Northern Axis

Kolarctic CBC EU FINLAND NORWAY RUSSIA SWEDEN

Barents Link

REGIONAL COUNCIL OF KAINUU

Northern Axis - Barents Link (KO4159) Project Report:

Study of Vartius/Lytta - Arkhangelsk Road 2021

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ДОМЕР ПРОИЗВОДСТВЕННАЯ КОМПАНИЯ

Content

Introduction

This is the report of the Vartius – Arkhangelsk road study made in the Northern Axis – Barents Link (NABL) project of the Kolarctic CBC Programme. The Northern Axis – Barents Link project is a project implemented with nine partners from four countries. NABL aims to enhance regional transport possibilities and cross border mobility in the Barents Region.

The goal of this road study was to analyse line alternatives and preliminary impacts of Vartius – Arkhangelsk direct road.

The study was launched in December 2020 and completed in May 2021. It is financed by the Kolarctic 2014-2020 CBC Programme including the EU financing, Russian, Finnish, Swedish and Norwegian national financing as well as own financing of the 9 partners.

The study was made under the supervision of the NABL project Lead Partner, the Regional Council of Kainuu and prepared by the consultant group consisting of experts from Traficon Oy (Finland, led) and Domer PK (Russia).

The study was conducted in a following sequence:

- contacting to main stakeholders (the federal and regional road administrations)
- obtaining and analysing the information available for the current roads that may be used as parts of the direct road between Vartius and Arkhangelsk (in the Republic of Karelia and in the Arkhangelsk Region)
- producing several road alignment variants
- making preliminary assessment on the road variants
- introducing variants to (consulting with) the current road administrations of reginal and federal roads
- making preliminary costs estimates and impacts assessment of the road variants
- making proposal for development variants

During the work, the intermediate results were introduced to (consulted with) the following road administrations:

- GKU Arkhangelsk Regional Road Administration (“Arkhangelskavtodor”)
- Republic of Karelia Road Authority, Petrozavodsk
- FKU UPRDOR Kola, Petrozavodsk
- FKU Agency of the federal road Moscow-Arkhangelsk, Vologda

Current driving distance between Vartius/Lytta border crossing and Arkhangelsk city centre by car is 1200 km and estimated driving time 17 hours and 40 minutes. The route taken from Yandex.ru-site goes through Kostomuksha, Kochkoma (A137), Medvezh’egorsk (E105), Pudozh (A119), Kargopol, Plesetsk, Samoded (A215), Brin-Navolok to Arkhangelsk (M8).

Establishment of the Vartius/Lytta – Arkhangelsk federal road (partly as new road and partly as improved current regional road) has been included in the “Russian Transport Infrastructure Plan 2010-2030”. Russian Government Commission on Transport has included the direct federal road Vartius/Lytta - Arkhangelsk into the “Long-term development plan until 2031” (decision from 13.04.2018).

Executive summary

Establishment of the Vartius/Lytta – Arkhangelsk federal road (partly as new road and partly as improved current regionals road has been included in the "Russian Transport Infrastructure Plan 2010-2030". Russian Government Commission on Transport has 13.4.2018 included the direct federal road Vartius/Lytta - Arkhangelsk into the Long-term Development Plan for the Network of Federal Public Roads until 2031.

This report has been produced by the Northern Axis – Barents Link (NABL) project with goals to study and analyse road line alternatives and preliminary impacts. The road itself would improve east-west transport possibilities inside NW of Russia and the Barents Region.

Origin - destination by road	distance currently by car	distance after the new road by car (km, hours)	difference between current and new route (km), (hours)
Arkhangelsk – Moscow	1200 km 16 h		
Arkhangelsk - St. Petersburg, via Vologda	1400 km 17,5 h	1145 km 14 h	**255 km, 3.5h**
Arkhangelsk - St. Pet., via Mirnyj, Vytegra	1160 km 18 h	1145 km 14 h	**15 km, 4h**
Arkhangelsk – Petrozavodsk via Pudozh	980 km 15 h	735 km 11 h	**245 km, 4 h**
Arkhangelsk- Murmansk via Pudozh	1600 km 23 h	1115 km 16 h	**485 km, 7 h**
Arkhangelsk- Vartius/Lytta via Pudozh	1200 km 19 h	705 km 11 h	**495 km, 8 h**

The following principles have been followed during the planning process:

- Current federal road A 137 between Vartius/Lytta border crossing and federal road "Kola" R-21 will function as part of Vartius – Arkhangelsk direct road without variants. Development of this road will continue based on the decisions of the "road owner", UprDorKola.
- When planning the road section variants between federal road "Kola" R-21 and Arkhangelsk, the main idea has been to utilize fully the resource of current regional roads, municipal roads and even roads "without owners". That approach would bring a direct road connection quickly into public use with rather low investments. After the direct road has been put into operation with modest investments, the quality improvements of the road connection can be launched, and they may last rather a long time. This way all the investments are immediately in use after the opening of each rehabilitated road section.

The following describes road alignment variants analyzed between the crossing of federal road R-21 ("Kola") / federal road A 137 and Arkhangelsk. Variants between R-21 and the border of the Republic of Karelia and the Arkhangelsk Region:

- R-21 road - Nadvoicy – Valdai road – Arkhangelsk border ("red", about 157 km)
- R-21 road – Belomorsk – Nyuhcha - Arkhangelsk border ("yellow", about 239 km)

Variants between the border of the Republic of Karelia /the Arkhangelsk Region and Onega river:

- The border of the Republic of Karelia – Zolotukha - railway station Nimenga – Trudovaya Sloboda - a 1200 m long new bridge over Onega River ("red", about 108 km)
- The border of the Republic of Karelia – Zolotukha - railway station Nimenga – White Sea coast - Trudovaya Sloboda - 1200 m long new bridge over Onega River ("red-black", about 122 km)
- The border of the Republic of Karelia – Zolotukha – railway stations Nimenga and Chasta - Naumovskaya - 500 m long new bridge over Onega River ("red -violet", about 128 km)

- The border of the Republic of Karelia – Zolotukha - railway stations Nimenga and Chasta - Porog - 250 m long new bridge over Onega River (”red - blue”, about 149 km)
- The border of the Republic of Karelia – Unezhma – Zolotukha- railway station Nimenga – Trudovaya Sloboda - 1200 m long new bridge over Onega River (“yellow-red”, about 102 km)

Variants between the Onega river and the city of Arkhangelsk:

- Onega town – Kyanda – Rikasikha and Arkhangelsk city via Arkhangelsk-Severodvinsk current federal road M-8 (“red”, about 208 km)
- Porog – Kodino – Samoded (new road) – Brin-Navolok and Arkhangelsk city via current Kholmogory federal road M-8 (“blue – brown”, about 328 km)
- Porog – Savinskij- Samoded – Brin-Navolok (via two current regional roads) and Arkhangelsk city via current Kholmogory federal road M-8 (“blue”, about 468 km).

Forecast of the traffic volumes on the border of the Republic of Karelia and the Arkhangelsk Region using the new road is 1200…1300 vehicles per day (24 h, Annual average daily traffic – hereinafter referred to as AADT) in 2050 dividing 30-32% into heavy and 68-70% into passenger cars. The new road would be partly constructed as a new and partly reconstructed from the current road to class III with 90 km/h planning speed with 2 lanes (one carriageway) and 7,5 m width.

A very preliminary economic assessment shows that the variant “red” would give the best benefits to society against the investment (b/c = 2.3 or 13 years of paying back period). The red variant would have the alignment through Vartius/Lytta – Kochkoma (A-137) – Kola road (R-21) – Nadvoicy – Valdai road – Zolotukha - Maloshujka – upper Nimenga railway station Nimenga – lower Nimenga - Trudovaya Sloboda - 1200 m new bridge over Onega River – Onega – Kyanda – Rikasikha - Arkhangelsk city.

The cost of the road investment in “red” variant has been estimated of 32.500 MRub (about 360 M€) dividing 14.700 MRub (163 M€, 93 km reconstruction and 38 km new construction) for the territory of the Republic of Karelia and 17.800 MRub (198 M€, 94 km reconstruction and 13 km new construction) for the Arkhangelsk Region territory. Onega - Kyanda – Rikasikha road improvement costs (161 km of regional road reconstruction) has not been included in these figures, because the Arkhangelsk Region is planning to make them in the nearest years. If also Onega-Kyanda-Rikasikha road rehabilitation costs would be included in the Vartius - Arkhangelsk new road costs, the b/c - ratio would be 1.5 or 20 years of paying back period.

Another alignment (”yellow”: Kola road (R-21) – Belomorsk - Nyuhcha - Unezhma – Zolotukha- continuing to “red”) through the White Sea coast villages in the Republic of Karelia would be also feasible (b/c = 1.7 or 17 years of paying back period), but only with the pre-condition that the road Belomorsk – Nyuhcha reconstruction/construction would be made as investment by the Republic of Karelia and not included in the road investment costs of the direct road.

The largest impacts of the new road will be inside Russian territories as for Arkhangelsk inhabitants the road will bring the northern capital St Petersburg 15-255 km closer (depending on the route used). The reginal centre Petrozavodsk would be 245 km and Murmansk 485 km closer to Arkhangelsk than today. Moreover, the 2 million inhabitants of Western side of the Barents Region would be 495 km closer than today about 1 million inhabitants of the

Arkhangelsk Region. This would tremendously shorten the east-west distance (for people and freight) between several regions in the Barents Region and bring new possibilities to faraway territories of the EU.

Impacts to villages along the new road route and demography are positive. The new road would increase GDP´s of the regions, countries, and the EU.

As recommendation for the improvement of the road planning/design process, it would be advisable:

- using the possibilities of the Russian Constitute and Federal Laws ruling of the Environmental Impacts Assessment and Citizen Participation in the road planning/design processes. Regional legislation for that should be made/completed.
- sharing a road planning/design into several phases, where in the more overall phases could be discussed and agreed upon the principles of the road with the society. This would ease the tedious detailed design phase to go smoother.

As for the first implementation phases of the Vartius -Arkhangelsk road would be recommended in the Republic of Karelia:

- Improvement of about **38 km** section of ”road without owner”, non-constructed road to from Nadvoicy – Valdai regional road and border between the Republic of Karelia and Arkhangelsk Region

and in the Arkhangelsk Region:

- Improvement of about **13 km** section of current non-constructed ground winter road “without owner” and carry out year - round road maintenance.
- Facilitating of about **1,5 km** ice road (in winter) and ferry (in summer) over Onega River as a service provided by the regional road administration. Organisation of current ferry is not enough stabile (reliable) in producing that service.
- Going on with implementing of the project of the Onega – Kyanda – Rikasikha regional road improvements.

When implementing the first steps of opening the route, the road through the following densely populated areas shall be facilitated with road lighting and separate path or paths for light traffic (walking and cycling):

- In the Republic of Karelia (variant “red”): Nadvoicy – Pristan Nadvoicy, Dubrovo, Senguba, Ponga (together 13 km)
- In the Arkhangelsk Region (variant “red”): Zolotukha, Maloshujka, Upper Nimenga, railway station Nimenga, Lower Nimenga, Ponga subdistrict of Onega river south bank, Trudovaya Sloboda, new bridge over Onega river (together 17 km)
- In the Arkhangelsk Region in Onega- Rikasikha road: Onega town, Pokrovskoe, non-commercial gardening association Lesopil'shchik – non-commercial gardening association Stroitel (along the sea embankment), Tamica, Kyanda, cottage villages Taiga 1, 2 and 3 as well as from Pinki to Rikasikha, (together 57 km)
- In the Republic of Karelia, if variant “yellow” there will be implemented, locations and indicative lengths of densely populated areas and accordingly road sections with road lighting and separate path or paths for light traffic would be: Sosnovec, Zolotec (Matygora – Vygostroi) railway station Vig, Belomorsk, Suhoe, Virma, railway station Virma, Sumskij Posad, Kolezhma, village Nyuhcha - railway station Nyuhcha, Unezhma (together 27 km).

It is recommended to alter the Russian Government Decision (13.04.2018) of the end point location of the future federal road between “Kola R-21” and “M-8” from Brin-Navolok into

Rikasikha. The first gives cost- benefit ratio 0,6 and paying back period 49 years. The last gives cost- benefit ratio 1,5 and paying back period 20 years.

The questions, by whom and when the road works could be implemented, will be solved during negotiations between current owners of the road (local and regional administrative bodies) and the potential future owner or owners of the road (federal road authorities).

Резюме

Создание автодорожного маршрута – федеральной трассы Вартиус/Люття – Архангельск – за счет нового строительства, реконструкции и капитального ремонта существующих региональных трасс включено в «План развития транспортной инфраструктуры Российской Федерации 2010-2030». Правительственная комиссия по транспорту включила прямое автодорожное сообщение Вартиус/Люття – Архангельск в «План перспективного развития сети автомобильных дорог общего пользования федерального значения до 2031 года».

Настоящий отчет подготовлен в рамках проекта «Северная ось – Баренц Линк» Программы приграничного сотрудничества «Коларктик» с целью изучения и анализа альтернативных вариантов трассировки и воздействия. Трасса улучшит широтное транспортное сообщение в Северо-Западном Федеральном Округе Российской Федерации, а также в Баренцевом регионе.

	Расстояние и продолжительность автомобильной поездки в настоящий момент	Расстояние и продолжительность автомобильной поездки по новому автодорожному сообщению	Разница между существующим и новым маршрутом
Архангельск – Москва	1200 км 16 час		
Архангельск – Санкт-Петербург через Вологду	1400 км 17,5 час	1145 км 14 час	**255 км, 3,5 час**
Архангельск – Санкт-Петербург через Вытегру	1160 км 18 час	1145 км 14 час	**15 км, 4 час**
Архангельск – Петрозаводск через Пудож	980 км 15 час	735 км 11 час	**245 км, 4 час**
Архангельск – Мурманск через Пудож	1600 км 23 час	1115 км 16 час	**485 км, 7 час**
Архангельск- Вартиус-Люття через Пудож	1200 км 19 час	705 км 11 час	**495 км, 8 час**

При подготовке к исследованию исполнитель руководствовался следующим:

• Существующая федеральная трасса А-37 от международного пограничного пункта Вартиус-Люття до федеральной трассы «Кола» будет функционировать, как часть прямого автодорожного сообщения Вартиус – Архангельск. Развитие данного автодорожного сообщения продолжится на основании решений Федерального казенного учреждения «Управление автомобильной магистрали Санкт-Петербург-Мурманск Федерального дорожного агентства» (ФКУ Упрдор «Кола»), в оперативном управлении которого данная трасса находится.

• Готовя альтернативные варианты дорожных участков между федеральной дорогой Р-21 "Кола" и Архангельском, исполнитель исходил из необходимости полного использования ресурса действующих региональных дорог, муниципальных дорог, а также дорог без балансовой принадлежности. Такой подход позволил бы быстро ввести в общественное пользование прямое автодорожное сообщение при достаточно низких инвестициях. После ввода в эксплуатацию прямого автодорожного сообщения за счет небольших инвестиций, можно будет приступить к его качественному долгосрочному улучшению. Таким образом,

будет обеспечено немедленное использование всех инвестиций после открытия каждого отремонтированного участка автодороги.

Ниже приведено описание вариантов трассировки участка трассы от Архангельска до развязки федеральных дорог Р-21 «Кола» и А-137.

Варианты от Р-21 до границы Республики Карелия и Архангельской области:
• Трасса Р-21 – Надвоицы – Валдай – граница Архангельской области («красная», около 157 км)
• Трасса Р-21 – Беломорск – Нюхча – граница Архангельской области («желтая»», около 239 км)

Варианты от границы Республики Карелия и Архангельской области до реки Онега:
• Граница Республики Карелия – Золотуха – ж/д станция Нименьга – Трудовая Слобода – новый мост протяженностью 1200 м через реку Онегу («красный», около 108 км)
• Граница Республики Карелия– Золотуха - ж/д станция Нименьга – берег Белого моря – Трудовая Слобода – новый мост протяженностью 1200 м через реку Онега («красный», около 122 км)
• Граница Республики Карелия– Золотуха – ж/д станции Нименьга – Шаста – Наумовская – новый мост протяженностью 500 м через реку Онега («красно-фиолетовый», около 128 км)
• Граница Республики Карелия– Золотуха - ж/д станция Нименьга – Шаста – Порог - новый мост протяженностью 250 м через реку Онегу («красно-синий», около 149 км)
• Граница Республики Карелия – Унежма – Золотуха – ж/д станция Нименьга – Трудовая Слобода – новый мост протяженностью 1200 м через реку Онега («желто-красный», около 102 км)

Варианты от реки Онега до Архангельска:
• Город Онега – Кянда – Рикасиха и город Архангельск по участку Архангельск–Северодвинск федеральной трассы М-8 («красный, около 208 км)
• Порог – Кодино – Самодед (новая дорога) – Брин-Наволок и город Архангельск по федеральной трассе М-8 «Холмогоры» («голубой-коричневы», около 328 км)
• Порог – Савинский – Самодед – Брин-Наволок (по двум существующим региональным трассам) и город Архангельск по федеральной трассе М-8 «Холмогоры» («голубой», около 468 км).

В 2050 году прогнозируемые объемы перевозок на границе Республики Карелия и Архангельской области по новой дороге составят 1200-1300 транспортных средств в сутки (24 ч, ССИД), где доля грузового автотранспорта составит 30-32%, легкового – 68-70%. Новое автодорожное сообщение будет состоять из участка нового строительства и участка с реконструкцией существующей дороги до III категории, с проектной скоростью 90 км/ч с 2 полосами движения (одна проезжая часть) и шириной 7,5 метра.

По предварительной экономической оценке, «красный» вариант обеспечит наилучшие выгоды для сообщества относительно инвестиций (соотношение выгод и затрат 2,3 при периоде окупаемости 13 лет). По «красному» варианту трасса пойдет по маршруту Вартиус/Люття – Кочкома (А-137) – трасса Р-21 «Кола» – Надвоицы – Валдай – Золотуха – Малошуйка – Верхняя Нименьга – нижняя Нименьга –Трудовая Слобода - новый мост протяженностью 1200 м через реку Онега – Онега - Кянда - Рикасиха - Архангельск.

Стоимость дорожных инвестиций в "красном" варианте оценивается в 32.500 миллионов рублей (около 360 млн. евро), из которых 14,7 миллионов рублей (реконструкция 93 км и новое строительство 38 км) приходится на территорию Республики Карелия, а 17,8 миллионов рублей (реконструкция 94 км и новое строительство 13 км) – на территорию Архангельской области.

Затраты на благоустройство дороги Онега – Кянда – Рикасиха (161 км реконструкции областной дороги) в эти цифры не включены, так как данные затраты заложены в бюджете Архангельской области на ближайшие годы. При включении затрат на благоустройство дороги Онега – Кянда – Рикасиха в затраты по новому автодорожному сообщению Вартиус – Архангельск, соотношение выгод и затрат составит 1.5 при периоде окупаемости 20 лет.

Еще одна трассировка («желтая»: трасса Р-21 «Кола» – Беломорск – Нюхча –Унежма – Золотуха, все остальное по «красной») через населенные пункты берега Белого моря в Республике Карелия также будет рентабельной (соотношение выгод и затрат 1.7, период окупаемости 17 лет), но только при условии, если строительство/реконструкция трассы Беломорск – Нюхча будет выполнена как инвестиция Республики Карелия, без включения данных инвестиций в стоимость прямого автодорожного сообщения.

Наибольшее воздействие новая дорога окажет на территории России, так как для жителей Архангельска она приблизит северную столицу – Санкт-Петербург – на 15- 255 км. Региональный центр Петрозаводск станет на 245 км, а Мурманск – на 485 км ближе к Архангельску. При этом на 495 км сократится расстояние между двумя миллионами жителей западной части Баренцева региона и миллионом жителей Архангельской области. Значительно уменьшится дистанция грузовых и пассажирских перевозок между несколькими регионами Баренцева региона, откроются новые возможности для отдаленных территорий ЕС.

Воздействие на населенные пункты, расположенные вдоль нового автодорожного маршрута, и демографические показатели являются положительными. Новая дорога увеличит ВВП регионов, стран и ЕС.

В качестве рекомендации по улучшению процесса планирования/проектирования дороги было бы целесообразно:
• использовать возможности российского законодательства в части оценки воздействия на окружающую среду и участия граждан в процессе дорожного планирования/проектирования. Для этого должно быть принято/завершено региональное законодательство.
• разделить дорожное планирование/проектирование на несколько этапов, где на более общих этапах можно было бы обсудить и согласовать принципы дороги с сообществом. Это облегчило бы трудоемкую стадию детального проектирования.

Проект прямого автодорожного сообщения Вартиус-Архангельск рекомендуется разделить на лоты. На первом этапе реализации рекомендуется:

В Республике Карелия:
Капитальный ремонт около 38 км участка без балансовой принадлежности, от региональной дороги Надвоицы – Валдай до границы Республики Карелия и Архангельской области

А также в Архангельской области:
• Капитальный ремонт и круглогодичное содержание 13 км участка без балансовой принадлежности существующего грунтового зимника.
• Обеспечение около 1,5 км ледовой дороги (зимой) и паромной переправы (летом) через реку Онега в качестве услуги, предоставляемой областной дорожной администрацией. Действующее паромное сообщение недостаточно стабильно (надежно) для предоставления этого сервиса.
• Продолжение реконструкции региональной трассы Онега – Кянда – Рикасиха.

В первую очередь необходимо обустроить дорожное освещение и трассы легкового транспорта (пешеходный и велосипедный) для дороги, проходящей через следующие густонаселенные районы:

• В Республике Карелия («красный» вариант): Надвоицы – Пристань Надвоицы, Дуброво, Сенгуба, Поньга (всего 13 км)

• В Архангельской области («красный» вариант): Золотуха, Малошуйка, Верхняя Нименьга, ж/д станция Нименьга, нижняя Нименьга, Поньга, микрорайон на южном берегу реки Онега, Трудовая Слобода, новый мост через реку Онега всего 17 км)

• В Архангельской области на трассе Онега - Рикасиха: город Онега, Покровское, СНТ «Строитель» - СНТ «Лесопильщик» (вдоль побережья), Тамица, Кянда, коттеджные поселки Тайга 1, 2 и 3, а также от Пинки до Рикасихи (всего 57 км)

• В Республике Карелия, при реализации «желтого» варианта, местоположение и ориентировочная протяженность густонаселенных районов и, соответственно, участков дорог с дорожным освещением и отдельными трассами легкого транспорта: Сосновец, Золотец (Матигора - Выгострой), ж/д станция Виг, Беломорск, Сухое, Вирма, ж/д станция Вирма, Сумский Посад, Колешма, деревня Нюхча - ж/д станция Нюхча, Унежма (всего 27 км).

Рекомендуется внести изменения в постановление Правительства Российской Федерации (13.4.2018) о местоположении конечной точки будущей федеральной дороги от трассы Кола Р-21 до трассы М-8 от Брин-Наволока до Рикасихи. Согласно постановлению от 13.4.2018, соотношение затрат и выгод составляет 0,6, а срок окупаемости – 49 лет. В случае изменения соотношение затрат и выгод составит 1,5, а срок окупаемости - 20 лет.

Вопросы о том, кем и когда могут быть осуществлены дорожные работы, будут решаться в ходе переговоров между нынешними владельцами автодорог (местными и региональными администрациями) и потенциальным будущим владельцем или владельцами автодорог (федеральными государственными органами).

1. Planning principles and variants in different sections

1.1 Federal and regional programs, strategies, and plans

Establishment of the Vartius/Lytta – Arkhangelsk federal road (partly as new road and partly as improved current regional roads) has been included in the "Russian Transport Infrastructure 2010-2030". A snapshot from that schema is in picture below.

Picture. Snapshots from the "Russian Transport Infrastructure 2010-2030"

Russian Government Commission on Transport has included the direct federal road Vartius/Lytta - Arkhangelsk into the "Long-term development plan until 2031" (decision from 13.04.2018).

Road route Arkhangelsk – Rikasikha - Onega – Nadvoicy is included in the Strategy of Socio-economic Development of the Arkhangelsk Region until 2035.

