F.5 Physical Resources

F.5.1 Air quality

Potential Air Quality Impacts

454. The potential impacts of the Project to air quality are described as follows:

Design and Pre-construction Phase

455. The road rehabilitation works are generally intermittent and not permanent in a specific site, the works move along the Project road as work progresses and as such air quality impacts will be short term in specific locations. However, fugitive emissions will be emitted on a longer-term basis from stationary sources such as quarries, borrow pits and asphalt plants. These sites can however be selected prior to construction and be placed in an area where it can cause the least impact on human and ecologic receptors.

Construction Phase

456. During construction, air quality is likely to be degraded by a range of operational activities including:

- Exhaust emissions from the operation of construction machinery (e.g. Nitrogen Oxides (NO_X), Sulfur Oxides (SO_X) and Carbon Monoxide (CO));
- Open burning of waste materials; and
- Dust generated from quarries, borrow pits, haul roads, unpaved roads, exposed soils and material stock-piles.

457. Dust is the major air quality problem from construction sites. Dust is a problem for a variety of reasons, as outlined below:

- Inconvenience to local people. For example, people may have to re-wash laundry that has been put outdoors to dry, and wash windows, curtains and vehicles. Dust can contaminate meat hanging up in open-air butchers and other food that is exposed to it in homes, shops and open-air restaurants, giving food a gritty texture.
- Health and safety problems. Dust may affect health by irritating eyes and worsening the health of people with asthma. Dust can reduce visibility for drivers on roads. It can also be blown for long distances by the wind.
- Crop damage. Even low concentrations of dust can affect plant and fruit growth as far away as one kilometer from a construction site. Plant growth is particularly susceptible to dusts that are highly alkaline, for example limestone and cement dust. Dust deposited during light rainfall can cause the soil surface to form a crust increasing run-off.
- Impact on ecology. Dust blowing onto watercourses may damage ecology by increasing sedimentation, reducing sunlight and suffocating fish. It may also affect plant growth and change the species of plants growing in an area. Dust may also damage trees and other vegetation planted as part of the construction contract.
- Damage to plant and equipment. Within the construction site, dust can cause mechanical or electrical problems in sensitive equipment such as computers. It can also increase abrasion of moving parts in equipment and clogging of air filters.

Operational Phase

458. The main source of air pollution during the operational phase will be vehicles moving on the highway. The main pollutants are: CO; NO_X; hydrocarbons (HC); SO_2; carbon dioxide (CO_2); and particulate matter (PM). These compounds can damage health and/or the environment. The concentration of pollutants generated by vehicles depends on factors such as the number, type and speed of vehicles. The effect of air pollution on local people depends on the distance between them and the road, wind direction, topography and other factors. The main direct effects are in the area closest to the road as the rapid dispersion and dilution of exhaust gases quickly reduces their concentrations to levels at which risks are minimal.

459. The impacts associated with air quality in the operational phase of the Project have been assessed using an air dispersion model. The findings of which are presented below.

Mitigation Actions

Pre-construction Phase

460. Locations for borrow pits, rock crushing facilities, concrete batching yards and asphalt plants will require approval from the Engineer, MoENRP and the RD during the Pre-construction phase. Efforts will be made to ensure that these facilities are as near to the Project road as practical to avoid unnecessary journeys and potential dust issues from vehicle movements during construction works on unpaved roads in urban areas. Haul routes will be prepared and submitted to the Engineer as part of his Traffic Management Plan (TMP).

461. To prevent impacts arising from asphalt plants, construction camps, batching plants and rock crushing plants, they will be prohibited within 500 meters of any urban area or sensitive receptor (school, hospital, etc). The locations of these facilities will be indicated within the Contractors SSEMP. Baseline air quality monitoring will also be undertaken by the Contractor during the pre-construction phase as described below under the recommended monitoring.

462. To adequately manage air quality impacts the Contractor will be responsible for the preparation of an Air Quality Plan, submitted to the Engineer as part of the SSEMP. The plan will detail the actions to be taken to minimize dust generation (e.g. spraying un-surfaced roads with water (including the types of equipment, sources of water, locations for watering and schedule), covering stock-piles, etc) and will identify the type, age and standard of equipment to be used and will also provide details of the air quality monitoring program for baseline and routine monitoring. The Plan will also include contingencies for the accidental release of toxic air pollutants.

Construction Phase

463. The Contractor will be responsible, through compliance with this EMP and his SSEMP, for the following;

- Exhaust emissions - No furnaces, boilers or other similar plant or equipment using any fuel that may produce air pollutants will be installed without prior written consent of the Engineer. Construction equipment will be maintained to a good standard and fitted with pollution control devices regularly monitored by the Contractor and Engineer.
- Open burning of waste materials - No burning of debris or other materials will occur on the Site without permission of the Engineer.

- Dust generated from haul roads, unpaved roads, material stock piles, etc:
- The Contractor will ensure and that material stockpiles will be located in sheltered areas and be covered with tarpaulins or other such suitable covering to prevent material becoming airborne.
- All trucks used for transporting materials to and from the site will be covered with canvas tarpaulins, or other acceptable type cover (which will be properly secured) to prevent debris and/or materials from falling from or being blown off the vehicle(s).
- Hard surfaces will be required in construction areas with regular movements of vehicles.
- Effective use of water sprays will be implemented (e.g., Carry out watering for dust control at least 3 times a day: in the morning, at noon, and in the afternoon during dry weather with temperatures of over 25°C, or in windy weather. Avoid overwatering as this may make the surrounding muddy). All water used for controlling dust will be free of odor and pollution.
- Earthwork operation to be suspended when the wind speed exceeds 20 km/h in areas within 500 m of any community.

464. In addition, any new borrow pits, concrete batching plant, rock crushing facility and asphalt mixing plant will be the subject of separate environmental application under the responsibility of the Contractor. The Engineer will ensure that no such facility becomes operational without the required permits.

465. The Contractor is also responsible for the preparation of a Health and Safety Plan. The Plan, required as part of the SSEMP, will include contingencies for the accidental release of toxic air pollutants.

466. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following should be considered:

- Regardless of the size or type of vehicle, owners / operators should implement the manufacturer recommended engine maintenance programmes.
- Drivers should be instructed on the benefits of driving practices that reduced both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits.
- Implement a regular vehicle maintenance and repair program.

Operational Phase

467. General - An Air Dispersion Model has been prepared for the Project. The following provides the results of the model along with maps illustrating the results.

468. Time frame of the model - The modelling has been developed for each of the below scenarios:

- Scenario year 2019
- Scenario year 2034.

469. The number of vehicles has been divided in 24 hours according to the provided traffic flow; the results of the modelling will be represented into values of concentration/time (hourly levels) for the considered pollutants in correspondence of the selected receptors.

