ca from km 2.000 to km 4.000 of the variants 2a,2b,7a,7b,7c)
- To respect the importance of the fen location in the implementation of the variant SPL Southern from the municipality Lozorno by routing of the line construction in such a way that the area is not destroyed by direct land take or drainage
- Selection of grass mixtures used for sowing of reclaimed areas shall be agreed with the administration of Protected Landscape Area Malé Karpaty (grass mixtures shall be suitable for given locations in terms of species and habitat)
- In reclaiming and planting it is necessary to use original woody and bush species
- The passage of the highway D4 through the valuable area of Jazero na Lysom shall be solved by a bridging (extension of the bridge construction over the stream Struha), or check the possibility of moving the highway away from the area.
- Negatively impacted hydrologic characteristics of waterways in the territory shall be resolved using retention tanks at least to such an extent as proposed in the 'Feasibility and Effectiveness Study for the backbone route of D4, for assessed variants

- Provide for transfer of the flow of all existing flows (even sporadic) through the body of the highway D4
- Check the possibility of adjustment of vertical alignment of the tunnel Karpaty for the need of drainage of the tunnel as much as possible towards the Western portal.
- Move three pieces of historical architecture (crosses, chapels) in the route of the highway D4 or in its close surroundings (variant 2a,2b,7a,7b,7c) Northern of the municipality Marianka
- In the next stage of project preparation to minimise the extent of adjustments of crossover riverbeds of watercourses.
- In the next stage of project documentation in cooperation with the administrator of the Šúr canal to prepare a more detailed project of dry polder between the Šúr canal and the highway D4 in the variants 2a,2b,7a,7b,7c (km 2.524 – 3.600); the necessity of which is detailed in chapter C.III.5, in the part Impact on flood protection in the city district Vajnory
- In case of implementation of any of the variants 2a,2b,7a,7b,7c it is necessary to build a concrete 1.2 m high safety fence (outside noise barriers) on the right side of the road from km 0.500 to km 4.000 as a partial noise barrier in relation to the National Nature Reserve Šúr.
- Near the confluence of the Račiansky stream and the Šúr canal to implement an alternative measure of forming a water meadow habitat
- Ventilation of the tunnel shaft shall be provided in a way that prevents injuries of animals, e. g. due to sucking into the fan (from the view of subjects of protection mainly birds and bats)
- Keep noiseless technology in installation of ventilation shafts
- Eventual noise barriers shall be installed preferably from non-transparent glareless material, to prevent bird collisions. For transparent noise barriers an adjustment of fillings is recommended using vertical strips 30 mm wide with axial spacing of 100 mm (sanded or adhesive strips). This measure is much more effective than e. g. using silhouettes of birds of prey.
- According to the results of the migration monitoring in the assessed territory the following technical measures are proposed for individual variants:

Variant Senec – Pezinok – Lozorno

km	Measures to minimise the impact of the intention
0,0 - 1,5	Fencing of the section on both sides, limiting entry of animals to the road, creation of alternative locations on the slopes of the body
1,5 – 5,0	Sections between km 1.000 – 1.200 are suitable for construction of an ecoduct to allow highway passage. Fencing of the section on both sides. In the sections leading on embankments tubosiders shall be built to improve migration of small animals
6,5 - 7,5	At the intersection of the body with water canals to keep a dry migration way under the bridge with minimum width equal to the width of the stream at surface, relays of flows of natural character with minimum technical fortifications; creation of alternative locations (shades) alongside the flows
10,3	Keep a dry migration way under the bridge with minimum width equal to the width of the stream at surface; minimisation of technical adjustments of flows

10,7	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations in the cut of the body
22,5 – 24,0	Keep a dry migration way under the bridge with minimum width equal to the width of the stream at surface; minimisation of technical adjustments of flows
25,0 - 26,5	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations on the slopes of the body. In the sections leading on sufficiently high embankments tubosiders shall be built for improving migration conditions for small animals
26,5 -27,0	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations on the slopes of the body. In sections leading on sufficiently high embankments tubosiders shall be built for improving migration conditions for small animals
27,5	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations on the slopes of the body. In sections leading on sufficiently high embankments tubosiders shall be built for improving migration conditions for small animals

Variant 7a,7b,7c

km	Measures to minimise the impact of the intention
0,25 – 3,5	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations on the slopes of the body. In sections leading on sufficiently high embankments tubosiders shall be built for improving migration conditions for small animals; Keep a dry migration way under the bridge with minimum width equal to the width of the stream at surface; minimisation of technical adjustments of the flow; in the space between the Šúr canal and the road a wide strip of tree and bush vegetation shall be planted to limit interference
3,7 -4,0	
4,0 -4,7	Fencing of the section on both sides, limiting entry of small animals to the road, necessary adjustments of the Račí stream towards renewal of the natural character similar to the upper part of the flow, remove migration barriers from the flow (riverbed drops, shafts)
14,0 – 16,5	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations on the slopes of the body. In sections leading on sufficiently high embankments tubosiders shall be built for improving migration conditions for small animals