GKU Arkhangelsk Regional Road Administration (Arkhavtodor) is carrying out preparation works (planning/detailed design) to road section between Onega and Rikasikha and implementation is planned in nearest years. It is part of the "red" variant introduced later in this report.

The Republic of Karelia Road Authority is conducting a study of variants of development of regional road between Belomorsk town and Nyuhcha village. There is no information of when the road will be implemented. This road section is a main part of the "yellow" variant introduced later in this report.

1.2 Principles in this road pre-study

The following principles has been followed during the planning process:

Current federal road A 137 between Vartius/Lytta border crossing and federal road "Kola" R-21 will function as part of Vartius – Arkhangelsk direct road without variants. Development of this road will continue based on the decisions of the "road owner", UprDorKola.

When planning the road section variants between federal road "Kola" R-21 and Arkhangelsk, the main idea has been to utilize fully the resource of current regional roads, municipal roads and even roads "without owners". That approach would bring a direct road connection quickly into public use with low investments. After the direct road has been put into operation with modest investments, the quality improvements of the road connection can be launched, and they may last rather long time. This way all the investments are immediately in use after the opening of each rehabilitated road section.

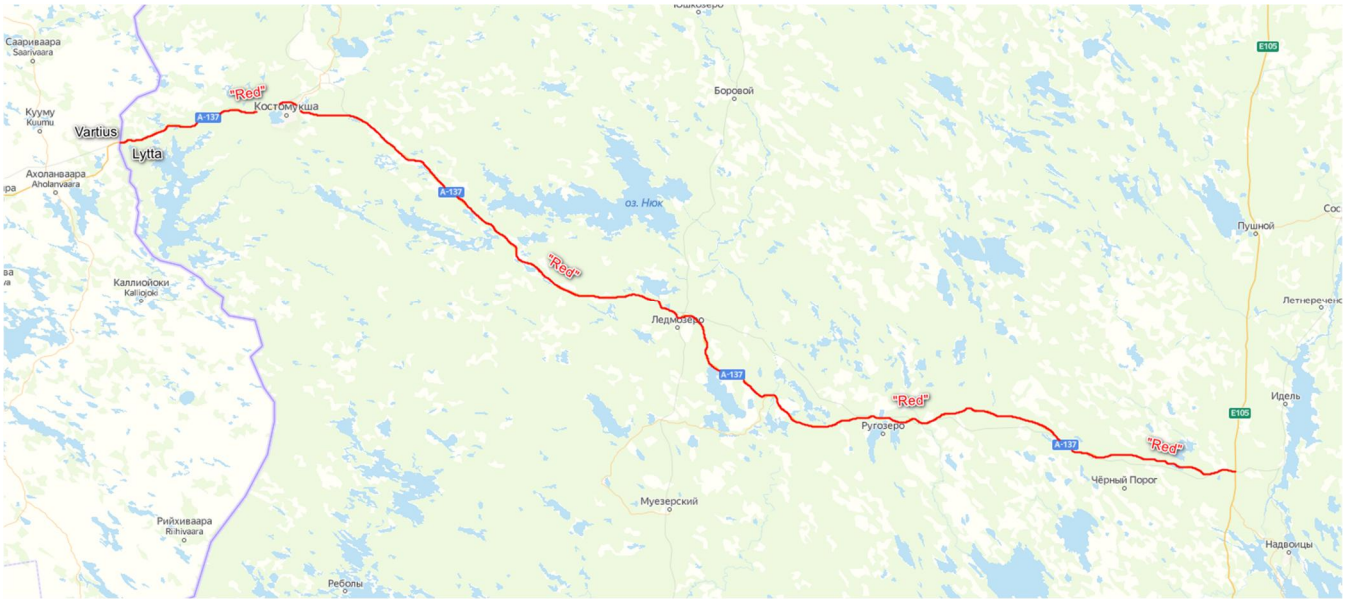
1.3 Distribution of the planned road in sections

To make variants and analyses, the road was divided into four sections:

- Road between Lytta/Vartius border crossing – and R-21 (current federal road A – 137 between EU/Russian border and St. Petersburg – Murmansk federal road R-21)
- Variants between Nadvoicy and the border of the Republic of Karelia and the Arkhangelsk Region
- Variants between the border of the Republic of Karelia and the Arkhangelsk Region and Onega river
- Variants between Onega river and current federal roads near the city of Arkhangelsk

1.4 Road between Vartius/Lytta and current federal road “Kola” (R-21)

The road section between Lytta/Vartius Russian/Finnish border crossing and St. Petersburg – Murmansk federal road at Nadvoicy is already a current federal road (A-137). This section is **232,3 km** long, asphalt-paved road between R-21 Kola – Tiksha – Ledmozero – Kostomuksha – border with Finland. It is situated in the Segezha and Muezerskij Districts and the Kostomuksha District of the Republic of Karelia. Most of the road is currently in class III (202 km) and a small part (30 km) in class IV. It has 11 bridges with total length of 412 m.



Picture. Road section between Vartius/Lytta – “Kola” federal road R-21 or E105 (map: Yandex.ru)

Picture. Road between Vartius/Lytta road border crossing and Kostomuksha (Photo: Vyacheslav Lyapin, Domer PK)

Picture. Road between Vartius/Lytta road border crossing and Kostomuksha (Photo: Vyacheslav Lyapin, Domer PK)

The current federal road A – 137 is the first section of the future Vartius/Lytta – Arkhangelsk road. No variants have been introduced nor assessed for this federal road managed by the FKU UPRDOR ”Kola” with headquarters in Petrozavodsk.

1.5 Variants between R-21 (Kola-road) and border of the Republic of Karelia and the Arkhangelsk Region

Two variants have been introduced and assessed for the Vartius – Arkhangelsk road between the federal road “Kola” (R-21) and the border of the Republic of Karelia and the Arkhangelsk Region. They are:

- R-21 road - Nadvoicy – Valdai road – Arkhangelsk border (“red”, about 157 km)
- R-21 road – Belomorsk – Nyuhcha - Arkhangelsk border (“yellow”, about 239 km)

They are located in the Segezha District and Belomorsk District.

1.5.1 The “red” road variant R-21 road – Valdai road – the Arkhangelsk Region border

Picture. Road variants between “Kola” federal road (R-21 or E105) and border of the Republic of Karelia and the Arkhangelsk Region (map: Yandex.ru)

This route variant continues from crossing of the roads R-21 and A-137 to south on the following road sections:

- Federal road “Kola” R-21 (E105) for about **6 km** between A137 and Segezha road
- “Kola” – Segezha road **11,2 km** (a section of current regional road)
- Access to Nadvoicy road **8,7 km** (whole current regional road)
- Nadvoicy – Ponga – Valdai - Vochmozero **93 km** (a section of current regional road)
- private (“with no owner”), non-constructed road to border between the Republic of Karelia and the Arkhangelsk Region **38 km** (whole current private road)

The length of this “red” variant section in the Arkhangelsk Region is together about **157 km**. Most of the road is currently in class IV and the “non-owner” section in class V. The section has 13 bridges with total length of 432 m. If to count together the length between Vartius/Lytta

border crossing and border between the Republic of Karelia and the Arkhangelsk Region, it will be about **389 km** during the “red” variant.

Picture. Current Nadvoicy–Ponga–Valdai-Vochmozero road
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current private (“with no owner”), non-constructed road between Nadvoicy–Ponga–Valdai-Vochmozero road and border of the Republic of Karelia and the Arkhangelsk Region
(Photo: Vyacheslav Lyapin, Domer PK)

1.5.2 The “yellow” road variant R-21 road - Belomorsk – Nyuhcha – the Arkhangelsk Region border

This route variant continues from crossing of the roads R-21 and A-137 to north on the following road sections:

- Federal road “Kola” R-21 (E105) for about **46 km** between A137 and Belomorsk road
- R-21 – Belomorsk road **45 km** (whole current regional road)
- Belomorsk – Sumskij Posad **49 km** (whole current regional road)
- Sumskij Posad – Kolezhma **25,5 km** (whole current regional road)
- Kolezhma - Virandozero **25,5 km** (new regional road under planning)
- Virandozero – Nyuhcha **22 km** (whole current regional road)
- Nyuhcha – the border of the Republic of Karelia and the Arkhangelsk Region, **26 km** (new regional road and a 100 m bridge over the main railway Belomorsk-Obozersjkij needed)

The length of this “yellow” variant section is together about **239 km**. Most of the current roads are in class IV and only R-21 road is in class III. About 52 km of new road is needed to construct. The current sections have 24 bridges with total length of 1338 m. If to count together the length between Vartius/Lytta border crossing and border between the Republic of Karelia and the Arkhangelsk Region via this “yellow” variant, it will be about 471 km.

Picture. Current Belomorsk – Sumposad regional road in the Republic of Karelia (Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current Sumposad - Kolezhma regional road in the Republic of Karelia
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current road near Kolezhma in the Republic of Karelia
(Photo: Vyacheslav Lyapin, Domer PK)

1.6 Variants between the border of the Republic of Karelia and the Arkhangelsk Region and Onega River

Five route variants have been introduced and assessed for the Vartius – Arkhangelsk road between the border of the Republic of Karelia and the Arkhangelsk Region and Onega river. They are:

- "red" variant: border of the Republic of Karelia – Zolotukha- railway station Nimenga – Trudovaya Sloboda and a 1200 m new bridge over Onega River and to Onega town (about 108 km)
- "red and black" variant: border of the Republic of Karelia – Zolotukha - Maloshujka – bank of White Sea - Trudovaya Sloboda - 1.2 km new bridge over Onega River - Onega town (about 122 km)
- "red and violet" variant: border of the Republic of Karelia – Zolotukha - Maloshujka – railway stations Nimenga and Chasta - along the north side of main railway to Naumovskaya - 500 m new bridge over Onega River - Onega town (about 128 km)
- "red and blue" variant: border of the Republic of Karelia – Zolotukha - Maloshujka – railway stations Nimenga and Chasta - along the south side of main railway to Porog - 250 m new bridge over Onega River and continuing to Onega town (about 149 km)
- "yellow and red" variant: border of the Republic of Karelia (near Unezhma) – Zolotukha- railway station Nimenga – Trudovaya Sloboda and a 1,2 km new bridge over Onega River and to Onega town (about 102 km)

The new bridge over Onega River is a very valuable and costly object to construct. In the road alignment variants has been preliminary assessed three variants of the bridge locations:

- Trudovaya Sloboda (with river width about 1200 m)
- Naumovskaya (with river width about 500 m) and
- Porog (with river width about 250 m).

At this phase as the length of a bridge has been taken the width of the river on that bridge location without bridge that is more detailed planning. In more detailed planning and design phases should be investigated, if the 1200 m bridge in "red" variant can be implemented much shorter. This decision needs negotiations between the responsible authorities.

These road variants are located on Onega, Primorskij and Kholmogory Districts.

Picture. Road variants between border of the Republic of Karelia and the Arkhangelsk Region and Onega river (map: Yandex.ru)

1.6.1 The "red" variant: border of the Republic of Karelia – Zolotukha- railway station Nimenga – Trudovaya Sloboda - Onega town

This route variant continues from crossing of the border of the Republic of Karelia and the Arkhangelsk Region on the following roads:

- border of the Republic of Karelia – Zolotukha **34,9 km** (whole current municipal road)
- Zolotukha – Maloshujka **24,2 km** (whole current municipal road)
- Maloshujka – railway station Nimenga **13,7 km** (whole current municipal road)
- railway station Nimenga – village Nimenga **8 km** (whole current regional road)
- current non-constructed ground road **13 km** (whole current road without owner)
- Vorzogory – Onega **13,3 km** (a section of the current regional road)
- a **1,2 km** new bridge over Onega River between Trudovaya Sloboda and Onega town

The length of this "red" variant section is together about **108 km.** Most of the current roads are in class V and about 13 km of new road has to be constructed. The current sections have 11 bridges with total length of 320 m. If to count together the length between Vartius/Lytta border crossing and Onega town via this "red" variant, it will be about 485 km.

Picture. Current border of the Republic of Karelia and the Arkhangelsk Region – Zolotukha municipal road (near Zolotukha village)
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current Zolotukha – Maloshujka municipal road
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current Zolotukha – Maloshujka regional road (near Maloshujka)
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current non-constructed ground road (without owner, near Nimenga village)
(Photo: Ivan Sinitsin, Onega District Administration)

Picture. Current non-constructed ground (winter) road without owner
(Photo: Ivan Sinitsin, Onega District Administration)

Picture. Current non-constructed ground (winter) road without owner
(Photo: Ivan Sinitsin, Onega District Administration)

Picture. Current Vorzogory – Onega regional road (near Onega River)
(Photo: Ivan Sinitsin, Onega District Administration)

Picture. Location of the new bridge over Onega River between Trudovaya Sloboda and Onega town
(Photo: Vyacheslav Lyapin, Domer PK)

1.6.2 The ”red and black” variant: border of the Republic of Karelia – Zolotukha - Maloshujka –White Sea Coast - Trudovaya Sloboda and to Onega town

This route variant continues from crossing of the border of the Republic of Karelia and the Arkhangelsk Region on the following roads:

- border of the Republic of Karelia – Zolotukha **34,9 km** (whole current municipal road)
- Zolotukha – Maloshujka **24,2 km** (whole current municipal road)
- Maloshujka – railway station Nimenga **13,7 km** (whole current municipal road)
- railway station Nimenga – village Nimenga **8 km** (whole current regional road)
- current non-constructed ground road along the White Sea coast **16,5 km** (a section of current road without owner)
- Vorzogory – Onega **24 km** (whole current regional road)
- a **1,2 km** new bridge over Onega River between Trudovaya Sloboda and Onega town

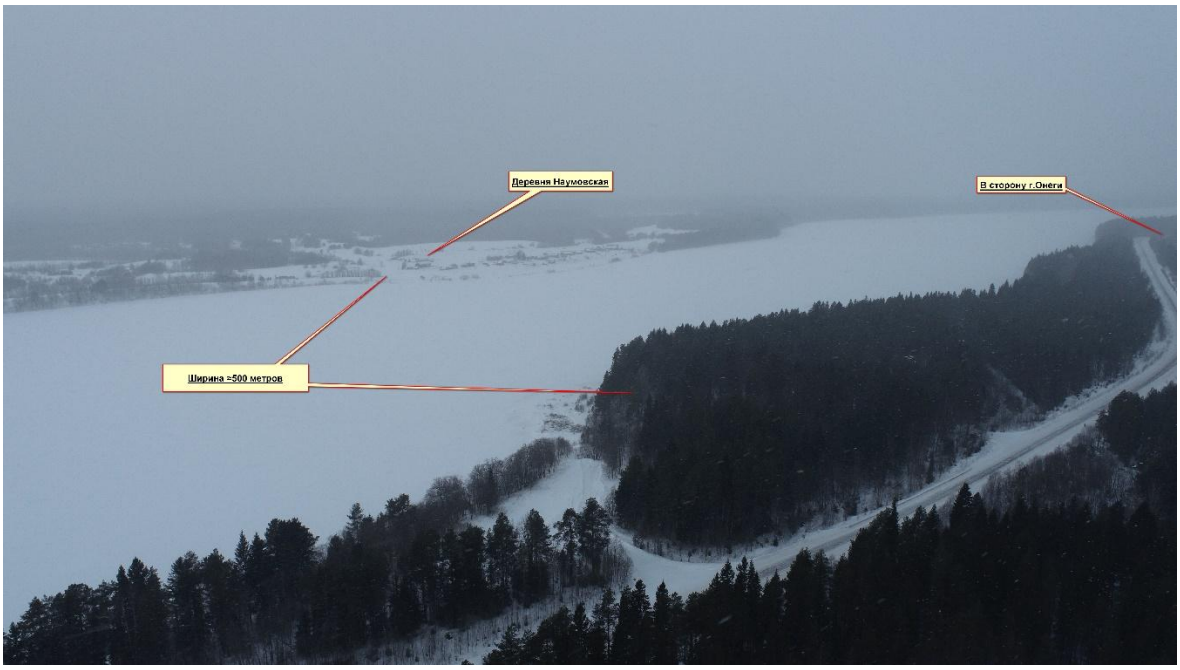
The length of this “red” variant section is together about **122 km**. If to count together the length between Vartius/Lytta border crossing and Onega town via this “red-black” variant, it will be about 511 km.

1.6.3 The ”red and violet” variant: border of the Republic of Karelia – Zolotukha - Maloshujka – railway stations Nimenga and Chasta - along the north side of main railway to Naumovskaya with 500 m new bridge over Onega River to Onega town

This route variant continues from crossing of the border of the Republic of Karelia and the Arkhangelsk Region on the following roads:

- border of the Republic of Karelia – Zolotukha **34,9 km** (whole current municipal road)
- Zolotukha – Maloshujka **24,2 km** (whole current municipal road)
- Maloshujka – railway station Nimenga **13,7 km** (whole current municipal road)
- railway station Nimenga – village Chasta **14,5 km** (whole current regional road)
- new road between villages Chasta and Naumovskaya along the north side of the main railway **29 km**
- and new bridge over Onega River of **0,5 km** (new regional road)
- a section of the road Savinskij – Yarnema - Onega **11 km** (section of current regional road)

The length of this “red and violet” variant section is together about **128 km**. If to count together the length between Vartius/Lytta border crossing and Onega town via this “red-violet” variant, it will be about 517 km.



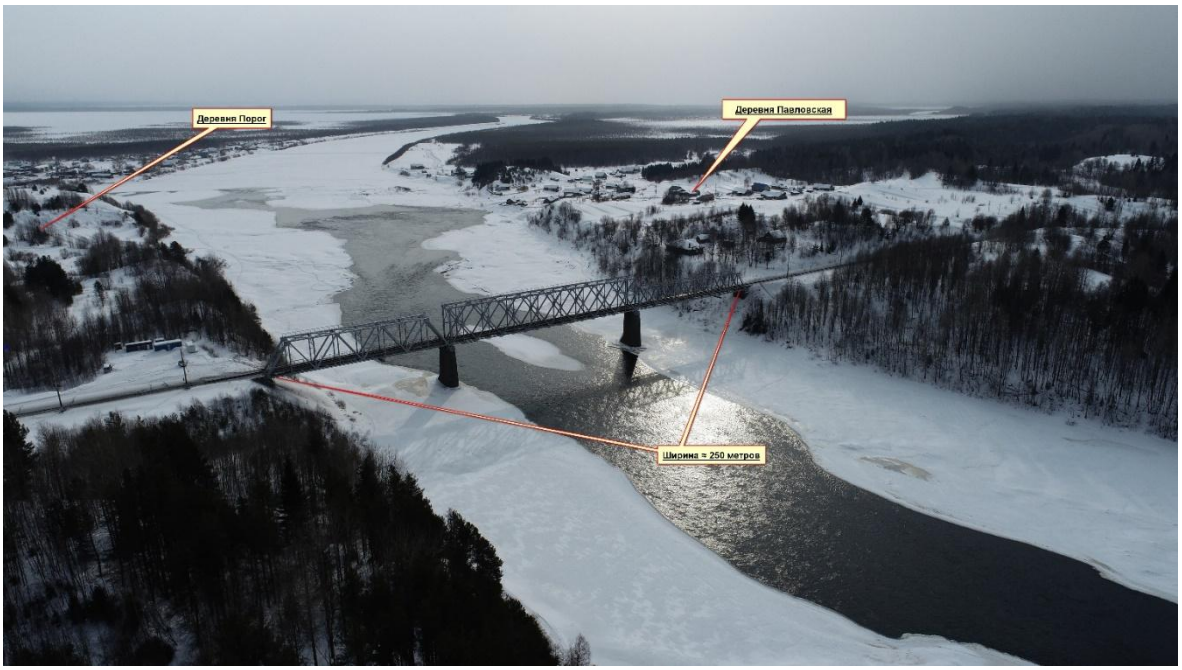
Picture. Location of the new bridge over Onega River near Naumovskaya village and the current regional road Savinskij – Yarnema - Onega (near Onega town)
(Photo: Vyacheslav Lyapin, Domer PK)

1.6.4 The ”red and blue” variant: border of the Republic of Karelia – Zolotukha - Maloshujka – railway stations Nimenga and Chasta and along the south side of main railway to Porog with 250 m new bridge over Onega River and to Onega town

This route variant continues from crossing of the border of the Republic of Karelia and the Arkhangelsk Region on the following roads:

- border of the Republic of Karelia – Zolotukha **34,9 km** (whole current municipal road)
- Zolotukha – Maloshujka **24,2 km** (whole current municipal road)
- Maloshujka – railway station Nimenga **13,7 km** (whole current municipal road)
- railway station Nimenga – village Chasta **14,5 km** (whole current regional road)
- new road between villages Chasta and Porog along the south side of the main railway **41 km**
- new bridge over Onega River of **0,25 km** (new regional road)
- a section of the road Savinskij – Yarnema- Onega **21 km** (section of current regional road)

The length of this “red and blue to Onega” variant section is together about **149 km.** If to count together the length between Vartius/Lytta border crossing and Onega town via this “red-blue” variant, it will be about 538 km.



Picture. Location of the current railway bridge, new road bridge location over Onega River (near Porog village) (Photo: Vyacheslav Lyapin, Domer PK)

1.6.5 The "yellow and red" variant: border of the Republic of Karelia (near Unezhma) – Zolotukha- railway station Nimenga – Trudovaya Sloboda and a 1200 m new bridge over Onega River and to Onega town

This route variant continues from crossing of the border of the Republic of Karelia and the Arkhangelsk Region on the following roads:

- border of the Republic of Karelia – Unezhma – "red" variant **11 km** (whole current municipal road)
- border of the Republic of Karelia – Zolotukha **18 km** (section of current municipal road)
- Zolotukha – Maloshujka **24,2 km** (whole current municipal road)
- Maloshujka – railway station Nimenga **13,7 km** (whole current municipal road)
- railway station Nimenga – village Nimenga **8 km** (whole current regional road)
- current non-constructed ground road **13 km** (whole current road without owner)
- Vorzogory – Onega **13,3 km** (a section of the current regional road)
- new bridge **1,2 km** over Onega River between Trudovaya Sloboda and Onega town.

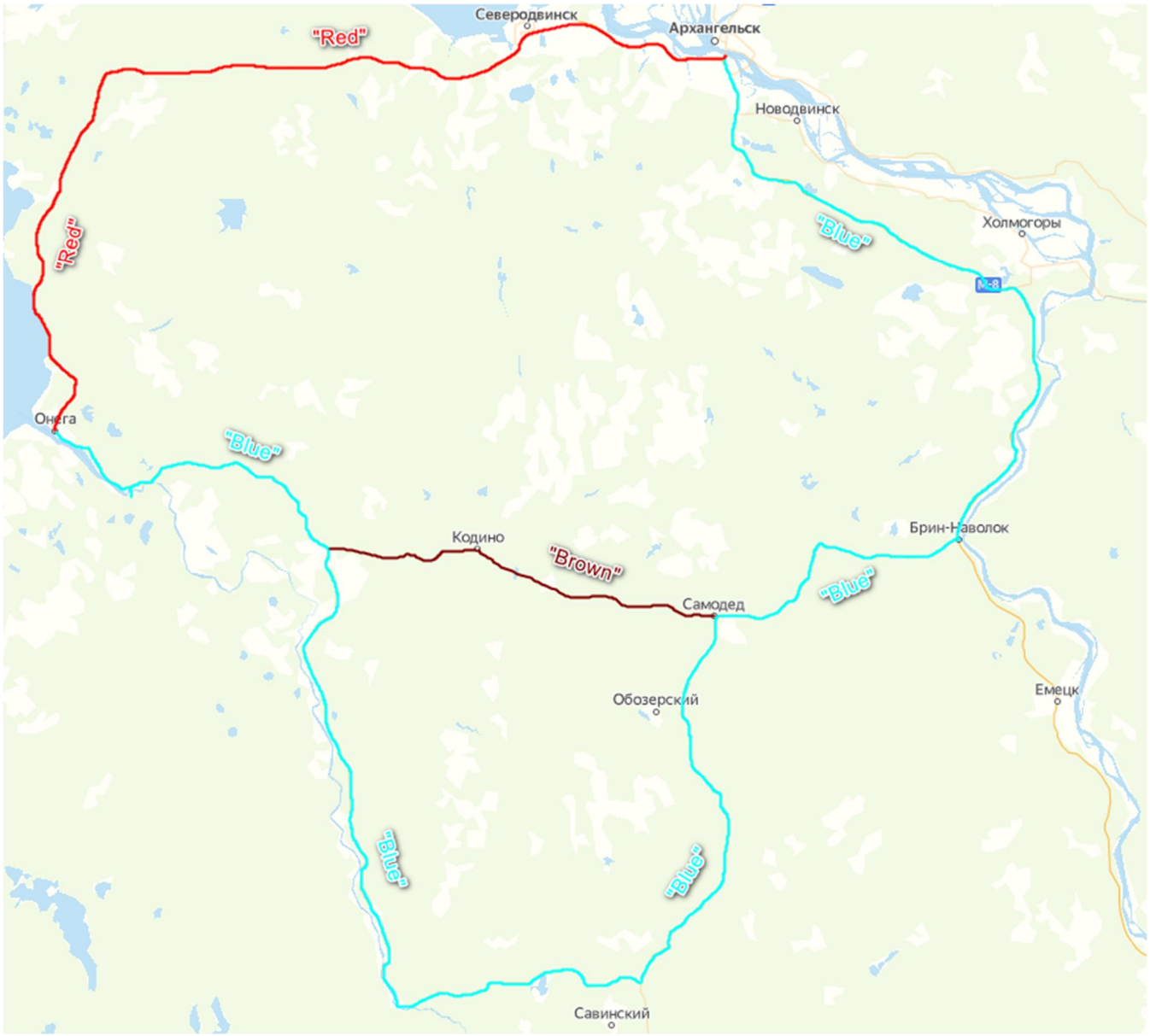
The length of this "yellow and red" variant section is together about **102 km**. All the current roads are in class V and about 13 km of new road has to be constructed on the place of current ground road. The current sections have 11 bridges with total length of 255 m. If to count together the length between Vartius/Lytta border crossing and Onega town via this "yellow-red" variant, it will be about 573 km.