470. Spatial domain and receptors - The model takes into consideration an area by far larger than the road strips and has been enlarged according to the morphology, the distribution of settlements and potential receptors for a total of about

20 square kilometres. The domain is a rectangle having dimensions of 6 km x 3.5 km; calculations have been carried out on the basis of progressive advancements for the road. Six main receptors have been inserted in group of three at the north and south of the road. They have been used for the considerations in terms of respect or excess of allowable limits.

471. Results - The results of the modelling are organized as follows:
- Scenario 2019 (probable start of road service).
- Scenario 2034.

472. The values of the concentration of pollutants are calculated in correspondence of the six selected receptors. The average yearly values and the values considered of reference by the present day legislation are put into evidence together to verify the threshold of acceptability. It must be put into evidence that the values only refers to the traffic in the new road, and do not consider any other external source.

Table F-4: Average yearly contribution of the road traffic to the background (concentration / µg/m^3)

Receptors	PM10	PM2.5	NO_2	NO_X	CO	SO_2	C6H6
Receptor 1 North	0.315	0.236	7.393	14.706	2.314	0.005	0.01
Receptor 2 North	0.156	0.113	3.171	6.553	1.072	0.002	0.005
Receptor 3 North	0.088	0.062	1.730	3.491	0.563	0.001	0.002
Receptor 1 South	0.617	0.469	9.215	23.806	4.666	0.01	0.021
Receptor 2 South	0.236	0.174	3.173	8.419	1.688	0.004	0.007
Receptor 3 South	0.164	0.119	2.094	5.584	1.128	0.002	0.005

473. The above values represent the contribution of the traffic to the background values in the year 2019 when the road is expected to enter in full service. With reference to the PM_{10} it can be assumed with high confidence a background value of 17 µg/m^3 in is in accordance with the field measurements carried in September 2017.

474. Scenario for the interval years 2019 to 2034 - The following estimations have been calculated according to **Table F-4**, which reports the estimated increments/year of the average monthly concentration for the expected traffic increments. When background values are available they are considered into the calculations.

475. The average resulting values are presented in the below **Table F-5** and **Table F-6** which shows the increments, the background and the final expect values.

Table. F-5 - PM_{10} (µg/m^3) Comparison of expected values at 2019, background and limits

Receptor	Δ estimated yearly increment (aver.) PM_{10}	Background level	Total	Limits (year)
Receptor 1 North	0,315	17	17.315	40.0
Receptor 2 North	0,156	17	17.156	40.0
Receptor 3 North	0,088	17	17.088	40.0
Receptor 1 South	0,617	17	17.617	40.0
Receptor 2 South	0,236	17	17.236	40.0
Receptor 3 South	0,164	17	17.164	40.0

476. The data analysis confirms that the emission of PM_{10} generated by the traffic, at 2019, is very limited and even taking into account the background levels will not exceed the allowable limits. It must be taken into account that the largest part of the traffic generating the background will be diverted into the new road, for that the above scenario has to be considered very conservative.

Table F-6 - NO_2 (µg/m^3) Comparison of expected values at 2019, background and limits

Receptor	yearly estimated Δ (average increment) NO_2	Background level	Total	Limits (in one year)
Receptor 1 North	7.393	-	7.393	40
Receptor 2 North	3.171	-	3.171	40
Receptor 3 North	1.730	-	1.730	40
Receptor 1 South	9.215	-	9.215	40
Receptor 2 South	3.173	-	3.173	40
Receptor 3 South	2.094	-	2.094	40

477. The impact of the NO_2 emissions can only be perceived in the proximity of the road; there are no background data available.

478. The application of increment of emissions determined by the expected increase of traffic, permitted to develop the following tables (**Table F-7**, **F-8**, **F-9** and **F-10**) where the yearly increment of pollution for the considered pollutants is put into evidence. This data is also mapped in **Figure F-1** to **Figure F-12**.

Table F-7: General scenario at 2034 for PM_{10}, NO_X and NO_2

Receptors	PM_{10}	$PM_{2.5}$	NO_2	NO_X	CO	SO_2	C6H6
Receptor 1 North	0.442	0.332	7.850	17.745	3.267	0.007	0.014
Receptor 2 North	0.220	0.160	3.417	8.019	1.528	0.003	0.007
Receptor 3 North	0.125	0.088	1.879	4.276	0.813	0.002	0.004
Receptor 1 South	0.872	0.663	10.299	29.579	6.612	0.015	0.029
Receptor 2 South	0.337	0.250	3.631	10.609	2.424	0.005	0.011
Receptor 3 South	0.235	0.171	2.429	7.103	1.635	0.004	0.007

Table F-8: Yearly scenario 2019 to 2034 for PM_{10} (including background at 2019)

year	**Receptor** 1 North	**Receptor** 2 North	**Receptor** 3 North	**Receptor** 1 South	**Receptor** 2 South	**Receptor** 3 South
2019	17.32	17.16	17.09	17.62	17.24	17.16
2034	17.44	17.22	17.12	17.87	17.34	17.24

Table F-9: Yearly scenario 2019 to 2034 for NO_2 (No background)

year	**Receptor** 1 North	**Receptor** 2 North	**Receptor** 3 North	**Receptor** 1 South	**Receptor** 2 South	**Receptor** 3 South
2019	7.39	3.17	1.73	9.21	3.17	2.09
2034	7.85	3.42	1.88	10.30	3.63	2.43

Table F-10: Yearly scenario 2019 to 2034 for CO (No background)

year	**Receptor** 1 North	**Receptor** 2 North	**Receptor** 3 North	**Receptor** 1 South	**Receptor** 2 South	**Receptor** 3 South
2019	2.31	1.07	0.56	4.67	1.69	1.13
2034	3.27	1.53	0.81	6.61	2.42	1.63

479. The analysis of the impact on operational phase air quality determined by the traffic on the new road suggests that there are no negative impacts on the environment. In addition to the fact that the maximum allowable limits are not surpassed, it must be taken into account that the road provides benefits in term of vehicular emission due to the smoother drive and optimized alignment.

480. The emissions of vehicles on a highway are lower than vehicles driving a urban type road as the existing one where the frequent bends, inclination and traffic congestions do not allow a fluid drive. If a similar traffic flow should transit via the existing road, the emissions would be almost 20% higher.