Variant 2a,2b

km	Measures to minimise the impact of the intention
4,0 - 6,5	Fencing of the section on both sides, limiting entry of small animals to the road, creation of alternative locations on the slopes of the body. In sections leading on sufficiently high embankments tubosiders shall be built for improving migration conditions for small animals

C.IV.3. TECHNOLOGICAL MEASURES

- Not to illuminate the surrounding of the highway (this way, there will be no significant attraction of insects, which is food for birds, into the risky area of the highway)
- Manipulation with oil products and fuels shall be done strictly outside the construction and only in dedicated areas; in case of an accident accompanied by leakage of harmful substances into the soil the accident area shall immediately be decontaminated, the contaminated soil shall be placed to a safe surface and provide for its subsequent placement on a safe landfill or another disposal.
- In the variant SPL to provide for stability of tunnel boring works in the massif of weathered rocks and semi-rocks of carbonate and shale, but in particular non-cohesive Neogene soils (grouting, micropile umbrellas, vertical segmentation)

- Recommended method for the tunnel boring is NRTM⁵, or open TBM⁶ in the sections of unstable zones of the massif
- In boring the tunnels using the method TBM, the type of TBM shall adapt to the selected variant (extent)

C.IV.4. ORGANISATIONAL AND OPERATIONAL MEASURES

- Conduct a detailed pedologic survey in the affected area to determine the topsoil layer and the amount of hidden topsoil. In the event of excess of the topsoil (unless the stripping is used for reclaiming of surfaces and slopes) it shall be decided about its next usage in cooperation with a body for protection of agricultural land).
- Temporary landfills of topsoil layer are to be provided in line with relevant regulations before and after the disposal, mainly to prevent reproduction of ruderal plant species and soil contamination with their seeds
- Back laying of topsoil shall be done during dormancy (November – March)
- All interventions in the areas of European interest and protected bird areas shall be minimised. For the transport of materials for construction of ventilation objects (vents of the Karpaty) to choose vehicle of such a size and terrain throughput, so that it was not necessary e. g. to more significantly extend or reinforce current forest roads. The same holds for eventual transport of boring sets drilling sets within the hydrogeological survey
- In the territory of the Protected Landscape Area Malé Karpaty to minimise permanent and temporary land take, in felling of forest cover the trees shall be replaced with geographically original and habitat suitable woody species typical for the other parts of the protected area
- During the construction activity near the border of the National Nature Reserve Šúr not to interfere into the protected area, not to place landfills of soils and not to build access roads to the construction site
- In places where there might be collisions with birds (concurrence of D4 with the Šúr canal and sections around tunnel portals), to prepare an ornithological monitoring (including survey of cadavers – perished individuals). In case of finding increased mortality construction solutions shall be proposed to minimise the factor
- On the highway body vegetation adjustments shall be conducted in line with the valid regulations and technical conditions TP 04/2010 issued by the Ministry of Transport, Posts and Telecommunications of the SR, so that the adjustments are in line with the nature of

⁵ NRTM – also called shotcrete method. The tunnel is bored using drilling and blasting technique. Drilling wagons with powerful hydraulic drilling hammers are used for drilling of blast holes. Drills are filled with commercial blasting agent. After the blasting the rock cut is carried out of the tunnel and the adit is mechanically (machine) shaped to desired shape. Alternatively, machine rock disintegration can be used without blasting (excavation with a tunnel excavator or disintegration e. g. with a cutter). To ensure excavation a thin primary rock protective coating 5 - 20 cm thick is applied. The main bearing element of the primary rock protective coating is sprayed, quick drying concrete. The shotcrete is reinforced with 1 to 2 layers of steel mats. In the cutting it is proceeded cyclically in bites with the length of 1.5 to 4.0 m depending on the rock's quality.