Picture. Current regional road between border of the Republic of Karelia - Unezhma (near Unezhma village) (Photo: Vyacheslav Lyapin, Domer PK)

1.7 Variants between Onega river and current federal roads near the city of Arkhangelsk

Three route variants have been introduced and assessed for the Vartius – Arkhangelsk road between Onega river and current federal roads near city of Arkhangelsk. They are:

- Onega town – Kyanda – Rikasikha and Arkhangelsk city via Arkhangelsk-Severodvinsk current federal road as continuation of road variants between border of the Republic of Karelia and the Arkhangelsk Region – Onega River (about 208 km)
- Porog – Kodino – Samoded (new road) - Brin-Navolok and Arkhangelsk city via current Kholmogory federal road M-8 as continuation of road variants between the border of the Republic of Karelia and the Arkhangelsk Region – Onega River (about 328 km)
- Porog – Samoded - Brin-Navolok (via current regional road) and Arkhangelsk city via current Kholmogory federal road M-8 as continuation of road variants between the border of the Republic of Karelia and the Arkhangelsk Region – Onega River (about 468 km).



Picture. Road variants between Onega river and Arkhangelsk city (map: Yandex.ru)

1.7.1 Variant Onega *town* – Kyanda - Rikasikha – Arkhangelsk city centre

The connection between Onega town and Arkhangelsk is formed as follows:

- Entrance road to the city of Onega **17 km** (whole current municipal asphalt-paved road)
- Onega - Tamica - Kyanda road **44 km** (whole current regional gravel road)
- Kyanda - Rikasikha **117 km** (whole current regional gravel and concrete-slab road)
- Rikasikha – Arkhangelsk city centre **28 km** (sections of current federal asphalt-paved road)

Picture. Current municipal road "Entrance to the city of Onega"
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current regional road Kyanda – Rikasikha near Onega
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current regional road Kyanda – Rikasikha between Kyanda and Severodvinsk
(Photo: Vyacheslav Lyapin, Domer PK)

Picture. Current regional road Kyanda – Rikasikha near Rikasikha (concrete road)
(Photo: Vyacheslav Lyapin, Domer PK)

The length of this “red” variant section is together about **208 km**. If to count together the length between Vartius/Lytta border crossing and city centre of Arkhangelsk, they are via different variants as follows:

variant between the border of the Republic of Karelia and the Arkhangelsk Region distance between Vartius/Lytta and Arkhangelsk
and Onega

“red“	485 km + 208 km = 693 km
“red and black”	511 km + 208 km = 719 km
“red and violet”	517 km + 208 km = 725 km
“red and blue”	538 km + 208 km = 746 km
“yellow and red”	573 km + 208 km = 781 km

1.7.2 Variant Porog – Kodino – Brin-Navolok - Arkhangelsk city centre

This route variant connects Porog village on the Onega river via current road Porog- Kodino and a new road between Kodino and Samoded (marked as brown in the schema) and following current road to Brin-Navolok and further to federal road Kholmogory to Arkhangelsk. The connection between Porog village and Arkhangelsk is formed as follows:

- Porog - Kodino **82 km** (section of current regional road)
- Kodino – Samoded **50 km** (new road)
- Samoded - Brin -Navolok **56 km** (section of current regional road)
- Brin-Navolok – Arkhangelsk city centre **140 km** (section of current federal road)

The length of this “red-blue-brown” variant section is together about **328 km.** If to count together the length between Vartius/Lytta border crossing and city centre of Arkhangelsk, they are via different variants as follows:

variant between the border of the Republic of Karelia and the Arkhangelsk Regiondistance between Vartius/Lytta and Arkhangelsk
and Onega

“red“	485 km + 21 km + 328 km = 834 km
“red and black”	511 km + 21 km + 328 km = 860 km
“red and violet”	517 km + 10 km + 328 km = 855 km
“red and blue	538 km + 328 km = 866 km
“yellow and red”	573 km + 21 km + 328 km = 922 km

1.7.3 Variant Porog – Savinskij – Samoded - Brin-Navolok - Arkhangelsk city centre

This route variant continues from Porog village via Savinskij regional road to Samoded and Brin-Navolok and further to federal road M-8 Kholmogory to Arkhangelsk. The connection between Porog village and Arkhangelsk is formed as follows:

- Porog - Savinskij **193 km** (a section of current regional road)
- Savinsij – Samoded – Brin-Navolok **135 km** (a section of current regional road)
- Brin-Navolok – Arkhangelsk city centre **140 km** (a section of current federal road)

The length of this variant section is together about **468 km.** If to count together the length between Vartius/Lytta border crossing and city centre of Arkhangelsk, they are via different variants as follows:

variant between the border of the Republic of Karelia and the Arkhangelsk Region distance between Vartius/Lytta and Arkhangelsk
and Onega

"red"	485 km + 21 km + 468 km = 974 km
"red and black"	511 km + 21 km + 468 km =1000 km
"red and violet"	517 km + 10 km + 468 km = 995 km
"red and blue" (through Savinskij)	538 km + 468 km =1006 km
"yellow and red"	573 km + 21 km + 468 km =1062 km

2. Preliminary assessment of the distribution of traffic

2.1 Current and forecasted traffic without and with the new road

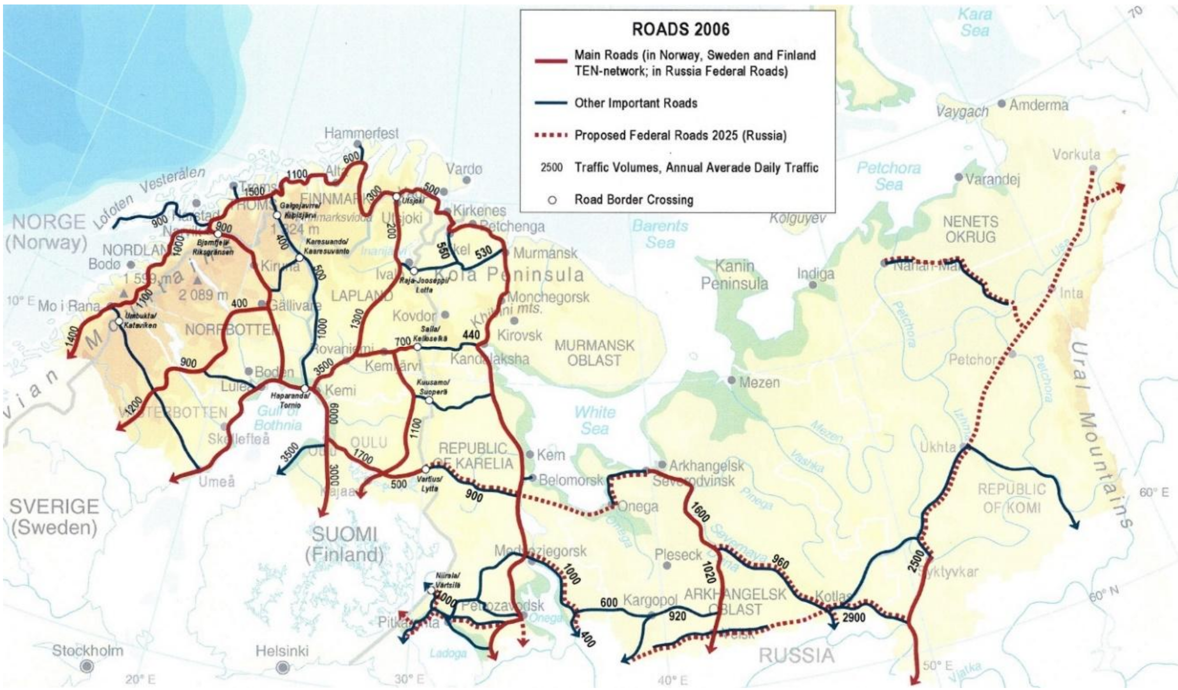
2.1.1 Road traffic by motor vehicles

The overall situation in the traffic volumes has been compiled from earlier studies by increasing the volumes from previous years by factors (following changes in Russian GDP) into current situation 2020. Some new traffic count results from 2020 were obtained from regional road administrations. New traffic counts or questionnaires have not been made.

Traffic forecasts to the year 2050 has been made by using an assumption that development of Russian economy and amounts of vehicles in average will increase the traffic in roads by 1,6 times in next 30 years.

The overall split of car traffic between passenger cars (light vehicles) and heavy vehicles (lorries) has been obtained from the information got from the regional road administrations.

As for the starting point has been shown road traffic volumes in the main roads of the Barents Region in 2006.



Picture. Road traffic volumes on the Barents Region main road network, Annual average daily traffic (AADT) 2006, vehicles/day. (Source: Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007)

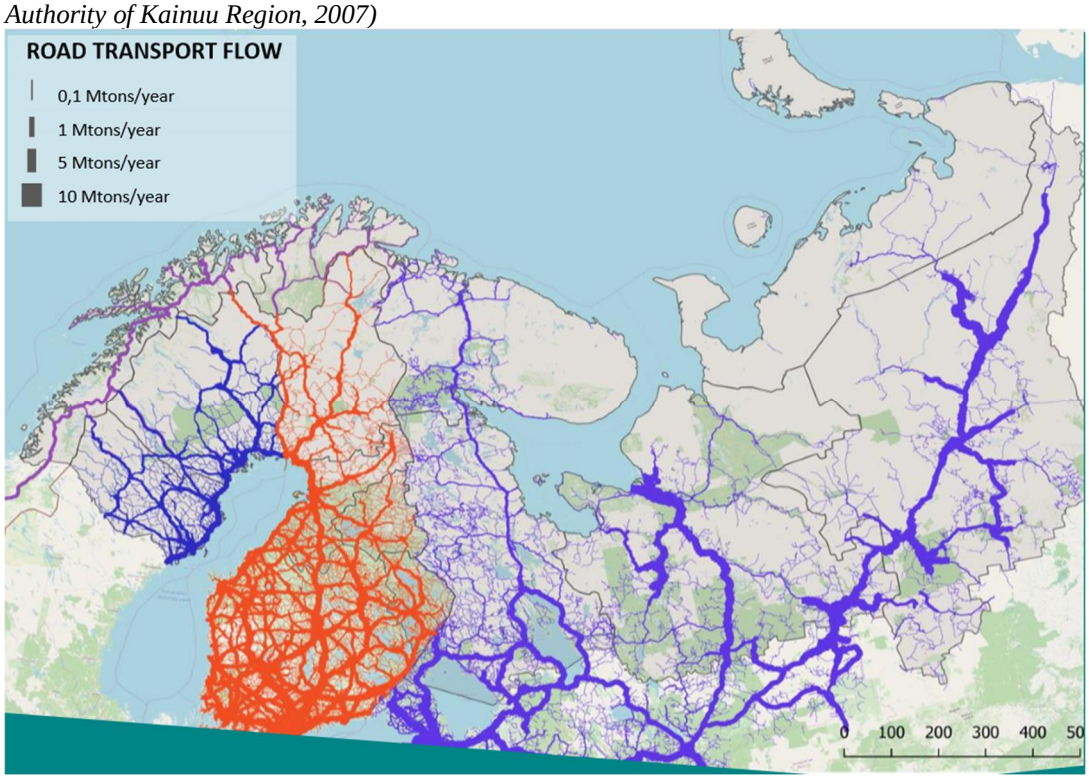
Traffic flows on the current roads in 2020 and forecasts in 2050 has been shown in the following pictures.

Picture. Current traffic volumes on the main road network, AADT 2020, vehicles/day. The figures of the year 2006 has been increased by 1.8 times following changes of Russian GDP). (Modified from the Source: Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007)

Picture. Forecast of the distribution of current traffic volumes on the main road network including the new road Vartius - Arkhangelsk, AADT 2020, vehicles/day. (Modified from the Source: Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007)

Picture. Forecast of the current traffic volumes on the main road network (without changing the network), AADT 2050, vehicles/day. (Modified from the Source: Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007)

Picture. Forecasted of the traffic volumes on the main road network including the new road Vartius - Arkhangelsk, AADT 2050, vehicles/day. (Modified from the Source: Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007)

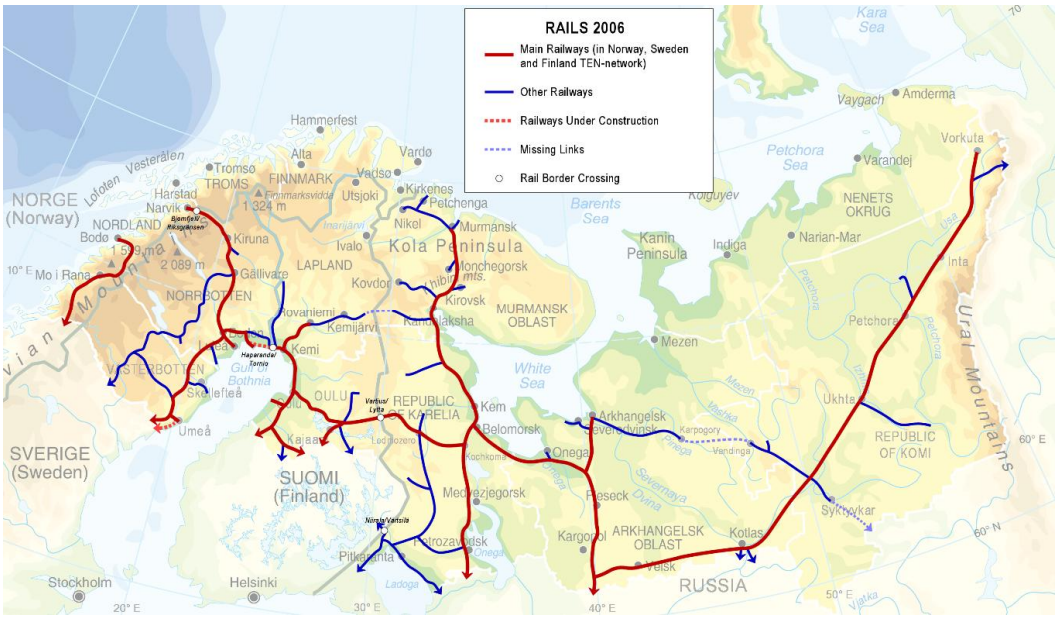


Picture. Current freight traffic volumes on the main railway network 2019, million tons/year 2019. (Source: KO1029 Barents Region Transport and Logistics -report "World Transport Market and Logistics Projects" with Lead Partner, the Regional Council of Kainuu 2020)

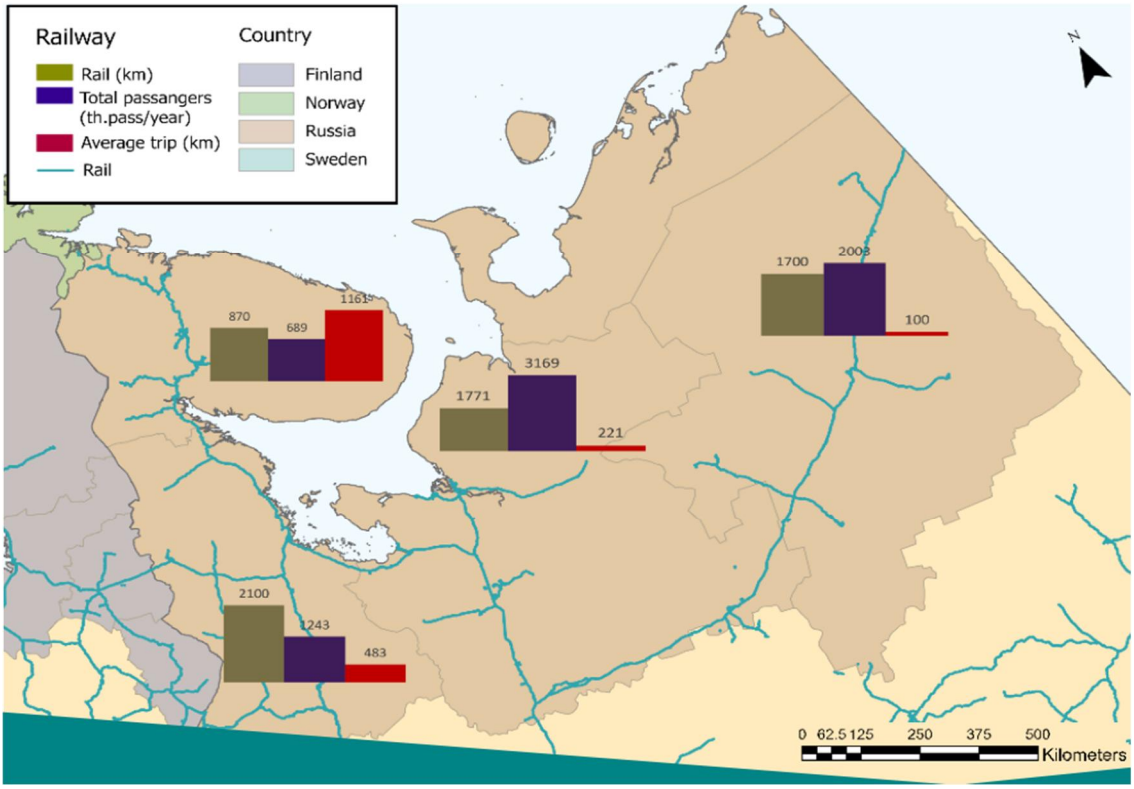
Division between the light and heavy vehicles in the road traffic can be estimated to remain like it is today:

- between 65 and 70% of light vehicles
- between 30 and 35% of heavy vehicles.

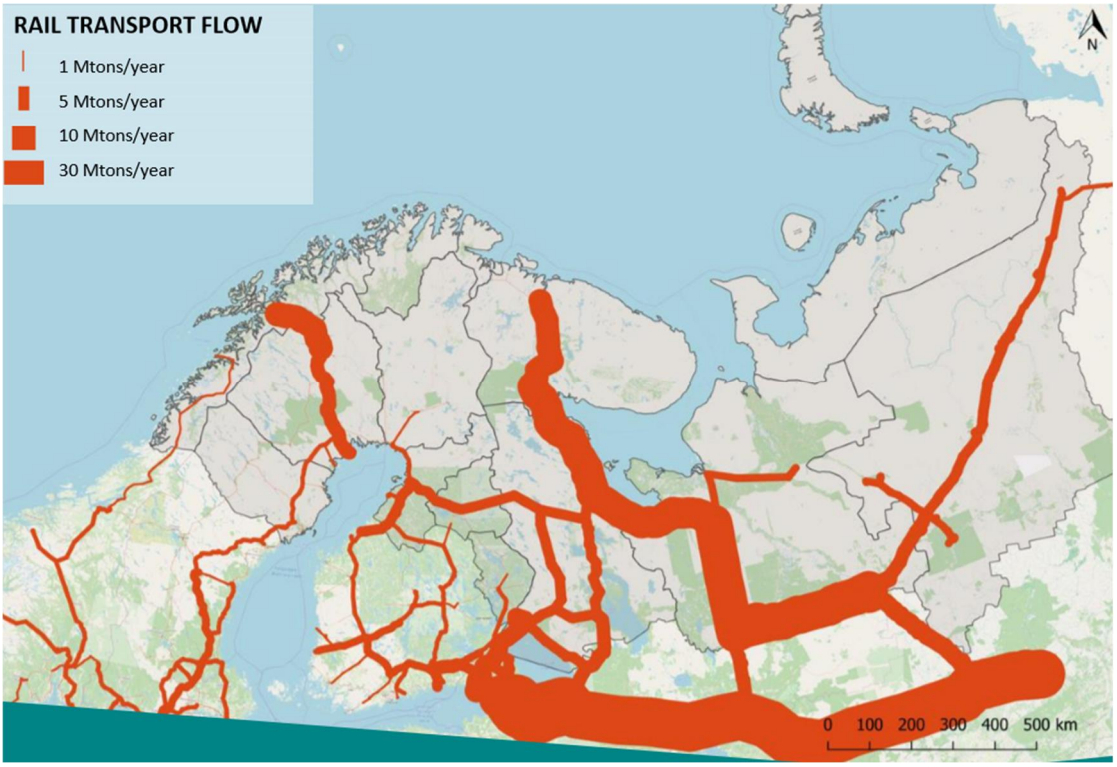
2.1.2 Railway passenger and freight transport



Picture. Main railway network in the Barents Region (Source: Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007)



Picture. Current passenger transport volumes in Russian Barents Region railways, passengers/year in 2019. (Source: KO1029 Barents Region Transport and Logistics -report "World Transport Market and Logistics Projects" with Lead Partner, the Regional Council of Kainuu 2020)



Picture. Current freight transport volumes on the main railways, Million tons in year 2019.
(Source: KO1029 Barents Region Transport and Logistics -report "World Transport Market and Logistics Projects" with Lead Partner Regional Council of Kainuu 2020)

2.1.3 Changes between the modes of transport

Passengers

Distributing of the volumes between the modes (e.g., from train to cars) will happen on the following reasons:

1. Totally new trips that would not have been made if the new road would not have been implemented. New trips will be made because of better accessibility.
2. Current trips that will be re-routed because of shorter or otherwise better (less expensive) other (new) transport connection. The new road offers about 495 km shorter (measures via the "red" variant) car trip Arkhangelsk – Vartius and Arkhangelsk – Murmansk, 15 - 255 km shorter car trip between car trip Arkhangelsk - St. Petersburg and 245 km between Arkhangelsk and Petrozavodsk.
3. Current trips that will be re-directed as the same service that earlier was bought from e.g., Moscow, can be via new road done by 15-255 km shorter car trip from St. Petersburg or 500 km shorter trip from Finland.
4. Trips that were earlier made by different mode of transport. E.g., a 485 km shorter road trip to Murmansk would be after the new road rather attractive compared to railway trip.

Freight

During 2018, when the Kolarctic -application was prepared and submitted by the Lead Partner of NABL -project, is it was planned to analyse changes of freight transport changes as impacts of the new Vartius/Lytta - Arkhangelsk road. For this was planned to use Frisbee – freight transport model (owned by the Finnish State and used in dozens of projects as an analyse tool) and STAN- computer program. Unfortunately, the model and the program were closed on the end of the year 2019 and the project could not carry out planned analyses.

Distributing of the volumes between the modes (e.g., train to cars) would not significantly happen, because train is very cost-competitive on long distance freight transport. However, new heavy vehicle trips may be born (feeding trips between forest and railway) when forest is better available to timber industry after the new road.