Figure F-1: PM10, 2019 (Km 0 – Km 8)

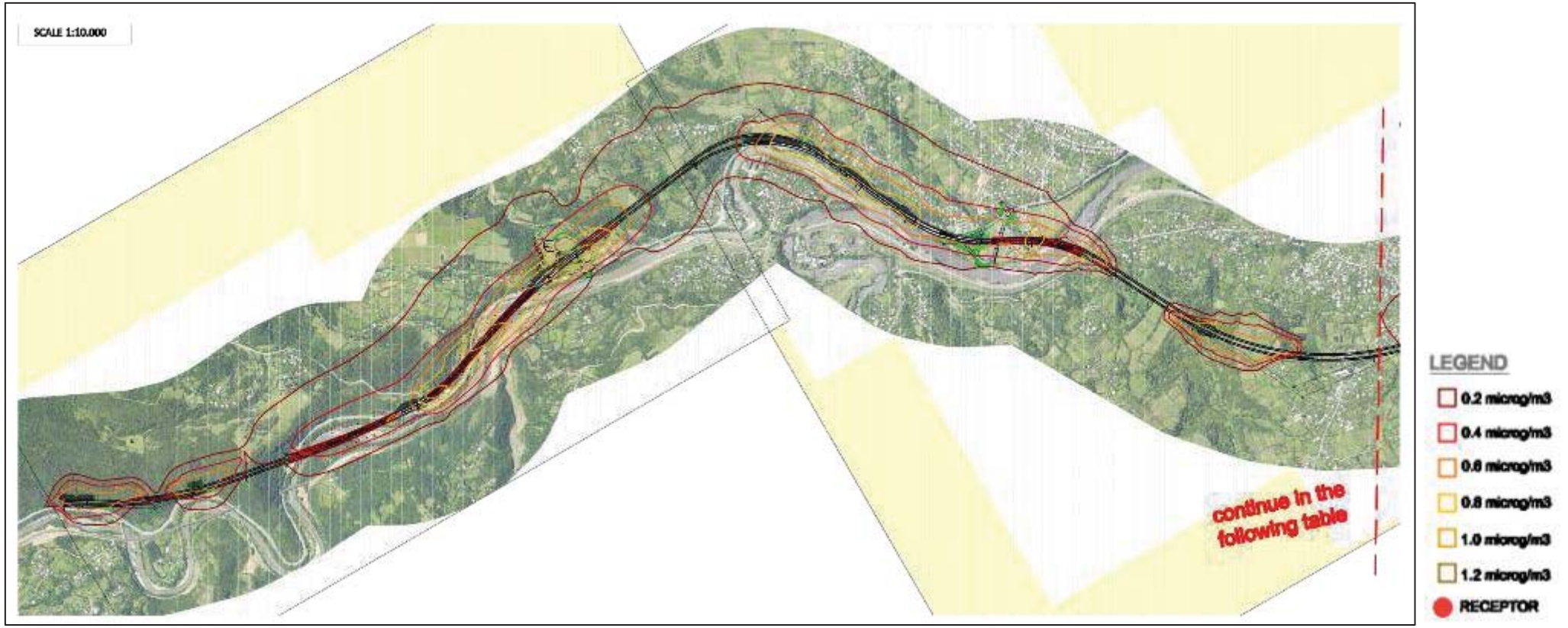


Figure F-2: PM10, 2034 (Km 0 – Km 8)

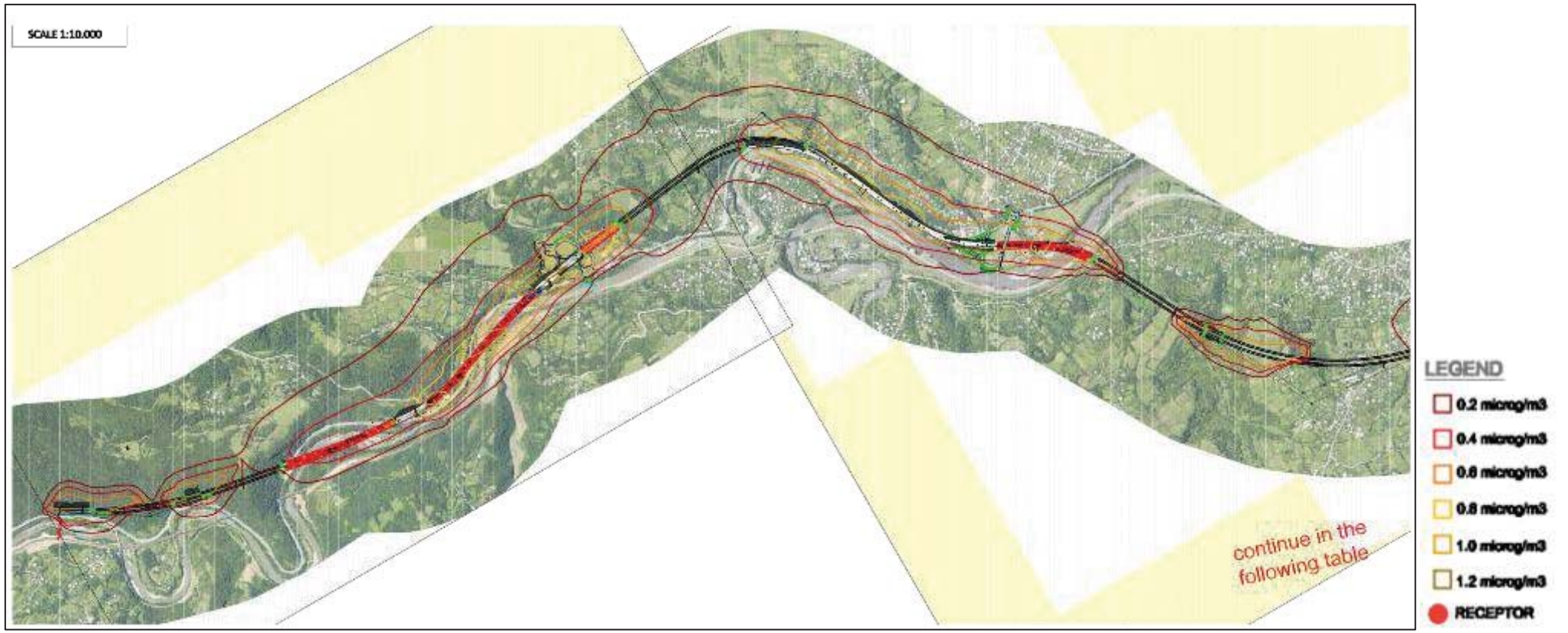


Figure F-3: PM10, 2019 (Km 8 – Km 14.7)