⁶ TBM – is an acronym of the German expression Tunnelbohrmaschine or the English Tunnel boring machine. It is a huge machine which literally drills a hole for a tunnel into rock. This method is about 30 years old and lately it began to be used ever more often. The fundament of the machine is a drilling head (or cutter). It is a machine with circular section and diameter equal to the height of the tunnel. As it shall turn as a whole, only circular forms of tunnels come into question. And the size of the tunnel means that its diameter is even more than ten meters.

the area and compose the technical construction as much as possible into the landscape. In flat area without grown woody greenery we recommend to avoid planting trees on embankments and cuts

- For planting geographically original species shall be used except for the central splitting strap, where plants resistant to deicing agents are to be used
- Propose an alternative planting for areas outside the road body, replacing felled ground wood within permanent and temporary land take of the construction
- Within Vegetation adjustments and Alternative planting near the construction to conduct complex landscaping so that the treatment leads to incorporation of the construction into the landscape and mitigating the impacts on the landscape, its nature, scenery and the overall landscape picture
- After completion of the construction there shall be full liquidation of construction yards and tertiary roads their reclaiming
- For ground wood located in close proximity of the construction, a complex protection shall be provided. Measures shall be undertaken to protect aboveground and underground parts of plants. I. e. in excavation works it shall not be interfered into root system of ground wood and keep protective distance of 2.5 m from tree trunk (the distance according to the standard STN 83 7010). Root system shall be protected against compacting by measures according to the standard STN 83 7010 Care, maintenance and protection of tree vegetation. Trunk and root system shall be protected as required by fencing from a solid material, so that bigger mechanisms cannot disrupt the protection and damage the plant. Trunk and bark of the ground wood shall be protected either with a boarding or wrapping with a thick cloth. The contractor shall remove the protective measures after the completion of the construction
- In excavation works and structural adjustments it is not allowed to bring soil, construction material or construction waste to the root zone of wood ground or increase impermeability of soil. If this is not possible, it shall be decided on subsequent measures by an authorised person (i.e. an employee of relevant environmental authority, in cooperation with the author of the survey Inventory and social valuation of ground wood)
- Near the root area of the ground wood within the construction site it is not possible to store chemicals and other substances which may cause damage to the plant, or to manipulate with such substances
- Minimise interference into plantations of non-forest woody vegetation in the landscape, accompanying lineal vegetation of roads, vegetation on border lines of farmed fields, vegetation following up on the Šúrsky canal, scattered vegetation in orchards in the territory of vineyards, making an important natural element in urbanised land
- As a replacement for felled ground wood within permanent and temporary land take by the construction (especially in forests which are part of Malé Karpaty) it shall be provided for vegetation planting on areas outside the road body itself
- Replace bank vegetation on affected waterways with planting new plants from among domestic (original) habitat suitable woody specie in the range of the land occupation of the construction.
- For vegetation adjustments of slopes of the road geographically original species of plants shall be used, except for the middle separating strip, where plants resistant to deicing agents can be used
- Protective archaeological survey shall be conducted on the selected route. It will be necessary to conclude (sufficiently in advance) a contract between the investor and the

Archaeological institute of the Slovak Academy of Science in Nitra, or another authorised organisation, on conditions of conducting advanced protective archaeological survey, based on the obligation of the investor, following from the Act No 49/2002 Coll. on heritage protection as amended

- In the variant SPL in the section drilled in Neogene complex of soils after specification of conditions of drilling by stages of engineering geological survey the most suitable drilling method will be recommended (NRTM – closed TBM)
- Right before the construction, during the construction and during the operation it is necessary to provide for monitoring of selected environmental elements, which will be based on the conditions set in the chapter C.VI. of this report
- For an optimum design of drainage of sewage water by soakaway it is necessary to conduct hydrogeological survey in the place of proposed soakaway object.
- We propose to divide the construction of the highway D4 in the section Ivanka north – Záhorská Bystrica into two stages; in the first stage to build the highway D4 up to the interchange Rača together with the section of the highway D4 Jarovce – Ivanka north; in the second stage to build the tunnel part passing the massif of Malé Karpaty
- Transport to construction site shall not run outside the line of the prospective body of the highway D4 in assessed section
- In the next stage of project preparation to plan the procedure and organisation of the construction in order to minimise eventual adverse impacts on population

C.IV.5. OTHER MEASURES

E. g. expected induced investments.

- Before the implementation of selected variant to implement a monitoring system, for monitoring starting geological and hydrogeological conditions and minimising negative impact on rock environment and underground water
- Before the construction of the tunnel Karpaty we recommend in all variants to make an exploratory adit with a specified length in order to verify optimum technology for drilling and securing the prospective tunnel

C.IV.6. OPINION ON TECHNICAL-ECONOMIC FEASIBILITY OF MEASURES

All of the proposed measures are technically viable. An exact financial evaluation of the measures will only be possible after completion of project documentation of the construction.

Disclaimer

This is an English translation of a document that was originally produced in the Slovak language. While we have exercised utmost care to make this translation accurate, it may contain typing or translation errors. Therefore, always consult the Slovak original before making decisions on the basis of this translation.

The name of this document in Slovak is *Správa o hodnotení*. The file name has not been changed.

We hereby confirm that the European Bank for Reconstruction and Development shall have no responsibility for the translated content.

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