2.1.4 Walking and bicycling

Light traffic (walking and cycling) will significantly appear on the road near and on the densely populated areas. This means that when the road passes or goes through a village or town, the new road or a current connection serving as part of the new main road have to be facilitated with separate walking/cycling paths. Proposals for these has been made in detailed description of each road alignment variant.

2.2 Preliminary assessment of the road parameters

Road parameters of the current road sections and proposal for the future parameters has been introduced in the annex 1 of this report. It consists of the following information for each variant by section:

- road class 2020 and proposal for 2050
- speed level (planning speed) 2020 and proposal for 2050
- number of lanes 2020 and proposal for 2050
- width of lanes 2020 and proposal for 2050
- pavement type 2020 and proposal for 2050
- length of the road structure
- amount of culvert pipes under the road
- amounts of bridges and their approximate summary length.

A second portion of parameters has been introduced in the report chapter 2.4.1 consisting of road lengths the road variants going through densely populated areas.

2.3 Planning principles

2.3.1 Overall principles in planning of the Vartius/Lytta - Arkhangelsk direct road

The following principles has been followed during the planning process:

Current federal road A-137 between Vartius/Lytta border crossing and federal road "Kola" R-21 will function as part of Vartius – Arkhangelsk direct road without variants. Development of this road will continue based on the decisions of the "road owner", UprDorKola.

When planning the road section variants between federal road "Kola" R-21 and Arkhangelsk, the main idea has been to utilize fully the resource of current regional roads, municipal roads and even roads "without owners". That approach would bring a direct road connection quickly into public use with low investments. After the direct road has been put into operation with modest investments, the quality improvements of the road connection can be launched, and they may last rather long time. This way all the investments are immediately in use after the opening of each rehabilitated road section.

More detailed road parameters of the current road sections and proposal for the future parameters has been introduced in the annex 1 of this report.

2.3.2 Principles of earth (soil) material obtaining

Rather huge amounts of basic road embankment materials are needed to replace peat taken away as a frequent ground material under the road variant alignments. What comes to upper layers (super-structures), crashed stone materials will be most likely transported by train. This goes at least in the Arkhangelsk side, which lacks quality stone materials.

However, the needed soil materials and crushed stones needed for the road improvements will be procured through in commercial base (through tenders).

2.3.3 Principles of special measures to protect the environment

Harm to environment can be made during construction or reconstruction works and during exploitation of the road. This goes especially the waters (rivers, lakes), where:

- During the construction time, the flow of water may not be regulated in a way that it could impact floods or decrease living conditions of fish. As well, preventing of chemical contamination to waters during the construction time has to be guaranteed.
- During exploitation time, the dangerous goods transport and road maintenance technologies (like slippery preventing materials) are environmental risks.

These risks will be recognized and mitigated during the road´s detailed design, construction, and exploitation periods.

The administrative body of **waters** (rivers, lakes) in the regions is the Federal state authority "Main water basin agency of fishing and protection of water biologic resources

(федерального государственного бюджетного учреждения «Главное бассейновое управление по рыболовству и сохранинию водных биологических ресурсов», ФГБУ). This is the stakeholder on the more detailed road design phases when the drafts of bridges and culverts and hydrological counts has been developed.

The road alignment variants do not cross or locate in the neighborhood of known **nature protection areas**.

The "standard" **forests** (not protected in nature protection areas) in the planning area are under the following administrations:

- Ministry of Nature Resources and Forest Industry of the Arkhangelsk Region (Министерство природных ресурсов и лесопромышленного комплекса Архангельской области)
- Ministry of Nature Resources and Ccology of the Republic of Karelia (Министерство природных ресурсов и экологии Республики Карелия).

As for the road **land allotment**, the road "owner" is engaged in land acquisition. Before the launch of construction, the road owner hires a cadastral engineer, who allocates a plot for the road, makes measurements, and coordinates the actions between all interested parties. After all the approvals, cadastral engineer receives decisions and if they are positive, the project will go on.

What comes to **old villages** that are along the road variants, it will be considered case by case in the detailed design phase, if a by-pass (detour) road should be facilitated to prevent possible harmful impacts to build cultural environments.

2.4 Proposals for the implementation in phases

2.4.1 First steps in the Republic of Karelia and in the Arkhangelsk Region

In the Republic of Karelia:

- Improvement of about **38 km** section of private ("with no owner"), non-constructed road to from Nadvoicy – Valdai regional road and border between the Republic of Karelia and Arkhangelsk Region.

In the Arkhangelsk Region:

- Improvement of about **13 km** section of current non-constructed ground road ("with no owner") and carry out year-round road maintenance.
- Facilitating of about **1,5 km** ice road (in winter) and ferry (in summer) over Onega River as a service provided by regional road administration. Organisation of current ferry is not enough stabile (reliable) in producing that service.
- Going on implementing the project of the Onega – Kyanda – Rikasikha regional road improvements.

When implementing the first steps of opening the route, the road through the following densely populated areas shall be facilitated with road lighting and separate path or paths for light traffic (walking and cycling):

In the Republic of Karelia, if variant “red” will be implemented, locations and indicative lengths are:

- Nadvoicy – Pristan Nadvoicy 10 km (2800 inh.)
- Dubrovo 1 km
- Senguba 1 km
- Ponga 1 km

In the Arkhangelsk Region, if variant “red” will be implemented, locations and indicative lengths are:

- Zolotukha 1,5 km (419 inh.)
- Maloshujka 5,5 km (2802 inh.)
- Upper Nimenga 1,5 km (689 inh.)
- railway station Nimenga 0,5 km (59 inh.)
- Lower Nimenga 2 km (17 inh.)
- Ponga, subdistrict of Onega on south bank 2 km (2300 inh.)
- Trudovaya Sloboda 2,5 km
- New bridge over Onega river 1,5 km

In the Arkhangelsk Region, if Onega- Rikasikha road will be the implemented variant, locations and indicative lengths are:

- Onega town 11 km
- Pokrovskoe 1,5 km
- Non-commercial gardening association Lesopil’shchik – non-commercial gardening association Stroitel (along the sea embankment) 13 km
- Tamica 1,5 km
- Kyanda 3 km
- cottage villages Taiga 1, 2 and 3 3 km
- cottage villages between Pinki and Rikasikha 26 km

In the Republic of Karelia, if variant “yellow” will be implemented, locations and indicative lengths are:

- Sosnovec 4 km
- Zolotec (Matygora – Vygostroi) 5 km
- railway station Vig 0,5 km
- Belomorsk 7 km (11.000 inh.)
- Suhoe 0,3 km
- Virma 0,5 km
- railway station Virma 0,3 km
- Sumskij Posad 2,5 km
- Kolezhma 2 km
- village Nyuhcha - railway station Nyuhcha 3 km
- Unezhma 2 km (342 inh.)

In the Arkhangelsk Region, if variant “black” will be implemented, locations and indicative lengths are:

- Vorzogory 2 km (116 inh.)

In the Arkhagelsk Region, if variant “violet” will be implemented, locations and indicative lengths are:

- Shasta 1 km (290 inh.)
- Medvedevskaya – Amosovskij 2 km (Medvedecskya, 6 inh.)
- Anda 1 km

In the Arkhangelsk Region, if variant “blue” will be implemented, locations and indicative lengths are:

- railway station Ponga 2 km
- Porog 2 km
- Mashalina 0,3 km

In the Arkhangelsk Region, if variant Porog – Kudino- Samoded - Brin -Navolok connection will be implemented, locations and indicative lengths are:

- Bonguda 2 km
- railway station Mud’yuga 1 km
- railway station Kudino 1 km
- Samoded 2 km

In the Arkhangelsk Region, if variant Porog – Savinskij - Samoded - Brin -Navolok connection will be implemented, locations and indicative lengths are:

- Bonguda 2 km
- Glashanikha 1 km
- Verhovie 1 km
- Bolshoi Bor 0,5 km
- Pavlovskij Bor 1 km
- Selskij Bor 1 km
- Ancyferovskij Bor 3 km
- Proshkovo 0,5 km
- Yarnema 1,5 km
- Emsha 1 km
- Malinovka 0,5 km
- Samoded 2 km

These measures would open a new all year round (maintained) road connection between Vartius/Lytta and the city of Arkhangelsk and guarantee traffic safety and mitigate negative impacts of transit traffic for the current densely populated areas along the improved road route.

2.4.2 Next phases

After the direct route is all year opened, improvements can be made choosing those sections of the (gravel) road that would have most urgent needs.

Whatever variant will be chosen, by-pass roads (detours) shall be carefully compared with variants to go through current densely populated areas (stated in chapter 2.4.1) along road to be improved or built.

The questions, by whom and when the road works could be implemented, will be solved during negotiations between current owners of the road (local and regional administrative bodies) and the potential future owner or owners of the road (federal road authorities).

2.5 Indicative costs estimations for construction and rehabilitation

Indicative cost estimations for (new) constructed and rehabilitated sections are shown in annex 1 for all the assessed alternatives.

Table. Summary of indicative cost estimations of the whole new road in different variants (rate 1 € = 90 Rub).

Variant in the Republic of Karelia **MRub (M€)**	Variant in the Arkhangelsk Region, **MRub (M€)**	Onega – Rikasikha road **MRub (M€)**	Total (without Onega – Rikasikha) **MRub (M€)**
"red" 14.700 (163)	**"red" 17.800 (198)**	**16.400 (182)**	**32.500 (361)**
"red" 14.700 (163)	**"black" 19.700 (219)**	**16.400 (182)**	**34.400 (382)**
"red" 14.700 (163)	**"violet" (till Onega) 18.400 (204)**	**16.400 (182)**	**33.100 (368)**
"red" 14.700 (163)	**"blue" (till Onega) 20.700 (230)**	**16.400 (182)**	**35.400 (393)**
"red" 14.700 (163)	**"blue-brown" (via Kodino till Brin--Navolok) 45.700 (507)**		**60.400 (671)**
"yellow"21.300 (237)	**"red" 16.800 (189)**	**16.400 (182)**	**38.100 (423)**
"yellow"* 3.400 (35)	**"red" 16.800 (189)**	**16.400 (182)**	**20.200 (224)**

*) Kola fed road – Belomorsk – Nyuhcha road investments are not counted as project costs

3. Preliminary assessment of environmental issues

3.1 Principles

When planning and designing the new road, it shall bring accessibility, fluency and safety to traffic and guarantee sustainability to environment.

During planning and implementing a new road, the following environmental aspects shall be recognized and assessed:

- Impacts to current nature, scenery, and cultural environment. A new road impacts always to nature, scenery, and cultural environment. Impacts can be rather negative, but they can be mitigated with good planning and design. This study has preliminary assessed the impacts of road variants to nature protection areas.

- Impacts to nature resources. A road construction needs rather big amounts of soil materials as peat will be removed under the road structure and complemented with materials with better baring capacities. As well, lower road structure, embankment under the superstructure needs bearable soils. These materials can be most likely taken from cuttings on the road line or if that is not enough, from the nearest available soil taking place. The road superstructure (upper layers and pavement needs crashed stone materials, which might not be found in the nearest soil taking places and may be transported by train from far away. This study has shown the locations of nearest existing soil taking places to road variants.

- A new road always in some extent impacts to spreading of flora and fauna populations into parts along the road alignment.

- Impacts to current regional and town structure can be at the same time negative and positive. The road can give possibilities to develop regional structure with quicker transport of passenger and freight. What comes to towns and villages along the road variants, there will be a basic question that has to be solved before starting the detailed design phase: to go through the densely populated area or to build a by-pass road. Both variants need careful planning and designing so that road will not spoil current land use. The biggest mistake is to reconstruct road through the village with too high embankment and with too high allowed speed of vehicles. If the road will go through a village or town, the level of pavement should be on or under the current ground level and speed not more than 40 km/h guaranteeing the likelihood to stay alive in case of accident between vehicle and human being. Planning speed 40 km/h should be facilitated with a corresponding designed road environment. This study has listed the densely populated areas along the road variants that need this kind of consideration.

- Impacts to quality of air. A new road brings new air pollution to neighbourhood of new road. Amounts of NOx – combinations will increase. The tendency of smaller pollution (or even without pollution) of modern vehicles will help to mitigate this problem.

- Noise always will be increased along a new road. Road noise will be taken into consideration if a road will be located near the objects that do not tolerate or is sensitive to additional noise. This is question of road planning designing and possible additional protection measures to eliminate or mitigate negative impacts of road traffic noise.

- Consumption of energy. Consumption of gasoline in general will decrease because of the new road. as mileage driven in the transport network will be decreasing.

- Impacts to waters (ground waters, lakes, rivers). Principles of special measures to protect the environment has been described in the chapter 2.3.3 and rivers crossing the studied road variants in the chapter 3.3.2.

3.2 Basic material

As basic material, nature protection areas and rivers were identified. As well, all the old villages along the rivers, lakes and the White Sea represent historical area of the Russian North, where is concentrated a layer of original culture presented in traditions of aboriginal population, in remarkable works of wooden architecture.

The only ancient objects found near the road alternatives were the rock picture area of Vygozero having over 2300 pictures of about 4000 years of age.

3.3 Preliminary assessment

3.3.1 Nature protection areas

There are two nature protection areas, one in the neighbourhood and one crossing the road alignment variants.

In the Republic of Karelia, the current federal road A137 between Vartius/Lytta – Kochkoma goes through (about 20 km length), Nature Protection Area ”Kostomuksha” in Kalevala and Muezerskij Districts. It is established in 1983 and in 492 km2 of space.

Partly in the Arkhangelsk Region and partly in the Republic of Karelia, south from ”red” variant of the road border of the Republic of Karelia and the Arkhangelsk Region – Zolotukha – Malinovka is located the National Park ”Vodlozerski ” established in 1991 having area close to 5.000 km2. In 2001, by decree of UNESCO, Park received a status of biosphere reserve, first in the system of national parks of Russia.

3.3.2 Rivers crossing the road variants

In the Republic of Karelia, along the “red” or/and “yellow” variants is located the following rivers that are crossing the alignment are:

- Onda river
- The White Sea – Baltic Sea Canal
- Nyuhcha river
- Kuz river
- Virma river
- Suma river
- Kolezhma river

In the Arkhangelsk Region are located the following rivers that are crossing several variants:

- Kushereka and Leveshka river
- Nimenga river
- Kushereka river

In the Arkhangelsk Region, crossing the Porog - Kodino – Samoded - Brin--Navolok road, are located the following rivers:

- Kodina river
- Vaimuga river

In the Arkhangelsk Region, crossing the Porog – Savinskij- Samoded - Brin-Navolok road, are located the following rivers:

- Mud'yuga
- Kodina
- Vaimuga

3.3.3 Built environment

In the Republic of Karelia, the following old villages are on the route of at least some of the variants:

- Nadvoicy, Dubrovo, Senguba, Ponga, Sosnovec, Zolotec, Belomorsk, Suhoe, Virma, Sumskij Posad, Kolezhma, Nyuhcha, Unezhma

In the Arkhangelsk Region, the following old villages are on the route of at least some of the variants:

- Zolotukha, Maloshujka, Upper Nimenga, Lower Nimenga, Pokrovskoe, Tamica, Kyanda, Vorsogori, Shasta, Medvedevskaya, Anda, Porog, Mashalina, Bonguda, Samoded, Bonguda, Glashaniha, Verhovie, Bolshoi Bor, Pavlovski Bor, Selski Bor, Ancyferovskij Bor, Proshkovo, Yarnema, Emsha, Malinovka.

In the Arkhangelsk Region, the following densely populated areas are on the route of at least some of the variants:

- Onega town, Non-commercial gardening association Lesopil'shchik – non-commercial gardening association Stroitel embankment along the White Sea, cottage villages: Taiga 1, 2 and 3 and several cottage villages between Pinki and Rikasikha.

These villages have been presented in more detailed in chapter 2.4.

3.4 Preliminary measures to mitigate possible negative impacts to environment

3.4.1 Nature protection areas

There are two nature protection in the neighbourhood or crossing the road alignment variants.

Nature Protection Area "Kostomuksha" has current federal road A137 between Vartius/Lytta – Kochkoma inside herself in about 20 km length. A harmonic co-existence will continue.

National Park "Vodlozerski" is located some kilometres south from the nearest road variants. There will not be at least negative impacts to the Park from this road project. Moreover, better road conditions on those roads leading to the Park, will improve utilization of park with more accessible logistics.

3.4.2 Rivers and lakes crossing the road variants

Harm to environment can be made during construction or reconstruction works and during exploitation of the road. This goes especially when the road crosses a river. The biggest rivers listed in chapter 3.2.2 almost all have very wide variety of sorts of fish living in them (most of them even salmon-related).

During the construction time, the flow of water may not be regulated in a way that it could impact floods or decrease living conditions of fish. As well, preventing of chemical contamination to waters during the construction time must be guaranteed.

During exploitation time, the dangerous goods transport and road maintenance technologies (like slippery preventing materials) are environmental risks. These risks will be recognized and mitigated during the road´s detailed design, construction, and exploitation periods.

The administrative body of waters (rivers, lakes) in the regions is the Federal state authority "Main water basin agency of fishing and protection of water biologic resources" (FGBU). This is the stakeholder for more detailed road design phases when the drafts of bridges and culverts and hydrological counts has been developed.

3.4.3 Built environment

What comes to old villages along the road variants, it will be considered case by case in the detailed design phase, if a by-pass (detour) road should be facilitated to prevent possible harmful impacts to build cultural environments. If the through going road variant will be chosen, the road pavement level should be enough low (near or under the current ground level) and speed limit not more than 40 km/h. If these first pre-conditions cannot be accepted and followed on road detailed designs, a by-pass road should be seriously considered.

4. Other impacts

4.1 Citizen participation

4.1.1 Principles in Russia road projects

The starting points are:

- The normative Act concerning Content of Design Documentation and Requirements of Russian Federation N87 approved by the Russian Government on 16.2.2008 and its changes 21.12.2020 ("Content of the design documentation") and
- Clause 48 of the City Planning Code of the Russian Federation.

The normative Act N 87

Objectives of the Act is establishing content of design documentation and requirements to the items of the content when preparation of design documentation for:

- different types of capital construction and
- separate stages of construction, reconstruction, and capital repair.

Objects of capital construction are classified by their functional purposes and characteristics as follows:

- industrial constructions, besides line structures
- civil constructions
- linear structures (pipes, roads and railways, electricity lines, etc.)

In relation to roads – a stage of construction is also a complex of works on preparation of territory for construction (including official procedures of rights on land plots, demolition of old buildings, removing engineer communications, deforestation, archeology excavations within the territory of construction, mine clearing and other works.

Design documentation consists of text and graphical parts. The text part includes information of the items of capital building, description of technical and other solutions, explanations, references to normative and technical acts used, results of calculations justifying the decisions made. The graphical part represents the technical and other solutions (drawings, schema, plans, etc.). Working documentation consists of texts, working graphics, specifications of materials and elements, which support process of construction and implementation of architecture, technical, technological solutions provided with the design documentation/
Special technical conditions mast prior developing design documentation in case of normative requirements insufficiency to design documentation concerning safety and reliability (or absence of the requirements).

A necessity to develop requirements to some items of content of design documentation, which in accordance with this Act are not obligatory, shall be agreed between the Designer and Client. Documentation for capital constructions financed fully or partly from the public budgets shall be developed in a coordinated manner. In other cases the necessity and amount of development of some items of design documentation is determined by Client in the Order to design.

A necessity to develop design documentation as applied to stages of construction shall be defined by Client with the Order to design. A possibility to develop design documentation in relation to the stages shall be justified with calculations, which prove technological possibility to implement the applied design solutions when stage-by-stage construction.

The text part of the design documentation shall include:

- Description of design solution and arrangements on environment protection when construction process.

- Information of degrees of dangerous impacts to environment when construction (noise, vibration, emissions, change of ground water horizons and pollutions, barrage effect, karst, and landslides effects
- Justification of accepted duration of construction works and stages
- List of buildings and constructions (with their characteristics), which are designed within the line construction.

Clause 7 of the **text part** "Arrangements on protection of environment" shall include:

a) Results of Environmental Impact Assessment

b) List of arrangements on prevention and (or) decreasing risks of negative impacts of planned project on environment as well as rational usage of natural resources when line object construction and operation, including:

- air protection
- protection and rational usage of land and soil
- rational usage of:
  water and protection of water Sources and bio-resources when crossing them with the line construction; mineral resources;
- arrangements on collecting, usage, neutralization, transportation and utilization of dangerous wastes
- arrangements on protection of flora and fauna, including ways of migration, habitats
- information of storages of soils, quarries
- a program of environmental control (monitoring) of changing ecosystem components when construction and operation of the line construction in a whole and on certain sensitive sections and in case of accidents;
- constructive and protective solutions to prevent access of animal to dangerous sites of the line constructive

c) a list and calculation of costs to implement protective arrangements and compensations.

The **graphical part** shall include:

- Plan of land allotment with details (buildings, boundaries of deforestation, places reserved for storage of construction materials, assembling of constructions
- Schema of the line construction, embankment alignments
- Drawings of cross sections of embankments and excavating, pavement constructions
- Schema of location of buildings and constructions providing functionality of the line construction, which are designed within the line construction
- Schema with markings of boundaries of zones with special conditions of usage, habitats of animal and plants listed in the National Red Book or Regional Red Books.

Legislative acts related to issues, which are considered with this act are:

- The Decision of the Government of 5.03.2007 N 145 "Concerning Order to organize and execute state expertise of design documentation and results of engineer surveys"
- The Order of execution of state building supervision in the Russian Federation, approved by Decision of the Government
- The Order of development and approving special technical conditions in related sectors.
- Resolution of the Russian Government 23.01.2016 N 29 "Concerning requirements on provision of transport safety of subjects of transport infrastructure by transport modes

at the stages of their design, construction and requirements on safety of subjects (buildings, constructions), which are not items of transport infrastructure, but they are located on land plots adjacent to subject of transport infrastructure and classified by the Land Code to protected transport lands".

The Order of State Ecological Committee N 372

The Order of GoscomEcologija (The Russian Federation State Ecological Committee) 16/05/2000 N 372 "Concerning Assessment of Planned Activity on Environment" has a starting point from The Federal Act 23.11.95 N 174 "Concerning the state expertise". The legislative base to environmental impact assessment is formed with the legislations of the Russian Federation, regions, international agreements, decisions of referendum and other forms of democracy.

The objectives that have been stated in this Act are:

- Establishing the unified rules to organize and implement the state ecological expertise in the Russian Federation and definition of basic conditions to assess environmental impacts in the Russian Federation
- Regulating process of environmental assessment of planned projects on environment and preparing related materials as a base to justifying documentation for objects of the state ecological expertise.

Definition of terms, applied within the Act:

- **Assessment of impacts of a planned activity** on environment is a process facilitating making decision, which is environmentally oriented in relation to planned activity through identification of possible negative impacts, assessment of ecological consequences, taking into consideration of public opinion, development of actions to eliminate and prevent the negative impacts.

- **Ecological expertise** is establishing a correspondence between planned activity and ecological requirements and identification of acceptability to implement the activity in order to prevent risks to natural environment and related social, economic and other impacts.

- **Research on impact assessment** is a collection, analysis, documentation of the information necessary to achieve the objective of the impact assessment.

- **Planned activity** is an activity able to impact onto natural environment which is a subject of the state. A material on impact assessment – is a package of documentation prepared when assessing impacts of the planned activity onto environment, which is a part of documentation submitted to the state ecological expertise. Public discussion is a complex of actions, executed within the frames of impact assessment in accordance to the Order and other normative documents, targeted to: public informing concerning the planned activity and its possible impact onto environment; clarifying public preferences with taking them into account when impact assessing process.

Key issues of the Order N 372 are:

- The order and content of works, the content of environmental impact assessment documentation is defined with the actual national legislation related to kinds and concrete characteristics of planned activity.

- Client, ordering the impact assessment shell provide full and reliable initial information, means and methods of measurements, calculations, assessments in accordance with the legislation of the Russian Federation. Specially authorized state bodies in the sphere of environment protection shall provide available information concerning ecological condition of territories and environmental impacts of analogic activities in order to implement assessment of impacts.