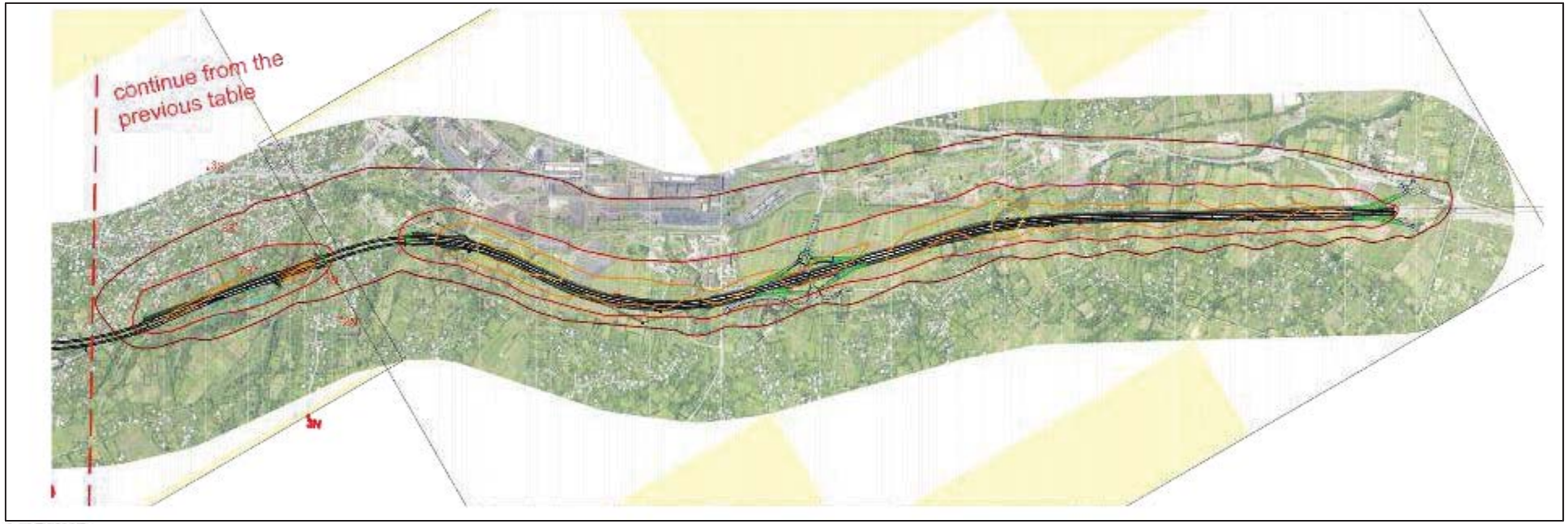


Figure F-4: PM10, 2034 (Km 8 – Km 14.7)

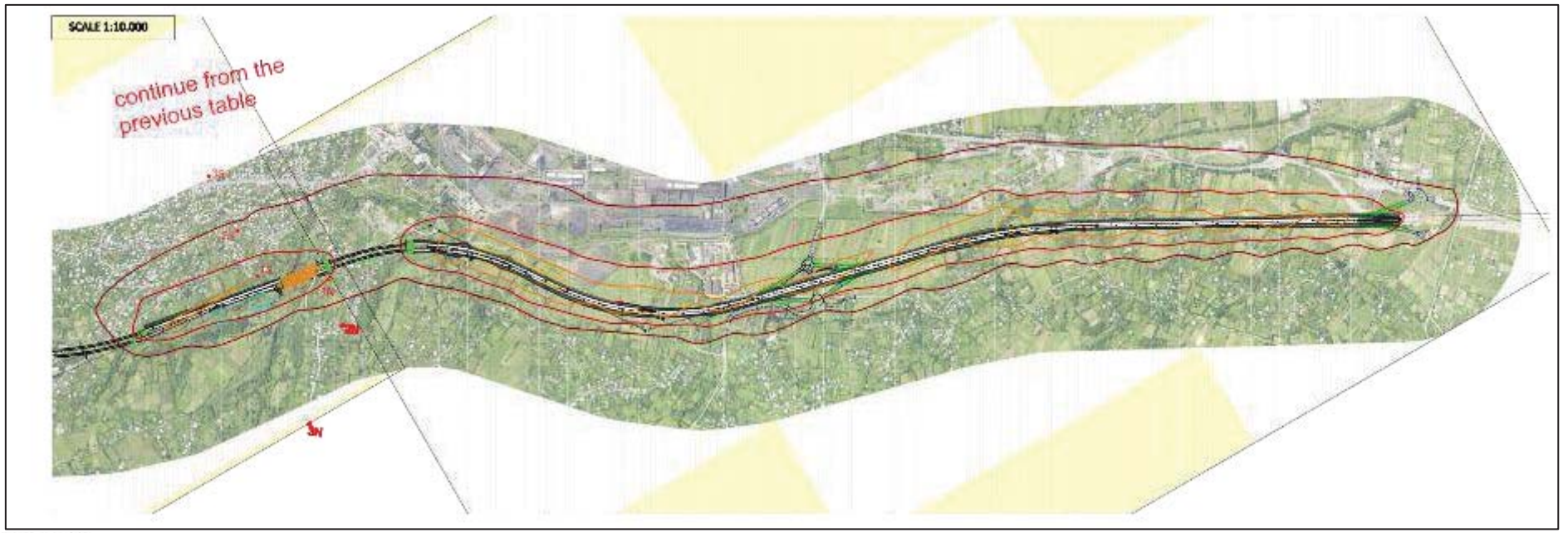


Figure F-5: NO2, 2019 (Km 0 – Km 8)

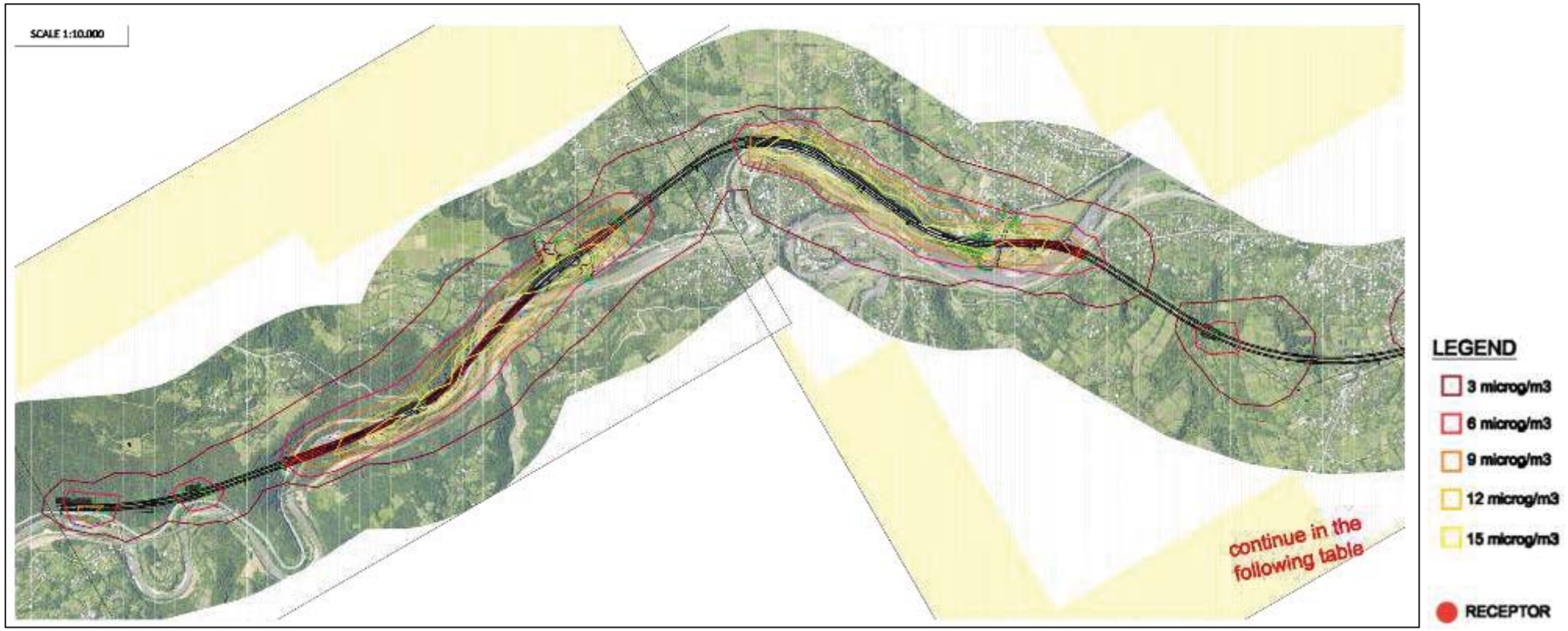


Figure F-6: NO2, 2034 (Km 0 – Km 8)

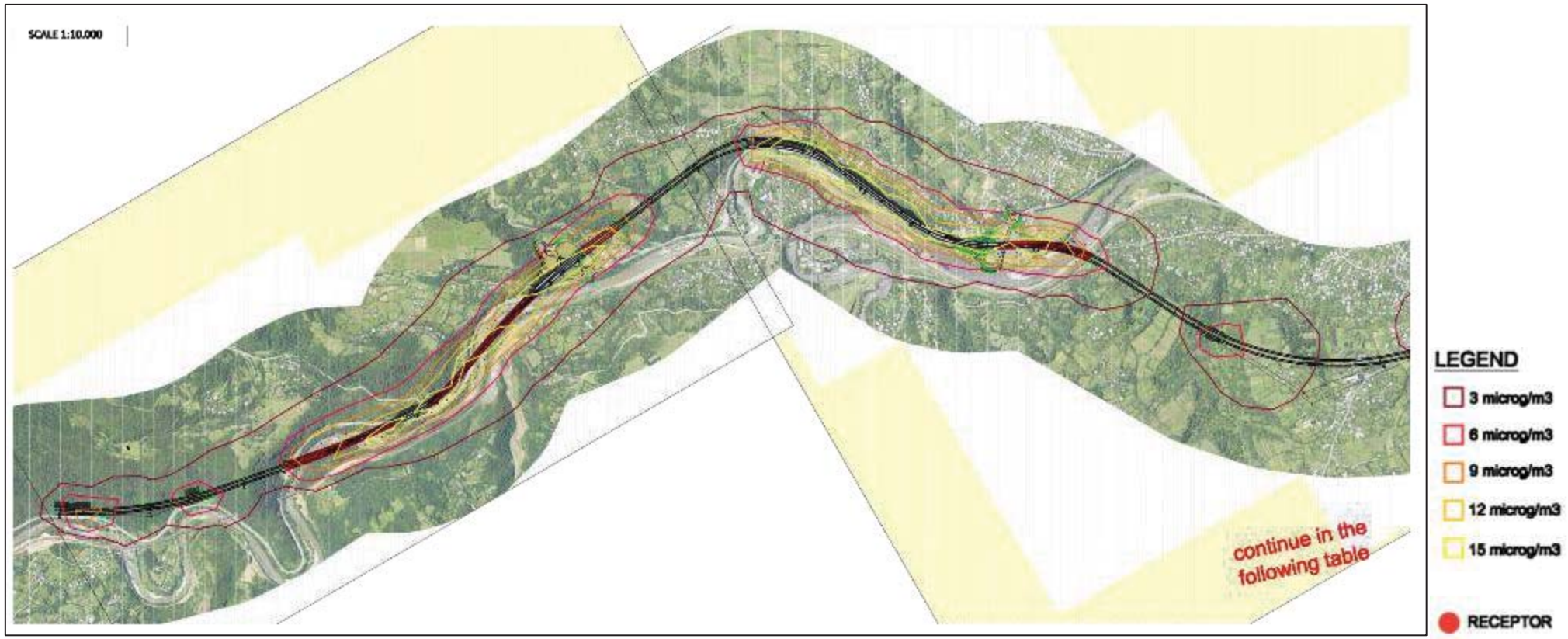


Figure F-7: NO2, 2019 (Km 8 – Km 14.7)

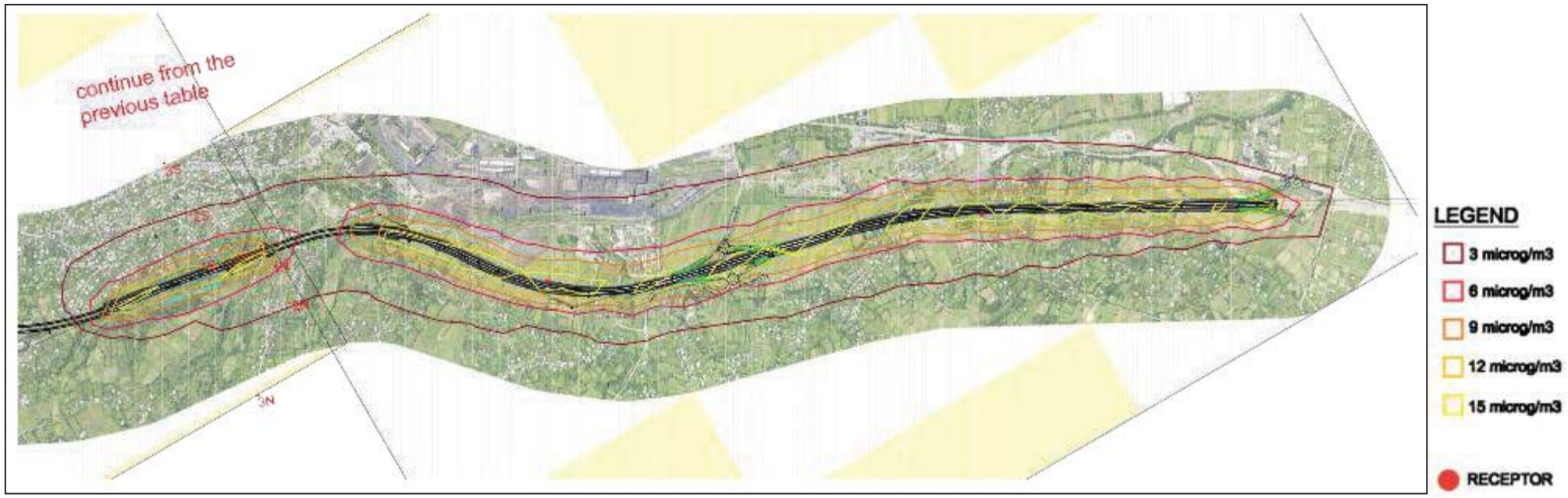


Figure F-8: NO2, 2034 (Km 8 – Km 14.7)