- A degree of specification and completeness of assessing are defined depending on specifics of planned activities. It shall be sufficient to define and assess of all possible environmental and other related social, economic, and other effects of implementing the planned activity.

- Additional research shall be planned by Client in case of insufficiency of information necessary to assess impacts or appearance of uncertainty factors of impacts when decision making. The material of environment impact assessment shall include a developed program of ecological monitoring and control aiming to elimination of uncertainties.

The principles of the Order N 372 are:

- When executing EIA is necessary to originate from potential ecological danger of any activity (the principle of presumption of potential ecological dander).

- EIA executing is must on all stages of preparation documentation justifying activities until its submitting to the state expertise (the principle of obligatory the state ecological expertise).

- Provision of public participation when preparation and discussion materials on EIA of a planned activity is an integral part of the process EIA (the principle of openness, participation of public organizations, accepting public opinion when ecological expertise).

- EIA materials shall be scientifically justified, reliable, based on research, made with interrelations of environmental, social and economic factors (the principle of scientific justifying, objectivity of conclusions of the ecological expertise).

The results of the EIA are:

- Information of characters and scales of impact, alternatives of the EIA implementing, assessments of environmental and related social and economic consequences and their importance, possibility to eliminate the impacts.

- Identification and acceptance of public preferences when Client decision making in relation planned activity.

- Client’s decision on identification of alternatives to implement the planned activities (location, technologies, etc.) or rejection of the activity resulting the EIA.

All the results of EIA shall be documented in the EIA materials, which are a part of documentation submitted to the state expertise and used to managing decision making related to the activity.

Providing public participation (in that – informing public of the planned activity and attracting public to process of EIA) is implemented by Client on all stages of the process, starting from preparation of Technical Order on EIA.

Public discussions of the activity (the subject of expertise), including EIA of the planned activity shall be organized by Client together with bodies of local self-governance in accordance with the legislation of the Russian Federation.

In case of transboundary activities, the research and preparation of EIA materials shall be provided on the base of Convention UNO concerning EIA in the cross border context.

The order of public hearings during the EIA

Sequence of public hearings are regulated in:

- The Federal Act 23.11.95 N 174 "Concerning the state expertise" and
- The Order of GoscomEcologija №372 of 2000.

Public hearings are possible to organize in relation to any project, if it affects public interests and they are obligatory for project, which demands state ecological expertise.

Participants of public hearings are: Client, (initiator of the project or activity), bodies of executive power and local self-governance, interested public.
Minutes of public hearings is an annex of final EIA material, which is submitted to the "State ecological expertise" and to the "Public ecological expertise" (in case it takes place).

An order of public hearings is determined by the bodies of local self-governance with participation of Client and interested public. The final documents of hearings can be:

- send to the federal and regional bodies of state power, responsible for managing of natural resources to decision making with taking into account of public opinion and
- published by Media.

4.1.2 Comparison the procedures in the Russian legislation and rules of the EU

There are no principal differences between procedures of assessments based on the Russian legislation and rules of EBRD and EU. All of them provides involving public into process of assessments and decision making. The Russian and EBRD procedures concerning public participation have not any contradictions.

Contents and formats of assessments (including the EIA) have slight differences. The differences do not play a serious role because structures of assessment reports define individually by specific of concrete projects to optimize approach of analysis of environmental issues.

However, existing differences of practices to provide EIA have importance. It is known that not all Russian projects are developed with public involvement because insufficient

development of procedure (which sometimes is ignored) resulting low ecological culture of officials, designers, and population.

According to the Russian legislation, the final decision concerning a project made resulting the state ecological expertise, made after EIA. It makes the whole process of economic assessment more bureaucratic, labor and time demanding. Nevertheless, the state body, which made decision of a project, has to cancel the decision: to stop or postpone the project after revealing additional environmental risk factors during any stage of project implementation.

4.1.3 Principles in Finland on road projects

Principles form the laws

Starting points of the citizen participation are stated in the Constitution. The Land Use and Construction Act from the year 2000 strengthened possibilities of citizen participation by e.g., ruling the participation during land use plans, participation and evaluation plans, public hearings of proposal for land use plans and possibilities to notes for those that the plan may concern.

The Environment Protection Act and the law of Assessment of Environmental Impacts have objectives to improve citizen participation and guarantee possibilities to give notes/opinions also for those that have no direct interest or concern.

The Law of Administration from 2004 rules e.g., the publicity of matters in processes. The Law states that documents in process of authorities (civil servants) are public and the authorities should activate citizen participation in the preparation phases of decision-making.

Road Planning and land use planning

Road planning is a process in phases. Exactness of every phase and decision-making will be coordinated with land use planning. Road planning has 4 phases: Preliminary planning/studying, preliminary engineering road administrative planning and detailed designing. Plan of the new road or rehabilitated road has to be based (cannot contradict) on land use plan ruled by The Land Use and Construction Act.

During preliminary plans and studies of large road projects, the statements will be requested from municipalities and state authorities. Preliminary engineering and administrative road plan are plans that need to follow administrative procedures of the Road Act meaning e.g. spreading information, public hearings of the plans, possibilities to make notes and requesting of statements.

Phases in road planning

In preliminary plans and studies, the main aim is to understand the need and timing of this or that project or projects and their preliminary impacts and costs. The accuracy is that of regional plans and general land use plans.

Preliminary engineering gives approximate location of the road and connections to current and future other roads and land use as well as principles to avoid or mitigate harmful environmental impacts. If the project needs environmental assessment, it will be done in this phase. Approved preliminary engineering can limit civil building and other construction and rules road owner to compensations for land acquisition. As for citizen influencing and participation, this phase is the most important.

Road administrative plan is already detailed design and compares in land use plan accuracy to city planning. Location of the road and needed land will be defined exactly. After approval of the road plan, the road owner has the right to take (use) the lad for road purposes.

Detailed construction design will be made only after the financing has been guaranteed to the road project. Road construction may start already before the detailed construction designs are ready but newer before approval of the Road administrative plan.

Citizen participation in road planning

Road planning and designing is interactive co-operation in all phases. Participants, largeness and content and varies between phases, size and character of the project. In preliminary plans and studies, the emphasis is in co-operation between the organizations (road administration, municipalities, and regions).
In preliminary engineering phase, the co-operation partners for road administrations are regional councils, environmental authorities, landowners, local inhabitants, entrepreneurs and NGOs. Large citizen participation is important in this phase, because all meaningful and impacting decisions will be made during this phase. During road administrative plan phase, the citizen participation concentrates on details and will be carried out with municipalities, landowners, inhabitants and entrepreneurs.

Via citizen participation several stakeholders, interested parties, and citizens can participate with and impacts to road planning and designing. At the same time, road planners and designers will get valuable information. The main aim of the citizen participation is to achieve solutions that can be acceptable for all participants. In practice, citizen participation produces the better results the earlier it was started.

4.1.4 Carried out measures of citizen participation in this study

In this study, citizen participation has been conducted only through regional and local administrations and expert organizations. This is because the administrations have best overall picture of current situation in a scale that is used in this phase of the infrastructure project. At the same time, the local administrations can always decide what way and content of information they consider right to forward to their citizens. The administrations and expert organizations informed during (or consulted within) this road studying process were:

- GKU Arkhangelsk Regional Road Administration (“ArkhangelskAvtodor”) https://www.ador.ru/
- The Republic of Karelia Road Authority, Petrozavodsk https://upravtodor-rk.ru/
- FKU UPRDOR Kola, Petrozavodsk

https://fad.karelia.ru/
- FKU Agency of the federal road Moscow-Arkhangelsk, Vologda
https://www.ud-Kholmogory .ru/

- Ministry of Nature Resources and Forest Industry of the Arkhangelsk Region
https://dvinaland.ru/gov/iogv/minlpk/
- Ministry of Nature Resources and Ecology of the Republic of Karelia
https://ecology.gov.karelia.ru/

- Onega district (in the Arkhangelsk Region)
http://www.onegaland.ru/
- Primorskij District (in the Arkhangelsk Region)
https://www.primadm.ru/
- Plesetsk District (in the Arkhangelsk Region)
http://plesadm.ru/
- Segezha District (in the Republic of Karelia)
http://home.onego.ru/~segadmin/
- Belomorsk District (in the Republic of Karelia)
https://www.belomorsk-mo.ru/

- Administration of the National Vodlozerski Park (the Arkhangelsk Region, the Republic of Karelia)
vodlozero.ru/en
- Novgorod branch of JSC Stroyproekt Institute (Новгородский филиал АО «Институт «Стройпроект»)

4.2 Impacts to regional transport

4.2.1 Current and projected regional transport

Preliminary distribution of traffic as well as current and forecasted traffic without and with the new road has been assessed in the chapter 2.

4.3 Socio - economic impacts of the new road

A new road brings new possibilities to business and economic activities. Better accessibility of the region and districts will bring economic benefits. A very important factor in decisions of establishment of new businesses is the location and accessibility of that location.

4.3.1 Problems of current regional transport

Problems of current regional transport can be divided into following items:

Accessibility of remote regional territories of the Republic of Karelia and the Arkhangelsk Region to regional services:

- Rather many villages on in the Republic of Karelia (especially on the White Sea coast) are not facilitated with all year round maintained road connection to any regional or federal road.

- In the Arkhangelsk Region, the villages south of (behind) the Onega river are depending of ice road on winter and ferry in summer. During spring and autumn, there are times when not the ice road nor the ferry is available. Onega town has about 2300 inhabitants´ Ponga subdistrict right behind the Onega river with everyday problem to go over the river. The same problem has several villages south of the Onega river.

Accessibility of citizens of the Arkhangelsk Region to St Petersburg as capital of the Federal District:

- In current road network, the distance by passenger car is 1400 km meaning about 17,5 hours driving time (through Vologda). To compare with the Federal Centre Moscow, the distance is 1200 km and about 16 hours driving time. The route and time are taken from Yandex.ru-site.

Accessibility of citizens between the Arkhangelsk Region and the neighboring regional center Murmansk:

- In current road network, the distance by passenger car is 1600 km meaning about 23-24 hours driving time (through Pudozh). The route and time are taken from Yandex.ru-site.

Accessibility of citizens between the Arkhangelsk Region and the neighboring regional center Petrozavodsk:

- In current road network, the distance by passenger car is 980 km meaning about 14,5 hours driving time. The route and time are taken from Yandex.ru-site.

Accessibility of citizens between the Arkhangelsk Region and the neighboring country Finland:

- In current road network, the distance by passenger car is 1200 km meaning about 18 hours driving time. The route and time are taken from Yandex.ru-site goes through Kostomuksha, Kochkoma (A137), Medvezh'egorsk (E105), Pudozh (A119), Kargopol, Plesetsk, Samoded (A215), Brin -Navolok to Arkhangelsk (M8)

Number of new public transport routes through the new road connecting areas to local, regional, and federal centres, will increase.

4.3.2 Socio - economic indicators

Proposed indicators that will describe the magnitude and amount of change after the implementation of new road connection between Vartius/Lytta border crossing and the city of Arkhangelsk:

- Trip length by passenger car for towns and villages along the new road and Arkhangelsk as well as trip length between Arkhangelsk and the neighboring regional centers, Murmansk and Petrozavodsk, federal centre Moscow and nearest Russian /EU(Finnish) border at Vartius/Lytta border crossing.
- Trip time by passenger car for towns and villages along the new road and Arkhangelsk as well as trip length between Arkhangelsk and the neighboring regional centers, Murmansk and Petrozavodsk, federal centre Moscow and nearest Russian /EU(Finnish) border at Vartius/Lytta border crossing.
- Amounts of inhabitants and amount of youth among the inhabitants in the municipalities (districts, towns, villages) along the new road route
- Amounts of jobs and companies registered in the municipalities (districts, towns, villages) along the new road route.
- Amount of new housing (homes and cottages) in the municipalities (districts, towns, villages) along the new road route.
- Amounts of sales in retail shops in the municipalities (districts, towns, villages) along the new road route.
- Amount of new public transport routes in the municipalities (districts, towns, villages) along the new road route.
- Amount of collected taxes in the municipalities (districts, towns, villages) along the new road route.
- Price levels of construction places, housing, and cottages in the municipalities (districts, towns, villages) along the new road route.

4.4 Impacts to demography

Business opportunities along the road will be improved. These impacts positively to one very important aspect, migration. It is very important, that it influences to migration of youth as the basic pre-requisites for small and medium business can be guaranteed access through transportation and communication.

Amounts of inhabitants in the impacts area of the new road will be increased or at least decreasing of number of inhabitants will be lower. If housing possibilities along the road will be provided, the locations will attract families with small children.

Owners of cottages will use their objects and the local services more often than before the new road.

4.5 Benefits to the Barents Region and to the EU

Improvement of the infrastructure (like the new road connection proposed in this project) additionally to mitigating of current administrative burdens enable the business to enlarge their activities both side of the border to neighboring markets. This development will enhance economic sustainability in the Barents Region. Improving of communications benefit firstly local inhabitants creating new opportunities via fluent movement of people, goods, and information. Along with the permanent discussion between the authorities of the Barents Region Countries can be added understanding, recognized transport bottlenecks and foster the

development of east - west transport corridors (like Northern Axis – Barents Link). In the larger scale the road improvements and transport corridor development impacts positively implementing of the Joint Barents Plan.

Along with the new road the Barents Region will get a new all year-round open, about 500 km shorter road connection between the Northern Finland and Northern parts of the Republic of Karelia and the Arkhangelsk Region. It creates a new and shorter road also inside Russian Barents Region between:

- The Republic of Karelia - the Arkhangelsk Region (about 265 km shorter way to Petrozavodsk)
- The Murmansk Region – the Arkhangelsk Region (495 km shorter way to Murmansk)
- St Petersburg – the Arkhangelsk Region (15- 270 km shorter way to St Petersburg, depending on the route used)

Beneficiaries to about 485 km shortened road connections can be named the following population of the Barents Region (shorter car trip between Arkhangelsk and the following areas:

- from the Arkhangelsk Region, about 1.000.000 inhabitants
- from the Republic of Karelia , about 100.000 inhabitants (from Northern part)
- from Finnish Northern Ostrobothnia and Kainuu, about 485.000 inhabitants
- from Finnish Lapland, about 175.000 inhabitants
- from Northern Sweden, about 520.000 inhabitants
- from Northern Norway, about 490.000 inhabitants.

In current road network, the distance by passenger car between Arkhangelsk and Vartius/Lytta EU/Russian border is 1200 km meaning about 18 hours driving time. The route and time are taken from Yandex.ru-site goes through Kostomuksha, Kochkoma (A137), Medvezh'egorsk (E105), Pudozh (A119), Kargopol, Plesetsk, Samoded (A215) , Brin-Navolok to Arkhangelsk (M8).

The road distance after the new road would be about 700 km and 10-11 hours. The road makes 1-2 million people in both sides of EU/Russian border about 8 hours closer to each other.

For the EU, the benefit is a new market area of more than a million inhabitants 500 km by road closer than today.

5. Economic evaluation

The economic evaluation analysis of the new east-west Vartius/Lytta – Arkhangelsk road between EU/Finland and Russia is divided into following chapters:

- Chapter 5.1 covers economic evaluation of the road variants.
- Chapter 5.2 assesses how the new road might affect the new growth centres of along the new road route.
- In chapter 5.3 the future development needs are estimated.

5.1 Profitability of road variants

5.1.1 Methodology

The economic analysis is performed using the savings induced by the project in transport costs passenger and heavy vehicles when trips by the new road will be shorter, quicker and safer. These driving benefits has been divided into:

- vehicle costs savings
- driving time savings and
- accident costs savings.

and together they are hereafter called as user benefits, Border crossing. They are counted through traffic forecasts for every year after opening of the new road route and then compared with the estimated cost of investment. With the limitations listed below, the method gives the first estimate of the benefit-cost ratio (BORDER CROSSINGR) and paying-back period for the project.

The generalized BORDER CROSSINGR is the discounted sum of annual benefits (B) minus annual costs (C) over the cost of investment during a given time period; in this case 30 years at 4% discount rate; that is:

$$BCR = \sum_{i=1}^{i=30} \frac{(B - C)i}{Cinvestment}$$

A project is believed to be feasible, if BORDER CROSSINGR is >1 and when the paying back period is less than 20 years.

In this study the quantities of B_s and $C_{investments}$ are somewhat disparate measures, but should their ratio be more than 1, it is an indication that a more detailed socio-economic study is recommended.

In a full-scale benefit-cost analysis a wider range of costs and benefits than the driving costs (vehicle, time and accident costs together) benefits are typically considered. This study remains insufficient in several regards due to resource limitations. Typical project benefits can be categorized in different way, but for the purposes of this study the following general groups with relevant explanations may suffice:

- *Business and industry benefits* has been counted through heavy vehicle driving cost benefits. These benefits are largely captured in these counting.
- *Benefits and losses (operator surplus)* between road, rail and sea transport operators due to modal and route changes are not considered.
- *Benefits of passenger transport* are counted as far as the mode is a passenger car.
- *Impacts on public budgets* (government and local) are not considered. These impacts are difficult to assess in cross border projects without knowing the nature of the financial package.
- *General public* may experience some external impacts which are however believed to be minor in monetary terms.
- *The environment* will also be impacted but presumably in a limited way. Cost of noise and contamination of air or soil has not been counted.

5.1.2 Costs

Road investment costs

The unit costs (km-costs) have been counted through implementing costs of similar roads in the Republic of Karelia and the Arkhangelsk Region. The investment costs of variants have been described in more detailed in chapter 2 and summarized in the table below.

As the opening the road has been assumed to the year 2030, the road costs of 2020 have been indexed to 2030 using the Finnish earthwork cost index (MAKU 150, 2010=100). It is the following:

Time	**Index (MAKU)**
Year 2010	100
At the end of 2020	115
Estimate on the year 2030	150

Table. Investment costs of the Vartius - Arkhangelsk road variants on 2030 (MAKU 150, rate 1 € = 90 Rub).

Variant in the Republic of Karelia **MRub (M€)**	Variant in the Arkhangelsk Region **MRub (M€)**	Onega – Rikasikha **MRub (M€)**	Total (w/o) Onega-Rikasikha **MRub (M€)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"red"** 94 km, reconstr. = 12.200 13 km, constr. = 1.850 New bridge constr. (1200 m) = 3.700 sub-total = **17.800 (198)**	180 km x 91= sub-total = 16.400 (182)	**32.500 (361)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"black"** 105 km, reconstr. = 13.600 17 km, constr. = 2.400 New bridge constr. (1200 m) = 3.700 sub-total = **19.700 (219)**	180 km x 91= sub-total = 16.400 (182)	**34.400 (382)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"violet"** 99 km, reconstr. = 12.800 29 km, constr. = 4.100 New bridge constr. (500 m) = 1.500 sub-total = **18.400 (204)**	180 km x 91= sub total = 16.400 (182)	**33.100 (368)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"blue"** 109 km, reconstr.= 14.100 41 km, constr. = 5.800 New bridge constr. (250 m) = 800 sub-total = **20.700 (230)**	180 km x 91= sub total = 16.400 (182)	**35.400 (393)**
"yellow" 141 km, reconstr. = 14.400 52 km of constr. = 6.900 sub-total= **21.300 (237)**	**"red"** 88 km, reconstr. = 11.200 13 km, constr. = 1.850 New bridge constr. (1200 m) = 3.700 sub-total = **16.800 (189)**	180 km x 91= sub total = 16.400 (182)	**38.100 (423)**

The annual road construction unit cost growth between the years 2020 and 2030 is estimated at about 3 %.

Comparison: Unit costs used in Finland 2020:

- Construction of main new section (2 lanes): 1,2 ME/km (108 MRub/km)
- Reconstruction of current main road section (2 lanes): 0,7 ME/km (63 MRub/km)
- Construction of new bridge: 1.000E/m2 (90.000 MRub/m2 or 0,75 MRub/length-m)

Table. Estimated investment unit costs used in the Vartius – Arkhangelsk road variants

Unit cost of similar road construction at the end of 2020 Index MAKU 2010 100	*Construction of the new road Russia (Finland)*	*Reconstruction of the current road Russia (Finland)*	*Construction of the new bridge Russia (Finland)*
year 2020, index 115	*110 MRub/km (1,2 M€/km)*	*70 MRub/km (0,8 M€/km)*	*2,5 MRub / length-m 28.000 € /length - m)*
year 2030 index 150	*143 MRub/km (1,6 M€/km)*	*91 MRub/km (1 M€/km)*	*3,3 MRub / length-m 37.000 €/ length-m*

Table. Investment costs of the Vartius - Arkhangelsk road in "red - blue- brown" variant on 2030 (MAKU 150)

Variant in the Republic of Karelia, MRub **(M€)**	Variant in the Arkhangelsk Region, MRub **(M€)**	Porog – Brin -Navolok MRub **(M€)**	Total MRub **(M€)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"blue"** (till Porog) 109 km, reconstr.= 14.100 41 km, constr. = 5.800 New bridge constr. (250 m) = 800 sub-total = **20.700 (230)**	**"brown"** 138 km, reconstr.= 17.900 50 km, constr. = 7.100 sub-total = **25.000 (278)**	**60.400 (671)**

Road maintenance costs growth 2030 – 2060

The start point has been the estimation additional road maintenance costs due to additional road length to be maintained. As the length of "variant red" has been taken the road length of between Nadvoicy and Onega, 239 km. As estimation in the Russian similar roads annual of maintenance costs 0,9 MRub/km (10.000 E/km) on year on 2020. The annual growth of road maintenance costs 2020 are **215 MRub** (or **2,4 M€).**

This annual road maintenance cost 2030 - 2060 has been discounted into 2030 at 4% rate. The summary maintenance costs 2030 - 2060 in different variants are shown in the following table.

Table. Road maintenance additional costs of the Vartius - Arkhangelsk road in 6 variants on 2020

Variant in the Republic of Karelia (MRub)	Variant in the Arkhangelsk Region (MRub)	Total km more	Total **MRub (M€)**
red 131 km x 0,9 MR/km = 118	red, 108 km x 0,9 MR/km = 97	**239 km**	**215 (2,4)**
red 131 km x 0,9 MR/km = 118	black, 124 km x 0,9 MR/km = 112	**255 km**	**230 (2,6)**
red	violet,	**259 km**	**233 (2,6)**

131 km x 0,9 MR/km = 118	128 km x 0,9 MR/km = 115		
red 131 km x 0,9 MR/km = 118	blue, continuing through Onega-Rikasikha, 149 km x 0,9 MR/km =134	**280 km**	**252 (2,8)**
red 131 km x 0,9 MR/km = 118	blue and brown, continuing via Kodino - Brin--Navolok, 338 km x 0,9 MR/km = 304	**469 km**	**422 (4,7)**
yellow 146 km x 0,9 MR/km = 131	red 102 km x 0,9 MR/km = 90	**248 km**	**221 (2,5)**

5.1.3 Benefits to society

Benefits due to less driven kilometres on the road network

The new road connection makes the total driven vehicle kilometre sum shorter than in the situation where the road does not exist.

The starting point are the driving unit costs (Tie- ja rautatieliikenteen hankearvioinnin yksikköarvojen määrittäminen, Väylävirasto, Finnish Transport Infrastructure Agency publication, 48/2020) in use in Finland:

- vehicle costs for light vehicle (car) 0,072 €/veh.km/car
- time costs for light vehicle (car) 10,52 €/veh.h
- vehicle costs for heavy vehicle 0,29 €/km/car
- time costs for heavy vehicle 43,36 €/ veh.h
- accident costs for all vehicles 0,014 €/veh.km

The Russian vehicle and time costs have been counted by dividing these Finnish analogic costs to relation between Finnish and Russian corrected GDPs. The Russian GDP was about 55% of the Finnish one:

- vehicle costs for light vehicle (car) 3,6 Rub/km/car 0,04 €/ veh.km
- time costs for light vehicle (car) 522 Rub/h/car 5,8 €/ veh.h
- vehicle costs for heavy vehicle 14,4 Rub/km/ veh. 0,16 €/ veh.km
- time costs for heavy vehicle 2146 Rub/h/veh. 23,8 €/ veh.h

As the Russian accident costs have been used the following values. They are higher than in Finland as the accident likelihood is many times higher in Russia:

- accident costs for all vehicles 2,7 Rub/ veh.km 0,03 €/veh.km

Relation between light and heavy vehicles on the new road has been evaluated as 68%/32%. After this the unit costs used in the Vartius – Arkhangelsk road are:

- vehicle costs for this project (all vehicles), 7 Rub/saved veh.km 0,078 €/km
- time costs for this project (all vehicles), 1040 Rub/ saved h 11,57 €/h
- accident costs for this project (all vehicles), 2,7 Rub/ veh.km 0,03 €/km

The savings in distance and time has been introduced in the following table.