Figure F-9: CO, 2019 (Km 0 – Km 8)

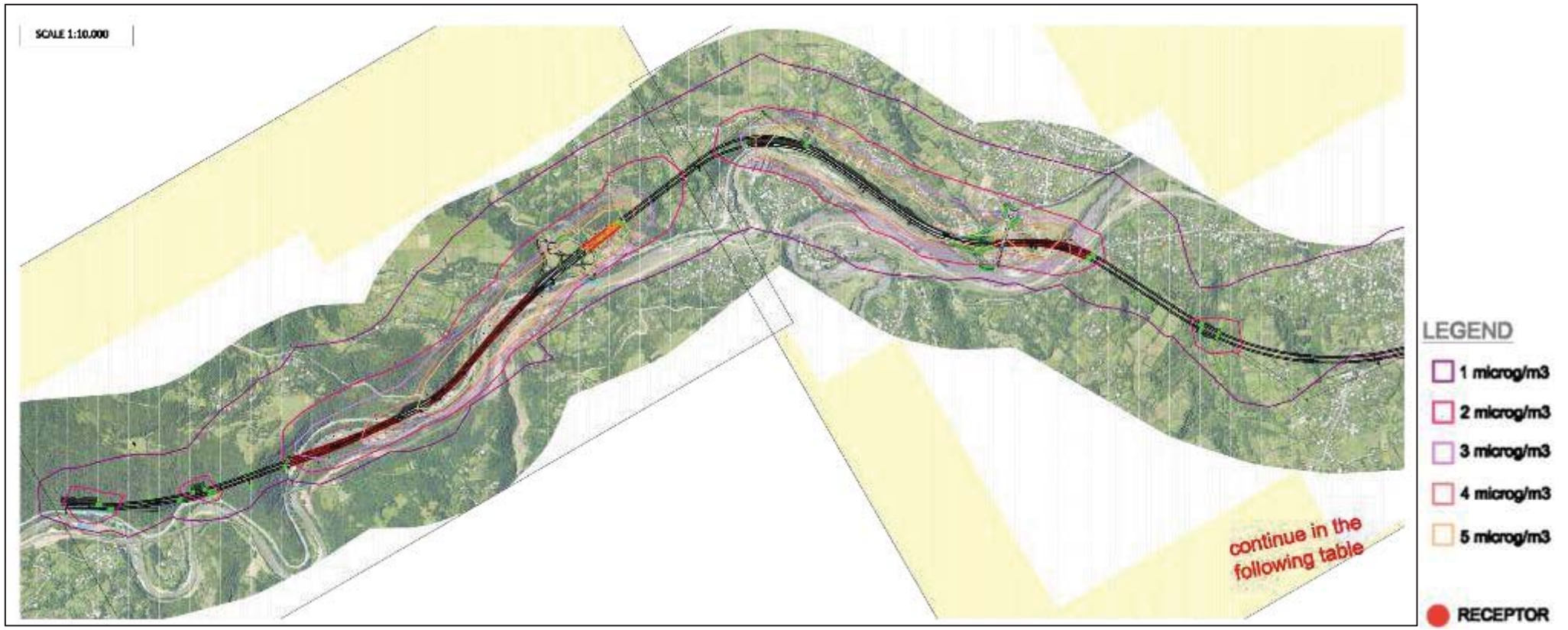


Figure F-10: CO, 2034 (Km 0 – Km 8)

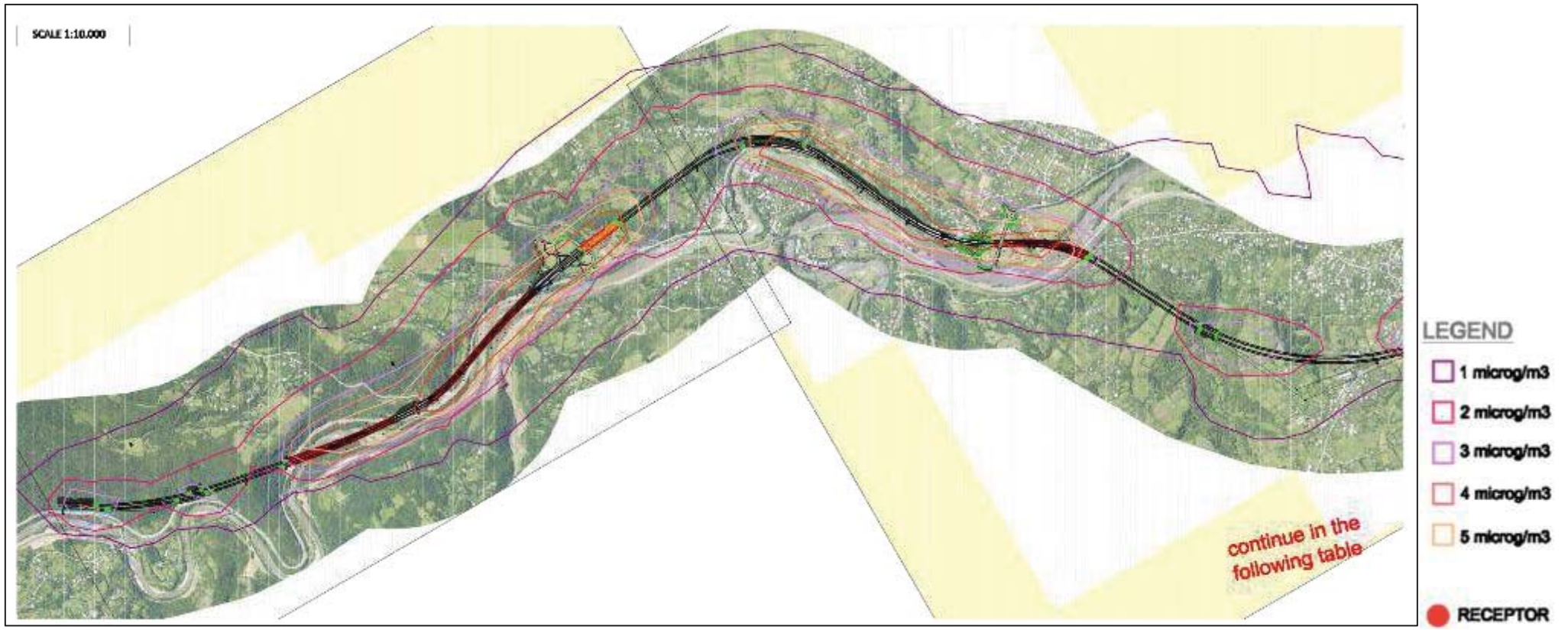


Figure F-11: CO, 2019 (Km 8 – Km 14.7)

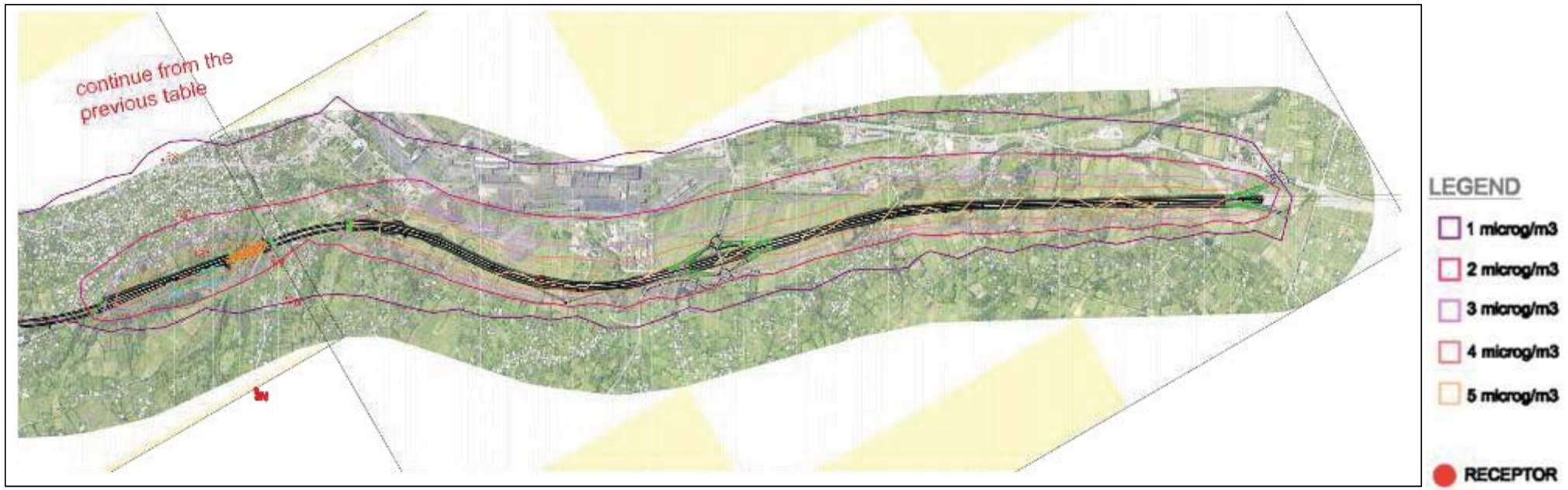
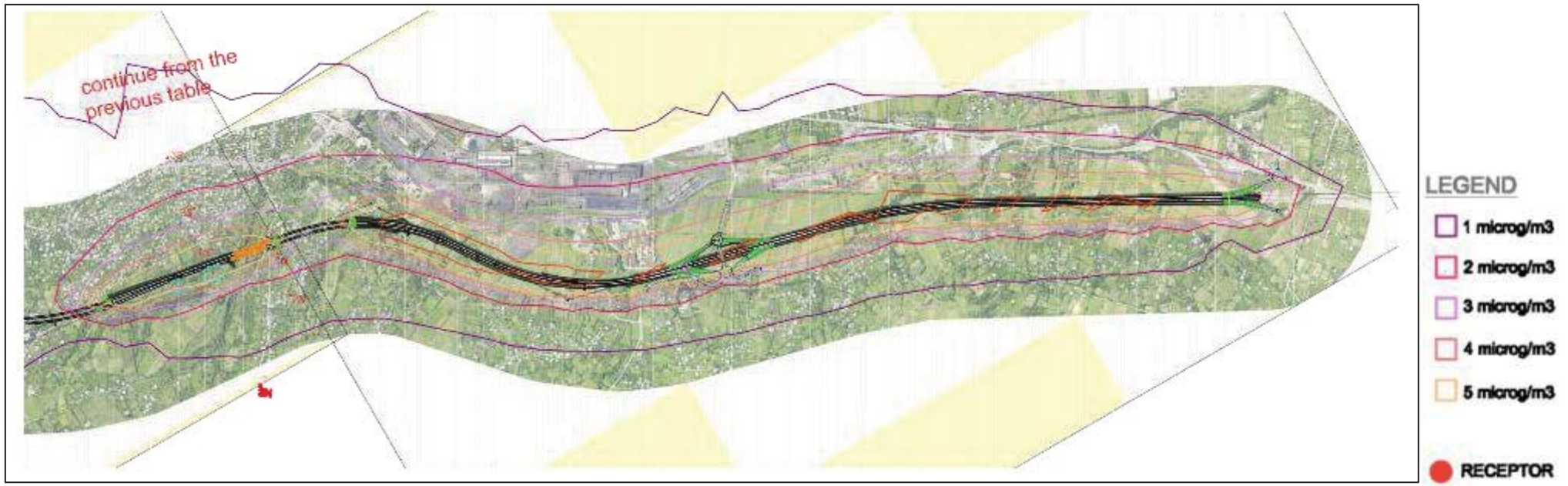


Figure F-12: CO, 2034 (Km 8 – Km 14.7)



481. The new road will have a positive impact on the air quality in term of reduced emissions compared to a similar flow of traffic along the existing one; it can also be pointed out that no air quality limits will be exceeded even considering that the composition of the fleet of vehicles is maintained. The higher values are recorded to the south of the road due to the main wind directions and morphology, these values are anyhow lower than the limits.

482. In addition it is reasonable to consider that in the next years a large part of the obsolete and aging vehicles now in circulation will be substituted by less polluting ones with additional benefits to air quality.

F.5.3 Climate Change

Potential Impacts Caused by the Project

483. Greenhouse Gas (GHGs) Emissions – The Greenhouse Gas (GHG) emissions resulting from road construction have been estimated to be 2.14 $ktCO_2$/km for a 26m wide road. Including operational and maintenance costs over a 40 year period this figure rises to 3.94 $ktCO_2$/km. Given a road length of 14.77 km, this would result in around 58,200 tCO_2 of GHG emissions from the construction and O&M phases of the Project over a 40 year period.

Table F-5: Estimated Energy Consumption, CO_2 Emissions and GHG Emissions for a Concrete Pavement 13 m wide.