Table. The distance and time savings for Vartius – Arkhangelsk new road.

Origin - destination by road	distance currently by car	distance after the new road by car (km, hours)	difference between current and new route (km), (hours)
Arkhangelsk – Moscow	1200 km 16 h		
Arkhangelsk - St. Petersburg, via Vologda	1400 km 17,5 h	1145 km 14 h	**255 km, 3.5h**
Arkhangelsk - St. Pet., via Mirnyj, Vytegra	1160 km 18 h	1145 km 14 h	**15 km, 4h**
Arkhangelsk – Petrozavodsk via Pudozh	980 km 15 h	735 km 11 h	**245 km, 4 h**
Arkhangelsk- Murmansk via Pudozh	1600 km 23 h	1115 km 16 h	**485 km, 7 h**
Arkhangelsk- Vartius/Lytta via Pudozh	1200 km 19 h	705 km 11 h	**495 km, 8 h**

Counting by benefits of saved driven kilometres in variants, example "red-red" variant

In "red-red" variant, assumption for saved driven kilometres is evaluated as **275 km** per vehicle. It bases on the following distribution of origin – destination:

- 10% of traffic volumes use origin-destination Arkhangelsk - Murmansk (495 km saving/vehicle)
- 20% of traffic volumes use origin-destination Arkhangelsk – Vartius/Lytta border crossing (485 km saving/vehicle)
- 30% of traffic volumes use origin-destination Arkhangelsk – Petrozavodsk (245 km saving/vehicle)
- 40% of traffic volumes use origin-destination Arkhangelsk – St. Petersburg (135 km saving/vehicle)

In case of Arkhangelsk – St. Petersburg current distance has been used the medium value between Vologda and Vytegra routes. The traffic volume benefiting of the savings has been evaluated as 800 vehicles/day, AADT in 2020 and 1050 vehicles/day, AADT in 2030. Savings of other trips have been ignored in the following calculations.

The saving is opening year 2030 would be:

Vehicle cost savings: 275 km x 1050 veh./day x 365 d/year x 7 Rub/km = 738 MRub
Time costs savings: 1050 veh./day x 6.5 h/veh. 365 d/year x 1040 Rub/h = 2.591 MRub
Accident costs savings: 275 km x 1050 veh./day x 365 d/year x 2,7 Rub/km = 285 MRub
Driving costs savings together: = 3600 MRub (40M€)

In the situation of the year 2030, the savings would be about **3600** Million Roubles (**40 M€**) on "red-red" variant. By assuming that the traffic volumes would be 1,6 x bigger in 2060 (compared to 2030), we have used the following annual figures for savings:

year from opening	annual saving	traffic increase comp.to 2030
▪ 1st year	3.600 MRub (2030)	1,0x
▪ 5th year	3.960 MRub (2035)	1,1x
▪ 10th year	4.320 MRub (2040)	1,2x
▪ 15th year	4.680 MRub (2045)	1,3x

- 20th year 5.040 MRub (2050) 1,4x
- 25th year 5.400 MRub (2055) 1,5x
- 30th year 5.760 MRub (2060) 1,6x

Vehicle volumes increase between 2030 and 2060, meaning the 30 year´s growth, has been evaluated roughly 2-2,5 % increase per year.

The table in the following page introduces the annual forecasted driving cost savings and road maintenance cost increase in 30 years after opening of the road and discounted figures in 30 years. Discount rate used was 4%. Driving cost savings discounted in 2030 – 2060 are **76.700 MRub** (**852 M€**).

Table. Driving cost benefits and maintenance cost increases over 2030 – 2060 in "red-red" variant.

Year	Year (A.D.)	Driving cost savings MRUB	Maintenance costs MRUB	Residual value MAKU150 Mrub
1	2030	**3600**	215	0
2	31	3670	215	0
3	32	3740	215	0
4	33	3810	215	0
5	34	3880	215	0
6	**35**	**3960**	215	0
7	36	4030	215	0
8	37	4100	215	0
9	38	4170	215	0
10	39	4240	215	0
11	40	**4320**	215	0
12	41	4390	215	0
13	42	4460	215	0
14	43	4530	215	0
15	44	4600	215	0
16	45	**4680**	215	0
17	46	4750	215	0
18	47	4830	215	0
19	48	4900	215	0
20	49	4970	215	0
21	50	**5040**	215	0
22	51	5110	215	0
23	52	5200	215	0
24	53	5270	215	0
25	54	5330	215	0
26	55	**5400**	215	0
27	56	5500	215	0
28	57	5600	215	0
29	58	5680	215	0
30	59	**5760**	215	3250
	2060			
Total		139520	6450	3250
Disc. total.		**76 772,75**	**3 717,79**	**1 002,04**

Benefits due to remaining residual value of the road variant "red-red"

When counting the CB ratio, one benefit is the present value of residual value after 30 years of investment (including construction time interest costs) represents roughly 10% of the investment (32.500MRub*0.10 = 3250 MRub) and present value of **1000 Million Roubles (11,1 M€)** ("red-red").

Counting by benefits of saved driven kilometres in variant "yellow-red"

In "yellow-red" variant, assumption for saved driven kilometres is evaluated as **198 km** per vehicle. It bases on the following distribution of origin – destination:

- 10% of traffic volumes use origin-destination Arkhangelsk - Murmansk (500 km saving/vehicle)
- 20% of traffic volumes use origin-destination Arkhangelsk – Vartius/Lytta border crossing (420 km saving/vehicle)
- 30% of traffic volumes use origin-destination Arkhangelsk – Petrozavodsk (150 km saving/vehicle)
- 40% of traffic volumes use origin-destination Arkhangelsk – St. Petersburg (42 km saving/vehicle)

In case of Arkhangelsk – St. Petersburg current distance has been used the medium value between Vologda and Vytegra routes.

The saving is opening year 2030 would be:

Vehicle cost savings: 198 km x 1050 veh./day x 365 d/year x 7 Rub/km = 531 MRub
Time costs savings: 1050 veh./day x 2,7 h/veh. 365 d/year x 1040 Rub/h = 1075 MRub
Accident costs savings: 198 km x 1050 veh./day x 365 d/year x 2,7 Rub/km = 205 MRub
Driving costs savings together: = 1800 MRub (20 M€)

In the situation of the year 2030, the savings would be **1800** Million Roubles **(20 M€)** on "yellow- red" variant. By assuming that the traffic volumes would be 1,6 x bigger in 2060 (compared to 2030), we have used the following annual figures for savings:

year from opening	annual saving	traffic increase comp. to 2030
▪ 1st year	1.800 MRub (2030)	1,0x
▪ 5th year	1.980 MRub (2035)	1,1x
▪ 10th year	2.160 MRub (2040)	1,2x
▪ 15th year	2.340 MRub (2045)	1,3x
▪ 20th year	2.520 MRub (2050)	1,4x
▪ 25th year	2.700 MRub (2055)	1,5x
▪ 30th year	2.880 MRub (2060)	1,6x

Vehicle volumes between 2030 and 2060, meaning the 30 year´s growth, has been evaluated roughly 2-2,5 % increase per year. Driving cost savings discounted between 2030 – 2060 are **38.400 MRub (427 M€).**

Benefits due to remaining residual value of the road variant "yellow-red"

When counting the CB ratio, one benefit is the present value of residual value after 30 years of investment (including construction time interest costs) represents roughly 10% of the

investment (39.100MRub*0.10 = 3910 MRub) and present value of **1190 Million Roubles (13,2 M€)** in “Yellow-Red” variant**.**

Counting by benefits of saved driven kilometres in variant "red-black"

In "red-black" variant, assumption for saved driven kilometres is evaluated as **260 km** per vehicle. It bases on the following distribution of origin – destination:

- 10% of traffic volumes use origin-destination Arkhangelsk - Murmansk (481 km saving/vehicle)
- 20% of traffic volumes use origin-destination Arkhangelsk – Vartius/Lytta border crossing (471km saving/vehicle)
- 30% of traffic volumes use origin-destination Arkhangelsk – Petrozavodsk (231 km saving/vehicle)
- 40% of traffic volumes use origin-destination Arkhangelsk – St. Petersburg (121km saving/vehicle)

In case of Arkhangelsk – St. Petersburg current distance has been used the medium value between Vologda and Vytegra routes.

The traffic volume benefiting of the savings has been evaluated as 1050 vehicles/day (AADT 2030). Savings of other trips have been ignored in the following calculations.

The saving is opening year 2030 would be:

Vehicle cost savings: 260 km x 1050 veh./day x 365 d/year x 7 Rub/km = 968 MRub
Time costs savings: 1050 veh./day x 4,1 h/veh. 365 d/year x 1040 Rub/h = 1634 MRub
Accident costs savings: 260 km x 1050 veh./day x 365 d/year x 2,7 Rub/km = 269 MRub
Driving costs savings together: = 2900 MRub (32 M€)

In the situation of the year 2030, the savings would be **2900 million Roubles (32 M€)** on "red-black" variant. By assuming that the traffic volumes would be 1,6 x bigger in 2060 (compared to 2030), we have used the following annual figures for savings:

year from opening	annual saving	traffic increase comp.to 2030
▪ 1st year	2.900 MRub (2030)	1,0x
▪ 5th year	3.190 MRub (2035)	1,1x
▪ 10th year	3.480 MRub (2040)	1,2x
▪ 15th year	3.770 MRub (2045)	1,3x
▪ 20th year	4.060 MRub (2050)	1,4x
▪ 25th year	4.350 MRub (2055)	1,5x
▪ 30th year	4.640 MRub (2060)	1,6x

Vehicle volumes between 2030 and 2060, meaning the 30 year´s growth, has been evaluated roughly 2-2,5 % increase per year. Driving cost savings discounted between 2030 – 2060 are **61.800 MRub (687 M€).**

Benefits due to remaining residual value of the road variant red-black

When counting the CB ratio, one benefit is the present value of residual value after 30 years of investment (including construction time interest costs) represents roughly 10% of the investment (34.400MRub*0.10 = 3440 MRub) and present value of **1060 Million Roubles (11,8 M€)** in "Red-Black" variant.

Counting by benefits of saved driven kilometres in variant "red-violet"

In "red-violet" variant, assumption for saved driven kilometres is evaluated as **254 km** per vehicle. It bases on the following distribution of origin – destination:

- 10% of traffic volumes use origin-destination Arkhangelsk - Murmansk (475 km saving/vehicle)
- 20% of traffic volumes use origin-destination Arkhangelsk – Vartius/Lytta border crossing (465 km saving/vehicle)
- 30% of traffic volumes use origin-destination Arkhangelsk – Petrozavodsk (225 km saving/vehicle)
- 40% of traffic volumes use origin-destination Arkhangelsk – St. Petersburg (115 km saving/vehicle)

In case of Arkhangelsk – St. Petersburg current distance has been used the medium value between Vologda and Vytegra routes.

The traffic volume benefiting of the savings has been evaluated as 1050 vehicles/day (AADT 2030). Savings of other trips have been ignored in the following calculations.

The saving is opening year 2030 would be:

- Vehicle cost savings: 254 km x 1050 veh./day x 365 d/year x 7 Rub/km = 681 MRub
- Time costs savings: 1050 veh./day x 4,1 h/veh. 365 d/year x 1040 Rub/h = 1634 MRub
- Accident costs savings: 254 km x 1050 veh./day x 365 d/year x 2,7 Rub/km = 263 MRub

  Driving costs savings together: = 2580 MRub (28,7 M€)

In the situation of the year 2030, the savings would be about **2580 Million Roubles (28,7 M€)** on "red-violet" variant. By assuming that the traffic volumes would be 1,6 x bigger in 2060 (compared to 2030), we have used the following annual figures for savings:

year from opening	annual saving	traffic increase comp.to 2030
▪ 1st year	2.580 MRub (2030)	1,0x
▪ 5th year	2.840 MRub (2035)	1,1x
▪ 10th year	3.100 MRub (2040)	1,2x
▪ 15th year	3.350 MRub (2045)	1,3x
▪ 20th year	3.610 MRub (2050)	1,4x
▪ 25th year	3.870 MRub (2055)	1,5x
▪ 30th year	4.130 MRub (2060)	1,6x

Vehicle volumes between 2030 and 2060, meaning the 30 year´s growth, has been evaluated roughly 2-2,5 % increase per year. Driving cost savings discounted between 2030 – 2060 are **55.000 MRub (611 M€).**

Benefits due to remaining residual value of the road variant red-violet

When counting the CB ratio, one benefit is the present value of residual value after 30 years of investment (including construction time interest costs) represents roughly 10% of the investment (33.100MRub*0.10 = 3310 MRub) and present value of **1.020 Million Roubles (11,3 M€)** in "Red-violet" variant.

Counting by benefits of saved driven kilometres in variant "red-blue"

In “red-blue” variant, assumption for saved driven kilometres is evaluated as **233 km** per vehicle. It bases on the following distribution of origin – destination:

- 10% of traffic volumes use origin-destination Arkhangelsk - Murmansk (454 km saving/vehicle)
- 20% of traffic volumes use origin-destination Arkhangelsk – Vartius/Lytta border crossing (444 km saving/vehicle)
- 30% of traffic volumes use origin-destination Arkhangelsk – Petrozavodsk (204 km saving/vehicle)
- 40% of traffic volumes use origin-destination Arkhangelsk – St. Petersburg (94 km saving/vehicle)

In case of Arkhangelsk – St. Petersburg current distance has been used the medium value between Vologda and Vytegra routes. The traffic volume benefiting of the savings has been evaluated as 800 vehicles/day, AADT in 2020 and 1050 vehicles/day, AADT in 2030. Savings of other trips have been ignored in the following calculations.

The saving is opening year 2030 would be:

- Vehicle cost savings: 233 km x 1050 veh./day x 365 d/year x 7 Rub/km = 625 MRub
- Time costs savings: 1050 veh./day x 4 h/veh. 365 d/year x 1040 Rub/h = 1594 MRub
- Accident costs savings: 233 km x 1050 veh./day x 365 d/year x 2,7 Rub/km = 241 MRub

Driving costs savings together: = 2460 MRub (27,3 M€)

In the situation of the year 2030, the savings would be **2460 million Roubles (27,3 M€)** on “red-blue” variant. By assuming that the traffic volumes would be 1,6 x bigger in 2060 (compared to 2030), we have used the following annual figures for savings:

year from opening	annual saving	traffic increase comp.to 2030
▪ 1st year	2.460 MRub (2030)	1,0x
▪ 5th year	2.710 MRub (2035)	1,1x
▪ 10th year	2.950 MRub (2040)	1,2x
▪ 15th year	3.200 MRub (2045)	1,3x
▪ 20th year	3.440 MRub (2050)	1,4x
▪ 25th year	3.690 MRub (2055)	1,5x
▪ 30th year	3.940 MRub (2060)	1,6x

Vehicle volumes between 2030 and 2060, meaning the 30 year´s growth, has been evaluated roughly 2-2,5 % increase per year. Driving cost savings discounted between 2030 – 2060 are **52.400 MRub (582 M€).**

Benefits due to remaining residual value of the road variant ”red-blue”
When counting the CB ratio, one benefit is the present value of residual value after 30 years of investment (including construction time interest costs) represents roughly 10% of the investment (35.400MRub*0.10 = 3540 MRub) and present value of **1.090 Million Roubles (12,1 M€)** in “Red-blue” variant.

Counting by benefits of saved driven kilometres in variant “red-blue-brown” (Porog-Kodino - Brin-Navolok)

In “red-blue-brown” variant, assumption for saved driven kilometres is evaluated as **176 km** per vehicle. It bases on the following distribution of origin – destination:

- 10% of traffic volumes use origin-destination Arkhangelsk - Murmansk (397 km saving/vehicle)
- 20% of traffic volumes use origin-destination Arkhangelsk – Vartius/Lytta border crossing (387 km saving/vehicle)
- 30% of traffic volumes use origin-destination Arkhangelsk – Petrozavodsk (147 km saving/vehicle)
- 40% of traffic volumes use origin-destination Arkhangelsk – St. Petersburg (37 km saving/vehicle)

In case of Arkhangelsk – St. Petersburg current distance has been used the medium value between Vologda and Vytegra routes. The traffic volume benefiting of the savings has been evaluated as 800 vehicles/day, AADT in 2020 and 1050 vehicles/day, AADT in 2030. Savings of other trips have been ignored in the following calculations.

The saving is opening year 2030 would be:

Vehicle cost savings: 176 km x 1050 veh./day x 365 d/year x 7 Rub/km = 472 MRub
Time costs savings: 1050 veh./day x 3.3 h/veh. 365 d/year x 1040 Rub/h = 1315 MRub
Accident costs savings: 176 km x 1050 veh./day x 365 d/year x 2,7 Rub/km = 182 MRub
Driving costs savings together: = 1970 MRub (21,9 M€)

In the situation of the year 2030, the savings would be about **1970** Million Roubles **(21,9 M€)** in “red-blue-brown” variant. By assuming that the traffic volumes would be 1,6 x bigger in 2060 (compared to 2030), we have used the following annual figures for savings:

year from opening	annual saving	traffic increase comp.to 2030
▪ 1st year	1.970 MRub (2030)	1,0x
▪ 5th year	2.170 MRub (2035)	1,1x
▪ 10th year	2,360 MRub (2040)	1,2x
▪ 15th year	2.560 MRub (2045)	1,3x
▪ 20th year	2.760 MRub (2050)	1,4x
▪ 25th year	3.000 MRub (2055)	1,5x
▪ 30th year	3.150 MRub (2060)	1,6x

Vehicle volumes increase between 2030 and 2060, meaning the 30 year´s growth, has been evaluated roughly 2-2,5 % increase per year. Driving cost savings discounted between 2030 – 2060 are **42.100 MRub (468 M€).**

Benefits due to remaining residual value of the road variant ”red-blue-brown”

When counting the CB ratio, one benefit is the present value of residual value after 30 years of investment (including construction time interest costs) represents roughly 10% of the investment (60.400MRub*0.10 = 6040 MRub) and present value of **1.860 Million Roubles (20,7 M€)** in “Red-blue-brown” variant.

5.1.4 Benefit/cost ratio and paying back period of variants

CBorder crossing ratio = (Benefits in road network + Residual value – losses of road maintenance costs) / Investment costs including construction time interest costs on the variants):

Example: "Red-red" through Onega - Rikasikha

CBorder crossing ratio = (76.700 MRub + 1.000 MRub – 3.720 MRub) / 32.500 MRub **= 2,28**
CBorder crossing ratio = (427 M**€** + 11.1 M**€** – 41,3 M**€**) / 361 M**€ = 1,1**

Paying back period = 30 years /2,28 = 13 years.

Table. Summary of the factors and results of economic evaluation of the variants.

	User cost savings 2030-2060, **MRub M€**	Residual value 2030, **MRub M€**	Maintenance cost 2030-2060 **MRub M€**	Investment cost, 2030 **MRub M€**	B/C – ratio	Paying-back period, years
"Red-red" through Onega – Rikasikha	76.700 852	1.000 11,1	3.720 41,3	32.500 361	**2,28**	**13**
"Red-black" through Onega – Rikasikha	61.800 687	1.060 11,8	3.980 44,2	34.400 382	**1,71**	**18**
"Red-violet" through Onega – Rikasikha	55.000 611	1.020 11,3	4.030 448	33.100 368	**1,57**	**19**
"Red-blue" through Onega – Rikasikha	52.400 582	1.100 12,2	4.400 48,9	35.400 393	**1,39**	**22**
"Red-blue-brown" through Kodino – Brin-Navolok	42.100 468	1.850 20,6	7.300 81,1	60.400 671	**0,61**	**49**
"Yellow – Red" through Onega – Rikasikha	38.400 427	1.190 13,2	3.820 42,4	38.100 423	**0,94**	**32**
"Yellow – Red" without Kola R-21 – Belomorsk – Nyuhcha road costs	38.400 427	623 6,9	3.820 42,4	20.200 224	**1.74**	**17**

For those variants, that have the benefit-cost ratio more than one, the project is economically profitable.

What comes to "Yellow- Red" variant, it is either profitable or not profitable depending on the counting principle. If the road connection R-21 (fed road Kola) – Belomorsk – Nyuhcha will be constructed/reconstructed by the Republic of Karelia and as the construction costs of the new Vartius – Arkhangelsk road will be counted only implementation costs between Nyuhcha village and Onega town, the "Yellow – Red variant would be profitable. If the road connection R-21 (fed road Kola) – Belomorsk – Nyuhcha will be constructed/reconstructed as part of the new Vartius – Arkhangelsk road and the implementation costs will be counted in economy calculations as costs of this road project, the "Yellow – Red variant would be non-profitable.

5.1.5 Sensitivity of economic calculations

The sensitivity of economic calculations of the Vartius/Lytta – Arkhangelsk road was checked in the following cases:

- What if the annual savings in driving costs are 30% less than in the basic calculation?
- What if the annual savings in driving costs are 30% more than in the basic calculation?
- What, if the investment costs are 30 % less than in the basic calculation?
- What, if the investment costs are 30 % more than in the basic calculation?
- What, if the investment costs of Onega - Rikasikha road reconstruction would be added to the basic cost of the Vartius/Lytta – Arkhangelsk road?
- What, if the savings in emission costs will counted as benefits to the road variants?

What if the annual savings in driving costs are 30% less than in the basic calculation?

Table. Summary of the factors and results of economic evaluation in the three variants

	User savings 2030-2060, MRub **M€**	Residual value, MRub **M€**	Maintenance cost 2030-2060, MRub M€	Investment cost, 2030 MRub **M€**	B/C – ratio	Paying-back period, years
"Red-red" through Onega – Rikasikha	53.700 597	1.000 11,1	3.720 41,3	32.500 361	1,57	19
"Yellow – Red" through Onega – Rikasikha	26.900 299	1.190 13,2	3.820 42,4	38.100 423	0,64	47
"Yellow – Red" without Kola R-21 – Belomorsk – Nyuhcha road costs	26.900 299	623 6,9	3.820 42,4	20.200 224	1,17	26

If the road connection R-21 (fed road Kola) – Belomorsk – Nyuhcha will be constructed/reconstructed as part of the new Vartius – Arkhangelsk road and the implementation costs will be counted in economy calculations as costs of this road project, the "Yellow – Red variant would be non-profitable. All other variants shown above are economically viable.

What if the annual savings in driving costs are 30% more than in the basic calculation?

Table. Summary of the factors and results of economic evaluation in the three variants

	User savings 2030-2060, MRub **M€**	Residual value, MRub **M€**	Maintenance cost 2030-2060, MRub M€	Investment cost, 2030 MRub **M€**	B/C – ratio	Paying-back period, years
"Red-red" through Onega – Rikasikha	99.700 1100	1.000 11,1	3.720 41,3	32.500 361	2,98	10
"Yellow – Red" through Onega – Rikasikha	49.900 555	1.190 13,2	3.820 42,4	38.100 423	1,44	21
"Yellow – Red" without Kola R-21 – Belomorsk – Nyuhcha road costs	49.900 555	623 6,9	3.820 42,4	20.200 224	2,31	13

In this case all the shown above variants are not economically viable.

What if the investment costs are 30 % less than in the basic calculation?

Table. Summary of the factors and results of economic evaluation of the variants.

	User savings 2030-2060, MRub **M€**	Residual value, MRub **M€**	Maintenance cost 2030-2060, MRub M€	Investment cost, 2030 MRub **M€**	B/C – ratio	Paying-back period, years
"Red-red" through Onega – Rikasikha	76.700 852	1.000 11,1	3.720 41,3	22.700 253	**3,26**	**9**
"Yellow – Red" through Onega – Rikasikha	38.400 427	1.190 13,2	3.820 42,4	26.700 296	**1,34**	**22**
"Yellow – Red" without Kola R-21 – Belomorsk – Nyuhcha roasd costs	38.400 427	623 6,9	3.820 42,4	14.100 157	**2.50**	**12**

In this case all the shown above variants are not economically viable.

What if the investment costs are 30 % more than in the basic calculation?

Table. Summary of the factors and results of economic evaluation of the variants.

	User savings 2030-2060, MRub **M€**	Residual value, MRub **M€**	Maintenance cost 2030-2060, MRub M€	Investment cost, 2030 MRub **M€**	B/C – ratio	Paying-back period, years
"Red-red" through Onega – Rikasikha	76.700 852	1.000 11,1	3.720 41,3	42.300 470	**1,75**	**17**
"Yellow – Red" through Onega – Rikasikha	38.400 427	1.190 13,2	3.820 42,4	49.500 550	**0,72**	**42**
"Yellow – Red" without Kola R-21 – Belomorsk – Nyuhcha road costs	38.400 427	623 6,9	3.820 42,4	26.300 292	**1.34**	**22**

If the road connection R-21 (fed road Kola) – Belomorsk – Nyuhcha will be constructed/reconstructed as part of the new Vartius – Arkhangelsk road and the implementation costs will be counted in economy calculations as costs of this road project, the "Yellow – Red variant would be non-profitable. All other variants shown above are economically viable.

What, if the investment costs of Onega- Rikasikha road reconstruction would be added to the basic costs of the Vartius/Lytta – Arkhangelsk road?

This chapter makes a summary of the analyse, how the Onega - Rikasikha road investment costs will impact to economy of the Vartius/Lytta - Arkhangelsk road, if the reconstruction costs of the Onega-Rikasikha road will be added to costs of the Vartius/Lytta - Arkhangelsk road.

The tables below show the investment and the impact of that to economic parameters of the Vartius/Lytta - Arkhangelsk road. In this case, the "Red-red" variant remains economically the most feasible. The "Red-black and "Red-violet" are also economically viable.

Table. Investment costs of the Vartius - Arkhangelsk road variants on 2030 with Onega Rikasikha road rehabilitation included into the federal road Vartius- Arkhangelsk costs (MAKU 150, rate 1 € = 90 Rub).

Variant in the Republic of Karelia between "Kola" R-21 – border of the Republic of Karelia and Arkhangelsk reg. **MRub (M€)**	Variant in the Arkhangelsk Region between border of the Republic of Karelia and the Arkhangelsk Region and Onega, **MRub (M€)**	Onega – Rikasikha **MRub (M€)**	Total with Onega-Rikasikha **MRub (M€)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"red"** 94 km, reconstr. = 12.200 13 km, constr. = 1.850 New bridge constr. (1200 m) = 3.700 sub-total = **17.800 (198)**	180 km x 91= sub-total = **16.400 (182)**	**48.900 (543)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"black"** 105 km, reconstr. = 13.600 17 km, constr. = 2.400 New bridge constr. (1200 m) = 3.700 sub-total = **19.700 (219)**	180 km x 91= sub-total = **16.400 (182)**	**50.800 (564)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"violet"** 99 km, reconstr. = 12.800 29 km, constr. = 4.100 New bridge constr. (500 m) = 1.500 sub-total = **18.400 (204)**	180 km x 91= sub total = **16.400 (182)**	**49.500 (550)**
"red" 93 km of reconstr. = 9.700 38 km of constr. = 5.000 sub-total= **14.700 (163)**	**"blue"** 109 km, reconstr.= 14.100 41 km, constr. = 5.800 New bridge constr. (250 m) = 800 sub-total = **20.700 (230)**	180 km x 91= sub total = **16.400 (182)**	**51.800 (576)**
"yellow" 141 km, reconstr. = 14.400 52 km of constr. = 6.900 sub-total= **21.300 (237)**	**"red"** 88 km, reconstr. = 11.200 13 km, constr. = 1.850 New bridge constr. (1200 m) = 3.700 sub-total = **16.800 (189)**	180 km x 91= sub total = **16.400 (182)**	**54.500 (606)**

Table. Summary of the factors and results of economic evaluation of the variants when the Onega – Rikasikha road rehabilitation costs are included into investment costs of Vartius-Arkhangelsk road.

	User savings 2030-2060, **MRub M€**	Residual value 2030, **MRub M€**	Maintenance cost 2030-2060 **MRub M€**	Investment cost, 2030 **MRub M€**	B/C – ratio	Paying -back period, **Years**
"Red-red" through Onega – Rikasikha	76.700 852	1.000 11,1	3.720 41,3	**48.900 543**	**1,51**	**20**
"Red-black" through Onega – Rikasikha	61.800 687	1.060 11,8	3.980 44,2	**50.800 564**	**1,16**	**26**
"Red-violet" through Onega – Rikasikha	55.000 611	1.020 11,3	4.030 448	**49.500 550**	**1,05**	**29**
"Red-blue" through Onega – Rikasikha	52.400 582	1.100 12,2	4.400 48,9	**51.800 576**	**0,95**	**32**
"Yellow – Red" through Onega – Rikasikha	38.400 427	1.190 13,2	3.820 42,4	**54.500 606**	**0,66**	**45**
"Yellow–Red" w/o Kola R-21 – Belomorsk – Nyuhcha road costs	38.400 427	623 6,9	3.820 42,4	**38.100 423**	**0.92**	**33**

What, if the savings in emission costs will counted as benefits to the road variants?

The starting points are the unit costs of emission that the current vehicles produce in Finland. The unit costs are from the publication "Liikenneviraston tutkimuksia ja selvityksiä 23/2012, Liikenteen päästökustannukset" (Finnish Transport Agency publications 23/2012, Emission costs of Transport").

Table. Emission costs in Finland

Vehicle	**Cost of emission Eurocents (Rub) by driven kilometre**
Passenger car with gasoline engine	0.77 (0.69)
Passenger car with gasoline engine and catalysator	0.58 (0.52)
Passenger car with diesel engine	1.38 (1.24)
Delivery van with gasoline engine	1.03 (0.93)
Delivery van with gasoline engine and catalysator	0.85 (0.77)
Delivery van with diesel engine	1.98 (1.78)
Heavy vehicles in average	5 (4,50)

Every road variant of Vartius/Lytta - Arkhangelsk road will decrease the road mileage (driven kilometres) of the Russian roads and this way save emission costs from the society.

The Russian emission cost savings have been counted by dividing the above-mentioned Finnish analogic costs to relation between Finnish and Russian corrected GDPs. The Russian GDP was about 55% of the Finnish one:

Vehicle	**Cost of emission Eurocents (Rub) by driven kilometre**
Light vehicle (passenger car and delivery van) in average	0.49 (0.44)
Heavy vehicles in average	2.75 (2.48)

Finally, using the distribution between light and heavy vehicles in Russian roads (68%/32 %), can be estimated the cost that can be saved due to new road Vartius/Lytta - Arkhangelsk as **1.21 Eurocents (1.09 Rub)** per vehicle-kilometre.

The saving is opening year 2030 would be in variants:

- "red-red": 275 km x 1050 veh./day x 365 d/year x 1.09 Rub/km= **115 MRub (1,3 M€)**
- "red-black": 260 km x1050 veh./day x365 d/year x1.09 Rub/km= **109 MRub (1,2 M€)**
- "red-violet": 254km x1050 veh./day x365 d/year x1.09 Rub/km= **106 MRub (1,2 M€)**
- "red-blue": 233km x 1050 veh./day x365 d/year x 1.09 Rub/km = **97 MRub (1,1 M€)**
- "red-brown-blue":176km x1050veh./dayx365d/yearx1.09 Rub/km=**74 MRub (0,8 M€)**
- "yellow red": 198 km x1050 veh./day x365 d/year x1.09 Rub/km= **83 MRub (0,9 M€)**

The table below introduces the sum of annual savings in emission costs in 30 years after opening of the road (year 2030) and discounted figures in the next 30 years. The same unit cost has been used throughout the years, as the increase of the amount of vehicles and therefore

traffic volumes on the road will be compensated by more electric vehicles and less polluting other vehicles. Discount rate used was 4%.

Table. Summary of the factors and results of economic evaluation of the variants including the emission cost savings.

	User cost savings 2030-2060, **MRub M€**	Residual value 2030, **MRub M€**	Maintenance cost 2030-2060 **MRub M€**	Emission cost savings 2030-60 **MRub M€**	Investment cost, 2030 **MRub M€**	B/C – ratio	Paying -back period, years
"Red-red" through Onega – Rikasikha	76.700 852	1.000 11,1	3.720 41,3	**1.990** **22,1**	32.500 361	**2,34**	**13**
"Red-black" through Onega – Rikasikha	61.800 687	1.060 11,8	3.980 44,2	**1.880** **20,9**	34.400 382	**1,77**	**17**
"Red-violet" through Onega – Rikasikha	55.000 611	1.020 11,3	4.030 448	**1.830** **20,3**	33.100 368	**1,63**	**18**
"Red-blue" through Onega – Rikasikha	52.400 582	1.100 12,2	4.400 48,9	**1.680** **18,7**	35.400 393	**1,43**	**21**
"Red-blue-brown" through Kodino – Brin -Navolok	42.100 468	1.850 20,6	7.300 81,1	**1.280** **14,2**	60.400 671	**0,63**	**48**
"Yellow – Red" through Onega – Rikasikha	38.400 427	1.190 13,2	3.820 42,4	**1.440** **16**	38.100 423	**0,98**	**31**
"Yellow – Red" without Kola R-21 – Belomorsk – Nyuhcha road costs	38.400 427	623 6,9	3.820 42,4	**1.440** **16**	20.200 224	**1.81**	**18**

The emission cost savings have rather small impacts to economic feasibility of the road variants. However, their impacts are clearly positive as less driven kilometres means less emission.

5.1.6 Ignored issues in the economy calculations

Some issues were not counted in the feasibility calculations. From the costs they were:

- Possible up-grade of structures of the road before the year 2060
- road construction time drawbacks
- noise costs
- Costs due to more emissions
- Construction time interests.

From the benefits they were:

- benefits due to less emissions (analysed in this study through sensitivity)
- taxes.

5.2 New growth centres of along the new road

5.2.1 Impacts to villages along the new road route

The villages along the new road will have benefits and losses.
For the economy, the new road brings benefits. Better, all-year-round predictable accessibility by cars and heavy vehicles allows to just-on-time (JOT) deliveries and this way decreases e.g., needs of huge storages of goods for those times when accessibility is low. As well, a new road will shorten travel and transport times and costs between the villages and their nearest commercial/administrative centres. This makes living more attractive in the villages impacting increasing economic development activities and decreasing migration. The prices of houses, cottages and land in villages will grow due to new road.

New road will bring increased traffic volumes possible in the current village road meaning more noise, more emissions, and increased risks to traffic accidents. However, all foreseen these negative impacts can be mitigated or avoided with good land use and road planning and detailed design. During the road planning and design process, in every village along the road case by case, will be assessed if by-pass road is a better solution than the road going through the village.

5.2.2 Impacts of the new road to GDP

Impacts to GDP are definitely positive. Already the road construction investments will create more jobs that are direct for the local people and possibilities to make contracts for deliveries needed during the construction time. Moreover, the road will bring new possibilities to economic development and entrepreneurship.

5.2.3 Impacts of the new road to demography

Better economy because of the new road means better earning in villages, better possibilities to work as the internet already exists and the road guarantees the deliveries of goods and good passenger transport. In better economic situation, migration from the villages will be smaller. Quicker access to health care increases life expectancy in villages.

The future companies need most of all, specialists. Internet has brought possibilities to these specialists to work from home far away without traveling daily to location of the employer. The densely populated areas along the new road are attractive living places as they have many benefits compared (e.g., lower living costs) to regional or federal centres.

5.2.4 Impacts of the new road to activities in economy

Business and entrepreneurship and will be established along the new road because they demand predictable and reliable logistics because of more modest logistic costs and of possibility to better co-operate between other companies to share the work and specialisation.

Number of inhabitants and amount of youth among the inhabitants in the densely populated areas along the new road route will increase or at least the tendency of decreasing will go slower.

Number of jobs and companies registered and sales in retail shops in the densely populated areas along the new road route will increase.

Amount of new housing (homes and cottages) in the municipalities (districts, towns, villages) along the new road route will increase. Current cottages will be used more often and longer times after the new road.

The economic activities will start from business who will react already during or in the first years after implementation of the new road.

Because of increased economic activities, the collected taxes of the municipalities will also increase. However, new inhabitants would require more services, which may increase costs for the municipalities.

Price levels of construction places, housing, and cottages in the municipalities (districts, towns, villages) along the new road route will grow.

5.3 Estimation of the development needs

After rather facile research to Russian legislation and processes in road planning and designing, the following observations were made, and recommendations can be given:

Russian road planning procedure before the road detailed design phase is rather thin or does not exist. Very often the road detailed design is the first and the last (the only) planning and design phase when preparing the new construction or reconstruction of the current road. It would be advisable to strengthen the pre-design phases (study of need, pre-study, preliminary engineering) and include at least a minimum demand of them in required procedures.

The planning of land use and pre-phases of the road planning carried out simultaneously (and better, if possible, on the same table with a group of experts) seems to happen in Russia rather seldom. Western countries have good experience on these simultaneous procedures and the results could not be worse in Russia.

Very large amounts of citizen participation is realized in preliminary engineering phase of road planning procedure in the Western countries. This gives possibilities for road authorities to discuss with stakeholders of the society that is going to get (be beneficiaries of) the road with its pluses and minuses, but with full knowledge. This way road the whole society is more committed on the road project from start of planning till opening of the road. These pre-phases are rather seldom applied in Russian current road procedures and problems with the stakeholders (e.g., inhabitants along the road) will start during the detailed design, when launching of implementation is already near and time for full citizen participation already does not exist.

In the Western countries there cannot be introduced a road process without a serious economic evaluation. During this assessment procedure weaker road variants will be aborted and only economically viable alignment will be chosen to further development in more detailed design phases. Real economic evaluation of several real alignment variants can seldom be met in the Russian road projects. As well, there are no unit costs approved by society (authorities) for vehicle costs, time costs and accident costs, road noise costs and emission costs from the road traffic enabling to carry out economic counting. In addition, the required discount rate (%) approved by the authorities, does not exist for the road projects.

6. Conclusions and recommendations

This kind of pre-study is currently not normally included in road project´s procedure in Russia. However, it would be advisable to carry out this kind of very preliminary phase study to get preliminary information of the road project and understand its preliminary impacts like:

- Several possible variants of road alignment
- Preliminary geographical division of the road variants into administrative bodies (districts, regions)
- Preliminary construction costs of the variants
- Preliminary road user savings on vehicle, time and accident costs, and losses of society on noise and emissions.
- Preliminary impacts to environment, economy, and distribution of traffic after the road opening
- Preliminary economic assessment giving the idea, if the road project is economically viable or not
- Preliminary ideas of implementation in phases (stages)
- Disseminating information of the road project among the authorities of federal, regional and local bodies and giving those possibilities to spread the information to inhabitants and other stakeholders.

During this of Vartius/Lytta – Arkhangelsk road pre-study the following conclusions can be made:

- The most feasible variant is the shortest road alignment between Nadvoicy and Onega. It is less expensive and would give most of the economic benefits (savings on vehicle, time, and accident costs) to road users. The “red” variant Nadvoicy-Onega gives the best profitability of assessed variants (benefit/cost ratio over 1,0). If the Belomorsk – Nyuhcha road (partly reconstruction, partly new road) will be implemented by the Republic of Karelia as a regional road and therefore excluded from the costs of Vartius/Lytta – Arkhangelsk direct road, the “yellow - red” variant Belomorsk-Nyuhcha – Onega is also profitable with benefit/cost ratio over 1,0.
- The most feasible bridge location over the Onega river is the one nearest to Onega town. Although it is the longest, in other bridge location variants (Naumovskaya and Porog) the road owner would need to construct more road and they would give less road user benefits.

- It would be advisable to correct the decision of the end location of the future federal road between “Kola R-21” and “M-8” from Brin-Navolok into Rikasikha. The first gives cost- benefit ratio 0,6 and paying back period 49 years. The last gives cost-benefit ratio 1,5 and paying back period 20 years.

As the first implementation road sections are proposed:

In the Republic of Karelia:

- improvement of about 38 km section of ”road without owner”, non-constructed road to from Nadvoicy – Valdai regional road and border between the Republic of Karelia and the Arkhangelsk Region.

In the Archangelsk Region:

- Improvement of about **13 km** section of current non-constructed ground road “without owner” and carry out year-round road maintenance.
- Facilitating of about **1,5 km** ice road (in winter) and ferry (in summer) over Onega River as a service provided by regional road administration. Organisation of current ferry is not enough stabile (reliable) in producing that service.
- Going on with implementing of the project of the Onega – Kyanda – Rikasikha regional road improvements.

When implementing the first steps of opening the route, the road through the following densely populated areas shall be facilitated with road lighting and separate path or paths for light traffic (walking and cycling):

- In the Republic of Karelia (variant “red”): Nadvoicy – Pristan Nadvoicy, Dubrovo, Senguba, Ponga (together 13 km).
- In the Arkhangelsk Region (variant “red”): Zolotukha, Maloshujka, Upper Nimenga, railway station Nimenga, Lower Nimenga, Ponga subdistrict of Onega river south bank, Trudovaya Sloboda, new bridge over Onega river (together 17 km).
- In the Arkhangelsk Region in Onega- Rikasikha road: Onega town, Pokrovskoe, Non-commercial gardening association Lesopil’shchik – non-commercial gardening association Stroitel (along the sea embankment), Tamica, Kyanda, cottage villages Taiga 1, 2 and 3 as well as from Pinki to Rikasikha, (together 57 km).

In the Republic of Karelia , if variant “yellow” will be implemented, locations and indicative lengths of densely populated areas and accordingly road sections with road lighting and separate path or paths for light traffic would be: Sosnovec, Zolotec (Matygora – Vygostroi) railway station Vig, Belomorsk, Suhoe, Virma, railway station Virma, Sumskij Posad, Kolezhma, village Nyuhcha - railway station Nyuhcha, Unezhma (together 27 km).

The questions, by whom and when the road works could be implemented, will be solved during negotiations between current owners of the road (local and regional administrative bodies) and the potential future owner or owners of the road (federal road authorities).

7. Some of the References

1. Barents Link Corridor- report, Joint Authority of Kainuu Region, 2007
2. KO1029 Barents Region Transport and Logistics -report “World Transport Market and Logistics Projects” with Lead Partner, the Regional Council of Kainuu 2020
3. Tie- ja rautatieliikenteen hankearvioinnin yksikköarvojen määrittäminen, Väyläviraston julkaisuja 48/2020 (Road and railway projects´ unit values definition, Finnish Transport Infrastructure Agency publication 48/2020)
4. Liikenteen päästökustannukset, Liikenneviraston tutkimuksia ja selvityksiä 23/2012, (Emission costs of Transport, Finnish Transport Agency publications 23/2012).

8. Annexes

A1 Parameters of the current road sections and proposed parameters for the road variants
A2 Schema page 1
A3 Schema page 2
A4 Schema page 3
A5 Schema page 4

Kolarctic CBC
EU FINLAND NORWAY RUSSIA SWEDEN

Northern Axis
Barents Link

REGIONAL COUNCIL OF KAINUU

A Northern Axis - Barents Link - project (KO4159) report annex:

Study of Vartius/Lytta - Arkhangelsk Road 2021

ANNEX 1

30.4.2021

TRAFICON

ДОМЕР
ПРОИЗВОДСТВЕННАЯ КОМПАНИЯ

6. Annexes

Annex 1: Road parameters of the current road sections and proposal for the future parameters on road variants.

Content:

Road between Vartius/Lytta and Federal Road Kola (R-21)

Current federal road without variants

Variants between Kola road R-21 (Nadvoitsy) and the border of Karelian Republic and Arkhangelsk Region:

"RED": **Nadvoitsy – Valdai road – Arkhangelsk border**
"YELLOW": **Nadvoitsy – Belomorsk – Njuhtsa - Arkhangelsk border**

Variants between the border of Karelian Republic and Arkhangelsk Region and Onega river:

"RED": **Karelian border – Zolotuha- railway station Nimenga – Trudovaja Sloboda - Onega town**
"RED – BLACK": **Karelian border – Zolotuha - Maloshuika – bank of White Sea - Trudovaja Sloboda - Onega town**
"RED – VIOLET": **Karelian border – Zolotuha - Maloshuika – railway stations Nimenga and Chasta – Naumovskaja - Onega town**
"RED – BLUE": **Karelian border – Zolotuha - Maloshuika – railway stations Nimenga and Chasta - Porog and Onega town**
"YELLOW- RED: **Karelian border (near Uneshma) – Zolotuha - railway station Nimenga – Trudovaja Sloboda - Onega town**

Variants between Onega river and current federal road M-8 near the city of Arkhangelsk:

"RED": **Onega town – Rikasiha – Arkhangelsk city centre**
" BLUE-BROWN-BLUE": **Porog – Kodino – Brin Navalok - Arkhangelsk city centre**
" BLUE": **Porog – Savinskij – Brin Navalok - Arkhangelsk city centre**

Road between Vartius/Lytta and Federal Road “Kola” (R-21)

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Section of current federal road A 137 b/w Lytta/Vartius border crossing and R-21 Kola federal road	**III*(IV**)/ III(IV)**	**90/90**	**2/2**	**Ab/Ab**	**232/232**	**106/ 142/ 22/ 1**	**106/ 142/ 22/ 1**	**11/432**	**11/432**	**0**	**0**
Total for the road section					**232**					**0**	**0**

*** - on the section km24,840 – km53,558;**
**** - on the section km0,00 – km24,840 and km53,558 – km232,263.**

Variants between Fed. Road R-21 (Nadvoitsy) and the border of Karelian Republic and Arkhangelsk Region: "RED"

Nadvoitsy – Valdai road – Arkhangelsk border

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Section of current federal road "Kola" R-21 (E105) b/w A137 and Shegesha road	**III/III**	**90/90**	**2/2**	**Ab/Ab**	**6/6**	**0/ 0/ 10/ 0**	**0/ 0/ 10/ 0**	**1/90**	**1/90**	**0**	**0**
Section of current regional road b/w Kola R-21 federal road and Shegesha road	**IV/IV**	**90/90**	**2/2**	**Ab/Ab**	**11,2/11,2**	**10/3/0/0**	**10/3/0/0**	**1/75**	**1/75**	**0**	**0**
"Access to Nadvoitsy" (whole current regional road)	**IV/IV**	**60/60**	**2/2**	**Ab /Ab**	**8,7/8,7**	**5/2/0/0**	**5/2/0/0**	**0/0**	**0/0**	**0**	**0**
Section of current regional road Nadvoitsy – Ponga – Valdai – Vochmozero	**IV/III**	**90/90**	**2/2**	**Gavel/Ab**	**93/93**	**10/95/15/0**	**0/105/15/0**	**8/201**	**8/220**	**0**	**9 700**
Current private road ("with no owner") ending up to Karelian/Arkghangelsk fed. subject border	**V/IV**	**no**	**1/2**	**not paved/Ab**	**38/38**	**3/1/0/0**	**5/12/0/0**	**3/66**	**3/90**	**5 004**	**0**
Total for the road section	**-**	**-**	**-**	**-**	**157**	**-**	**-**	**-**	**-**	**5 004**	**9 700**

Variants b/w Fed. Road R-21 (Nadvoitsy) and the border of Karelian Republic/Arkhangelsk Region: YELLOW”

Nadvoitsy – Belomorsk – Njuhtsa - Arkhangelsk border

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Section of current federal road “Kola” R-21 (E105) b/w A137 and Belomorsk road	**III/III**	**90/90**	**2/2**	**Ab/Ab**	**46/46**	**0/38/3/0**	**0/38/3/0**	**4/234**	**4/234**	**0**	**0**
Entrance to the city of Belomorsk from the federal R-21 «Kola» road, including passages in the city of Belomorsk	**IV/III**	**90(60)/ 90(60)**	**2/2**	**Ab/Ab**	**45/45**	**44/5/0/0**	**44/10/0/0**	**2/102**	**2/102**	**0**	**4 625**
Belomorsk – Sumskij Posad (whole currtent regional road)	**IV/III**	**90/90**	**2/2**	**Gavel/Ab**	**49/49**	**29/0/0/0**	**29/10/0/0**	**9/467**	**9/467**	**0**	**5 150**
Sumskij Posad – Koleshma (road reconstruction)	**IV/III**	**no/90**	**no/2**	**no/Ab**	**no/25,5**	**15/11/0/0**	**0/26/0/0**	**2/75**	**2/75**	**0**	**1 780**
Koleshma - Virandozero (new regional road under planning)	**-/III**	**no/90**	**no/2**	**no/Ab**	**no/25,5**	**0/0/0/0**	**0/26/0/0**	**6/310**	**6/310**	**3 469**	**0**
Virandozero – Njuhtsa (whole current regional road)	**IV/III**	**90/90**	**2/2**	**Gavel/Ab**	**22/22**	**15/0/0/0**	**0/25/0/0**	**1/150**	**1/150**	**0**	**2 825**
Njuhtsa – Karelian/Arkhangelsk border (new regional road)	**-/III**	**no/90**	**no/2**	**no/Ab**	**no/26**	**0/0/0/0**	**0/12/0/0**	**0/0**	**1/25**	**3 409**	**0**
Total for the road section					**239**					**6 878**	**14 380**

Variants between the border of Karelian Republic and Arkhangelsk Region and Onega river: "RED"

Karelian border – Zolotuha- railway station Nimenga – Trudovaja Sloboda - Onega town

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Karelian border – Zolotuha (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/ Ab**	**35/35**	**22/0/0/0**	**22/10/0/0**	**2/85**	**2/85**	**0**	**4 005**
Zolotuha – Malozuika (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/ Ab**	**24,2/24,2**	**30/0/0/0**	**30/5/0/0**	**2/50**	**2/88**	**0**	**2 789**
Malozuika – railway station Nimenga (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gavel/Ab**	**13,7/13,7**	**15/0/0/0**	**0/15/0/0**	**1/50**	**1/75**	**0**	**1 970**
Railway station Nimenga – village Nimenga (whole current regional road)	**V/III**	**60/60**	**1/2 4/3,75**	**Gavel/Ab**	**8/8**	**8/0/0/0**	**0/10/0/0**	**1/60**	**2/130**	**0**	**1 440**
Current private ground road ("with no owner") whole section	**-/III**	**No/90**	**1/2 5/3,75**	**not paved/Ab**	**13/13**	**0/0/0/0**	**10/0/0/0**	**0/0**	**2/70**	**1 847**	**0**
Varzogori – Onega ((section of the current regional road)	**V/III**	**90/90**	**2/2 4/3,75**	**Gavel/Ab**	**13,3/13,3**	**18/0/0/0**	**0/20/0/0**	**5/75**	**5/100**	**0**	**1 980**
A new bridge over Onega River between Trudovaja Sloboda and Onega town	**-**	**no/90**	**no/2**	**no/Ab**	**no/1,2**	**-**	**-**	**Ice road /ferry,1500**	**1200**	**3 717**	**0**
Total for the road section					**96**					**5 564**	**12 184**

Variants between the border of Karelian Republic and Arkhangelsk Region and Onega river: "RED-BLACK"

Karelian border – Zolotuha - Maloshuika – bank of White Sea - Trudovaja Sloboda - Onega town

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Karelian border – Zolotuha (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**35/35**	**22/0/0/0**	**22/10/0/0**	**2/85**	**2/85**	**0**	**4 005**
Zolotuha – Malozuika (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**24,2/24,2**	**30/0/0/0**	**30/5/0/0**	**2/50**	**2/88**	**0**	**2 789**
Malozuika – railway station Nimenga (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gavel/Ab**	**13,7/13,7**	**15/0/0/0**	**0/15/0/0**	**1/50**	**1/75**	**0**	**1 970**
Railway station Nimenga – village Nimenga (whole current regional road)	**V/III**	**60/60**	**1/2 4/3,75**	**Gavel/Ab**	**8/8**	**8/0/0/0**	**0/10/0/0**	**1/60**	**2/130**	**0**	**1 440**
Section of current non-constructed ground road along the White Sea bank ("with no owner")	**-/III**	**no/60**	**1/2 5/3,75**	**not paved/Ab**	**16,5/16,5**	**0/0/0/0**	**5/0/0/0**	**0/0**	**3/230**	**2 676**	**0**
Varzogori – Onega (whole current regional road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gavel/Ab**	**23/23**	**22/0/0/0**	**0/22/0/0**	**2/75**	**5/100**	**0**	**3 000**
A new bridge over Onega River between Trudovaja Sloboda and Onega town	**-**	**no/90**	**no/2**	**no/Ab**	**no/1,2**	**-**	**-**	**Ice road /ferry,1500**	**1200**	**3 717**	**0**
Total for the road section					**122**					**6 393**	**13 204**

Variants between the border of Karelian Republic and Arkhangelsk Region and Onega river: "RED-VIOLET"

Karelian border – Zolotuha - Maloshuika – railway stations Nimenga and Chasta - Naumovskaja (with 500 m new bridge over Onega River) - Onega town

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Karelian border – Zolotuha (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**35/35**	**22/0/0/0**	**22/10/0/0**	**2/85**	**2/85**	**0**	**4 005**
Zolotuha – Malozuika (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**24,2/24,2**	**30/0/0/0**	**30/0/0/0**	**2/50**	**2/88**	**0**	**2 789**
Malozuika – railway station Nimenga (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gavel/Ab**	**13,7/13,7**	**15/0/0/0**	**0/15/0/0**	**1/50**	**1/75**	**0**	**1 970**
Railway station Nimenga – village Chasta (whole current regional road)	**V/III**	**90/90**	**2/2 4/3,75**	**Gavel/Ab**	**14,5/14,5**	**12/0/0/0**	**0/15/0/0**	**1/60**	**1/60**	**0**	**2 005**
New road b/w villages Chasta and Naumovsaya along the north side of the main railway	**-/III**	**no/60**	**no/2 no/3,75**	**no/Ab**	**no/29**	**0/0/0/0**	**0/31/0/0**	**0/0**	**5/230**	**4 895**	**0**
A new bridge over Onega River near Naumovskaya	**-**	**90/90**	**no/2 no/3,75**	**no/Ab**	**no/0,5**	**-**	**-**	**-**	**500**	**1 500**	**0**
Savinskij – Jarnema-Onega (section of current regional road)	**V/III**	**90/90**	**2/2 4/3,75**	**gravel/Ab**	**11/11**	**7/2/0/0**	**7/2/0/0**	**1/50**	**1/50**	**0**	**1 100**
Total for the road section					**128**					**6 395**	**11 869**

Variants between the border of Karelian Republic and Arkhangelsk Region and Onega river: "RED-BLUE"

Karelian border – Zolotuha - Maloshuika – railway stations Nimenga and Chasta and along the south side of main railway to Porog with 250 m new bridge over Onega River and to Onega town

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Karelian border – Zolotuha (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**35/35**	**22/0/0/0**	**22/10/0/0**	**2/85**	**2/85**	**0**	**4 005**
Zolotuha – Malozuika (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**24,2/24,2**	**30/0/0/0**	**30/5/0/0**	**2/50**	**2/88**	**0**	**2 789**
Malozuika – railway station Nimenga (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gavel/Ab**	**13,7/13,7**	**15/0/0/0**	**0/15/0/0**	**1/50**	**1/75**	**0**	**1 970**
Railway station Nimenga – village Chasta (whole current regional road)	**V/III**	**90/90**	**2/2 4/3,75**	**Gavel/Ab**	**14,5/14,5**	**12/0/0/0**	**0/15/0/0**	**1/60**	**1/60**	**0**	**2 005**
new road b/w villages Chasta and Porog along the south side of the main railway	**-/III**	**no/90**	**no/2 no/3,75**	**no/Ab**	**no/41**	**0/0/0/0**	**36/0/0/0**	**0/0**	**1/155**	**5 682**	**0**
A new bridge over Onega River near Porog		**no/90**	**no/2 no/3,75**	**no/Ab**	**no/0,25**				**250**	**750**	**0**
Savinskij – Jarnema- Onega (section of current regional road)	**V/III**	**90/90**	**2/2 4/3,75**	**gravel/Ab**	**21/21**	**14/10/0/0**	**14/10/0/0**	**1/50**	**1/50**	**0**	**2 100**
Total for the road section					**149**					**6 432**	**12 869**

Variants between the border of Karelian Republic and Arkhangelsk Region and Onega river: "YELLOW - RED"

Karelian border (near Uneshma) – Zolotuha - railway station Nimenga – Trudovaja Sloboda - new bridge over Onega River - Onega

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Unseshma – red variant (whole current municipal road)	**-/III**	**90/90**	**0/2 4/3,75**	**Gravel/Ab**	**11/11**	**10/0/0/0**	**10/0/0/0**	**0/0**	**0/0**	**0**	**1 100**
Yellow variant – Zolotuha (section of current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**18/18**	**11/0/0/0**	**11/0/0/0**	**1/20**	**1/30**	**0**	**1 890**
Zolotuha – Malozuika (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gravel/Ab**	**24,2/24,2**	**30/0/0/0**	**30/0/0/0**	**2/50**	**2/88**	**0**	**2 789**
Malozuika – railway station Nimenga (whole current municipal road)	**V/III**	**90/90**	**1/2 4/3,75**	**Gavel/Ab**	**13,7/13,7**	**15/0/0/0**	**0/15/0/0**	**1/50**	**1/75**	**0**	**1 970**
Railway station Nimenga – village Nimenga (whole current regional road)	**V/III**	**60/60**	**1/2 4/3,75**	**Gavel/Ab**	**8/8**	**8/0/0/0**	**0/10/0/0**	**1/60**	**2/130**	**0**	**1 440**
Current private ground road ("with no owner") whole section	**-/III**	**No/90**	**1/2 5/3,75**	**not paved/Ab**	**13/13**	**0/0/0/0**	**10/0/0/0**	**0/0**	**2/70**	**1 847**	**0**
Varzogori – Onega ((section of the current regional road)	**V/III**	**60/60**	**2/2 4/3,75**	**Gavel/Ab**	**13,3/13,3**	**18/0/0/0**	**0/20/0/0**	**5/75**	**5/100**	**0**	**1 980**
A new bridge over Onega River between Trudovaja Sloboda and Onega town	**-**	**no/90**	**no/2**	**no/Ab**	**no/1,2**	**-**	**-**	**Ice road /ferry,1500**	**1200**	**3 717**	**0**
Total for the road section					**102**					**5 564**	**11 169**

Variants between Onega river and current federal roads near the city of Arkhangelsk

Variant "RED": Onega town – Rikasiha – Arkhangelsk city centre

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Entrance to the city of Onega, including passages in the city of Onega	**IV/IV**	**60/60**	**2/2 4/3,75**	**Ab/Ab**	**17/17**	**0/0/0/0**	**0/0/0/0**	**0/0**	**0/0**	**0**	**1 020**
Onega - Tamitsa - Kyanda road (whole current regional road)	**IV/III**	**90/90**	**2/2 4/3,75**	**Gravel, Ab/Ab**	**44/44**	**34/5/0/0**	**34/5/0/0**	**2/128**	**2/150**	**0**	**4 050**
Section of the Arkhangelsk (from the vill. of Rikasikha) - Onega road (whole current regional road)	**IV/III**	**90/90**	**2/2 4/3,75**	**concrete , gravel Ab /Ab**	**117/117**	**116/27/10/0**	**116/27/10/0**	**10/437**	**10/437**	**0**	**12 150**
Rikasiha – Arkhangelsk city centre (section of current federal road)	**III/III**	**90/90**	**2(3)/2(3) 3,75/3,75**	**Ab/Ab**	**28/28**	**-/-/-/-**	**-/-/-/-**	**-/-**	**-/-**	**0**	**0**
Total for the road section					**208**						**17 220**

Variant "Blue - brown-blue": Porog – Kodino – Brin Navalok - Arkhangelsk city centre

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)

Section of current Savinskij – Jarnema- Onega (section of current regional road) from Porog to Kodino (section of current regional road)	**IV/ III**	**90/90**	**2/2 4/3,75**	**Gravel, Ab /Ab**	**44/44**	**67/6/0/0**	**67/6/0/0**	**2/122**	**2/122**	**0**	**4 400**
Porog - Kodino (section of current regional road)	**IV/ III**	**90/90**	**2/2 4/3,75**	**gravel/ Ab**	**34/34**	**49/4/0/0**	**49/4/0/0**	**5/204**	**5/204**	**0**	**3 400**
Kodino – Samoded (new road)	**-/III**	**no/90**	**no/2 no/3,75**	**no/Ab**	**no/55**	**0/0/0/0**	**52/5/0/0**	**0/0**	**2/150**	**7 617**	**0**
Samoded - Brin Navalok (section of current federal road)	**IV/ IV**	**90/90**	**2/2 4/3,75**	**Gravel, Ab /Ab**	**56/56**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	**0**	**0**
Brin Navalok - Arkhangelsk city centre, section of current fed. road	**IV/ IV**	**90/90**	**2/2 4/3,75**	**Ab/Ab**	**no/140**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	**0**	**0**
Total for the road section					**328**					**7 617**	**7 800**

Variant "BLUE" : Porog – Savinskij – Samoded - Brin Navalok - Arkhangelsk city centre

Section	road class 2020/ proposed 2050	speed level 2020/ proposal for 2050 (km/h)	number of lanes and their width 2020/ proposal for 2050	pavement type 2020/ proposal for 2050	length of the road structure 2020/ proposal for 2050 (km)	Culvert pipes 2020 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	Culvert pipes 2050 diameter up to 1,0/1,01-1,5/1,51-3,0 / more 3,0 meters	amounts of bridges/ their approximate lengths 2020 (m)	amounts of bridges/ their approximate lengths 2050 (m)	cost estimate for new road construction (MRub)	cost estimate for road rehabilitation (MRub)
Porog - Savinsij (section of current regional road)	**IV/III**	**90/90**	**2/2 4/3,75**	**Gravel, Ab /Ab**	**193/193**	202/14/15/ 0	202/14/15/0	20/740	20/740	0	19 300
Savinskij - Samoded - Brin Navalok (section of current regional road)	**IV/III**	**90/90**	**2/2 4/3,75**	**Gravel, Ab /Ab**	**135/135**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	0	0
Brin Navalok - Arkhangelsk city centre, section of current fed. road	**III/III**	**90/90**	**2/2 4/3,75**	**Ab/Ab**	**140/140**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	**-/-/-/-**	0	0
Total for the road section					**468**					**x**	**19 300**

Трасса на участке между федеральной автомобильной дорогой Р-21 "Кола" и МАПП "Люття" (Вартиус).
Федеральная автомобильная дорога А-137 «Автомобильная дорога Р-21 «Кола» — Тикша — Ледмозеро — Костомукша — государственная граница с Республикой Финляндия»

The road on the section between the federal highway R-21 "Kola" and the checkpoint "Luttya" (Vartius).
Federal highway A-137 "Highway R-21" Kola "- Tiksha - Ledmozero - Kostomuksha - state border with the Republic of Finland".

Примечание

1) Пунктиром обозначены участки нового строительства.

Условные обозначения

- Вариант трассы №1
- Вариант трассы №2
- Вариант трассы №3
- Вариант трассы №4
- Вариант трассы №5
- Существующие дороги (гравийные, грунтовые дороги, зимники)
- Железная дорога

Схема расположения листов

4	3	1
		2

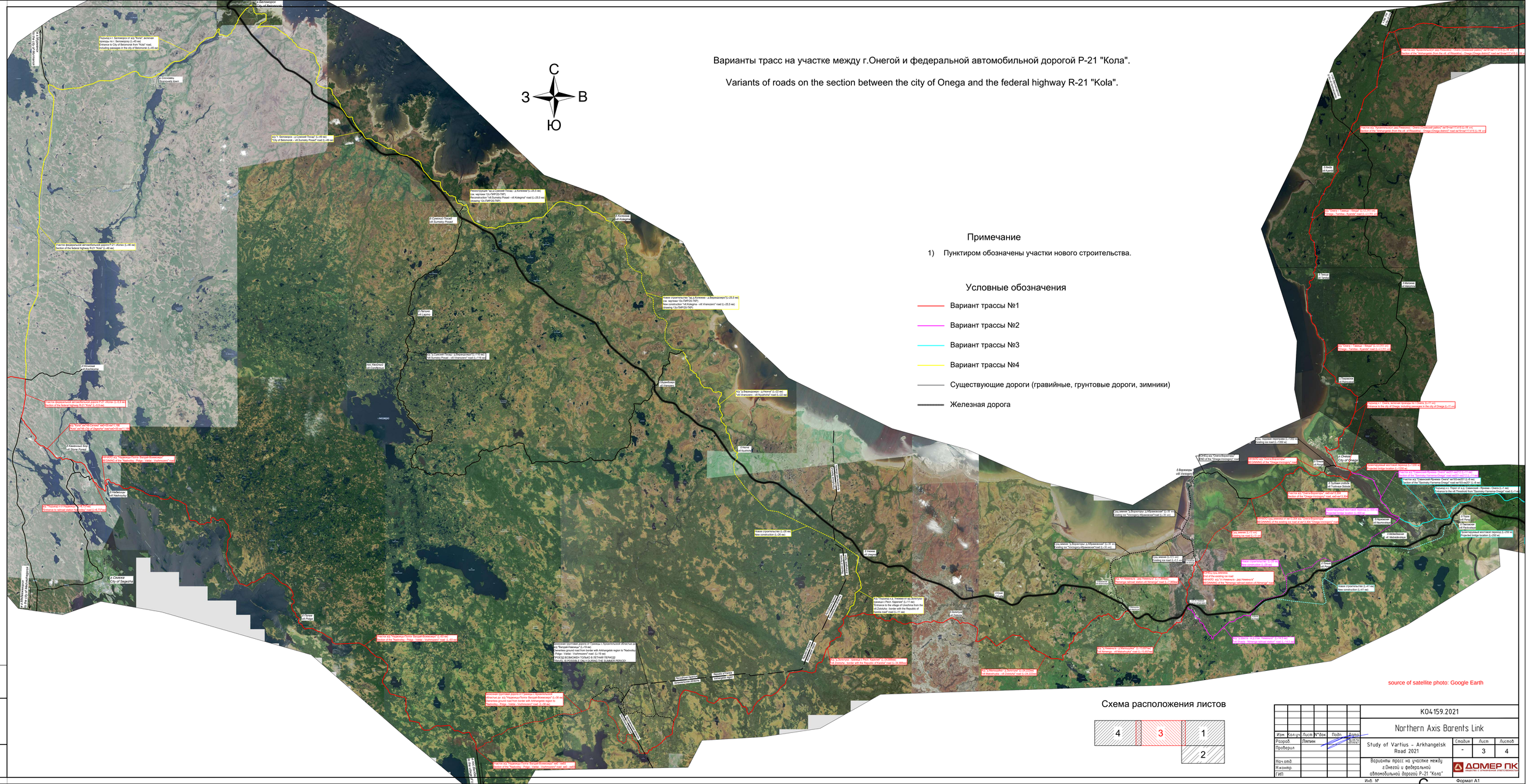
source of satellite photo: Google Earth

Изм.	Кол.уч	Лист	N°док.	Подп.	Дата	K04159 2021		
						Northern Axis Barents Link		
Разраб.		Ляпин			29.03.21	Study of Vartius - Arkhangelsk Road 2021	Стадия: -	Лист: 4 / Листов: 4
Проверил								
Нач.отд.						Трасса на участке между федеральной автомобильной дорогой Р-21 "Кола" и МАПП "Люття" (Вартиус).	ДОМЕР ПК общество с ограниченной ответственностью	
Н.контр.								
ГИП								

Инв. N°

Формат А1

Взам.инв.N° | Подп.и дата | Инв.N° подл.



						К04159.2021
						Northern Axis Barents Link
Изм.	Кол.уч.	Лист	№док.	Подп.	Дата	
Разраб.		Плетин			09.03.21	Study of Vartius – Arkhangelsk Road 2021
Проверил						Варианты трасс на участке между г.Онегой и федеральной автомобильной дорогой Р-21 "Кола"
Нач.отд.						
Н.контр.						
ГИП						

Стадия	Лист	Листов
-	3	4

ДОМЕР ПК

Инв. №

Формат А1

Взам.инв.№

Подп. и дата

Инв.№ подл.

Варианты трасс на участке между г.Архангельском и городом Онега.

Variants of roads on the section between the city of Arkhangelsk and the city of Onega.

Примечание

1) Пунктиром обозначены участки нового строительства.

Условные обозначения

- Вариант трассы №1
- Вариант трассы №2
- Вариант трассы №3
- Вариант трассы №4
- Вариант трассы №5
- Существующие дороги (гравийные, грунтовые дороги, зимники)
- Железная дорога

Схема расположения листов

source of satellite photo: Google Earth

Изм.	Кол.уч	Лист	N°док.	Подп.	Дата
Разраб.		Ляпин			29.03.21
Проверил					
Нач.отд.					
Н.контр.					
ГИП					

K04159.2021

Northern Axis Barents Link

Study of Vartius - Arkhangelsk Road 2021

Стадия	Лист	Листов
-	1	4

Варианты трасс на участке между г.Архангельском и городом Онега.

ДОМЕР ПК ОБЩЕСТВО С ОГРАНИЧЕННОЙ ОТВЕТСТВЕННОСТЬЮ

Инв. N°

Формат А1

Взам.инв.N°

Подп. и дата

Инв.N° подл.

Примечание

1) Пунктиром обозначены участки нового строительства.

Условные обозначения

- Вариант трассы №1
- Вариант трассы №2
- Вариант трассы №3
- Вариант трассы №4
- Вариант трассы №5
- Существующие дороги (гравийные, грунтовые дороги, зимники)
- Железная дорога

Схема расположения листов

source of satellite photo: Google Earth

						К04159.2021
Изм.	Кол.уч.	Лист	№докум.	Подп.	Дата	Northern Axis Barents Link
Разраб.		Лялин			29.03.21	
Проверил						Study of Varius – Arkhangelsk Road 2021
Рук.группы		Сидоров				
Нач.отд.						Варианты трасс на участке между г.Архангельском и городом Онега.
Н.контр.						
ГИП						

Стадия	Лист	Листов
-	2	4

ДОМЕР ПК

Инв. №

Взам.инв.№

Подп. и дата

Инв.№ подл.

Формат А1+А4

Трасса на участке между федеральной автомобильной дорогой Р-21 "Кола" и МАПП "Люття" (Вартиус).
Федеральная автомобильная дорога А-137 «Автомобильная дорога Р-21 «Кола» — Тикша — Ледмозеро — Костомукша — государственная граница с Республикой Финляндия»

The road on the section between the federal highway R-21 "Kola" and the checkpoint "Luttya" (Vartius).
Federal highway A-137 "Highway R-21" Kola "- Tiksha - Ledmozero - Kostomuksha - state border with the Republic of Finland".

Примечание

1) Пунктиром обозначены участки нового строительства.

Условные обозначения

- Вариант трассы №1
- Вариант трассы №2
- Вариант трассы №3
- Вариант трассы №4
- Вариант трассы №5
- Существующие дороги (гравийные, грунтовые дороги, зимники)
- Железная дорога

Схема расположения листов

4	3	1
		2

Взам.инв.№
Подп.и дата
Инв.№ подл.

Изм.	Кол.уч	Лист	N°док.	Подп.	Дата	К04159 2021		
						Northern Axis Barents Link		
Разраб.		Ляпин			29.03.21	Study of Vartius - Arkhangelsk Road 2021	Стадия	Лист	Листов
Проверил							-	4	4
Нач.отд.						Трасса на участке между федеральной автомобильной дорогой Р-21 "Кола" и МАПП "Люття" (Вартиус).	ДОМЕР ПК Общество с ограниченной ответственностью	
Н.контр.								
ГИП								

Инв. №

Формат А1