Phase	Energy Consumption, TJ/km (26m pavement)	CO_2 Emissions $ktCO_2$/km (26m pavement)	All GHG Emissions $ktCO_2$/km (26m pavement)
Construction	11.51 (23.02)	1.00 (2.00)	1.07 (2.14)
Maintenance – 40 years	2.99 (5.98)	0.19 (0.38)	0.20 (0.40)
Operation – 40 years	12.60 (25.20)	0.66 (1.32)	0.70 (1.40)
Total	27.09 (54.18)	1.85 (3.70)	1.97 (3.94)

Source: IEA ETSAP – Technology Brief T14 –August 2011

484. GHG emissions from traffic using the road have been calculated using the traffic forecasts presented in **Section B**. The existing road traffic is estimated to generate around 259 tons of CO_2 per day, or 94,661 tons of CO_2 per annum. A decrease of 13% of GHG emissions can be achieved when driving at 90 km/h as opposed to transient driving at 60 km/h. If we apply this condition to the traffic forecasts in 2037 a figure of approximately 186,000 tons of CO_2 would be generated by traffic using the road per year. However, this figure could reduce dramatically over the coming years as the performance of cars increase including the use of electric cars running of renewable energy.

Potential Impacts Upon the Project

485. The transport sector is vulnerable to changes in climate variables, expected changes in the frequency and intensity of extreme weather events, and increased sea level. The following are a few examples of the potential effects:

- Changes in temperature—both a gradual increase in temperature and an increase in extreme temperatures—are likely to impact road pavements (for example, heat-induced heaving and buckling of joints).
- Changes in temperature will also impact the behaviour of permafrost and thus the infrastructure lying on permafrost.
- Changes in precipitation and water levels will impact road foundations.
- Extreme weather events such as stronger and/or more frequent storms will affect the capacity of drainage and overflow systems to deal with stronger or faster velocity of water flows.
- Stronger or faster velocity of water flows will also impact bridge foundations.
- Increased wind loads and storm strengths will impact long span bridges, especially suspension and cable-stayed bridges.
- High levels of precipitation may threaten embankment stability.
- Increase in scouring of roads, bridges, and support structures. [18]

Mitigation Measures

486. Detailed pavement implications for climate change are scarce but growing in number and include work on the effect of rising average temperatures, changes in precipitation patterns, and increasing freeze-thaw cycling on pavement performance. The focus of these efforts is to integrate climate change into pavement design and predict pavement performance based on future climate scenarios. Most work has offered general advice or predictions but has stopped short of recommending immediate changes in practice. [19]

487. Most climate change impacts are projected to occur slowly over a long period of time and as such providing mitigation measure for topics such climate change impacts on pavement design need to be taken over time and cannot be determined in a study like this. Notwithstanding the above a number of simple measures can be taken to ensure that in the short term that extreme precipitation events do not result in significant impacts to the Project, they include:

- Increase ditch and culvert capacity;
- Maintain positive cross slope to facilitate flow of water from surface;
- Increase resistance to rutting;
- Reduce splashing/spray through porous surface mixtures;
- More frequent use of elevated pavement section;
- Improve visibility and pavement marking demarcation; and
- Ensure that all embankments are seeded to help increase stability.

F.5.4 Soils

Potential Impacts

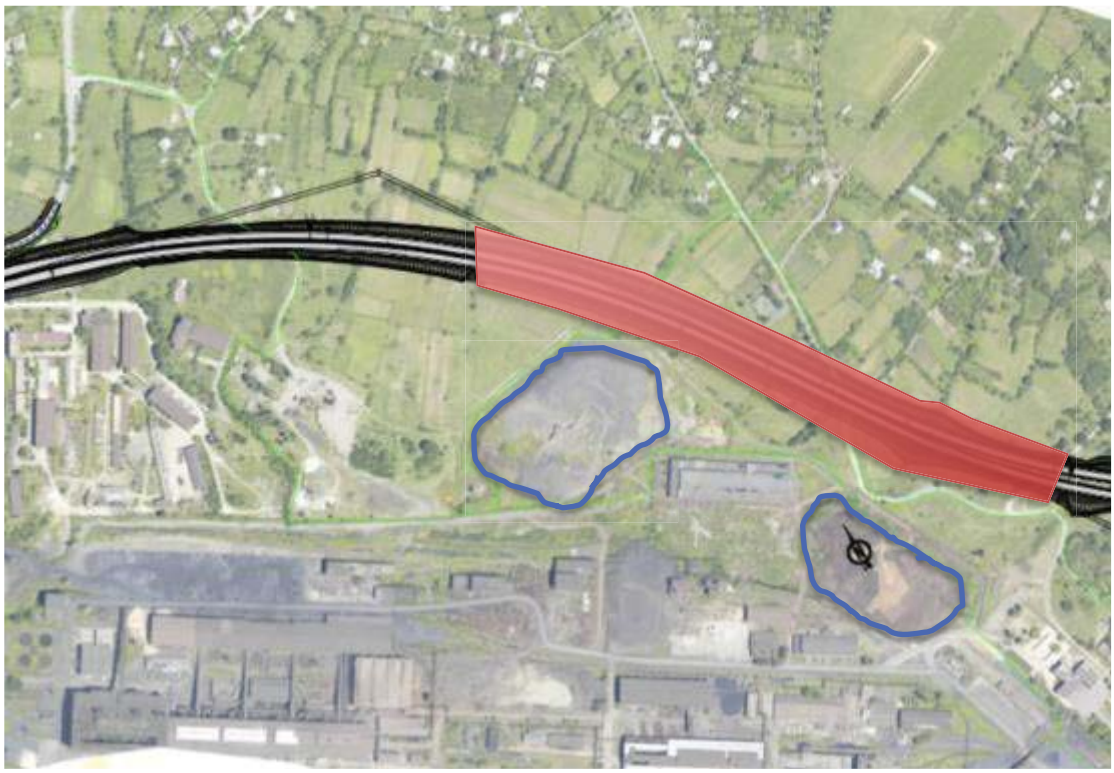
488. Potential impacts to soils include:

- Loss of Topsoil - Several impacts to topsoil may occur during the construction phase, including; removal of top soil for construction outside the ROW; compaction of topsoil; loss of top soil by wind and water erosion and covering of top soil by project works.

[18] Climate Proofing ADB Investment in the Transport Sector. ADB, 2014.
[19] Climate Change Adaptation for Pavements. US Department of Transport, Federal Highways Administration, 2015

- Erosion - It is possible, that without adequate protection measures soil erosion could occur on road embankments and bridge embankments. It is also possible, that stockpiles of soil located close to surface waters could infiltrate the water courses during heavy rainfall and cause siltation of the rivers.
- Borrow Pits – Potential impacts relating to borrow pits are discussed under **Section F.7.5 –** Borrow Pits.
- Induced Changes - Induced changes in the Project Area leading to industrial and commercial development are conceivable, thereby decreasing soil availability for agricultural purposes.
- Contamination Due to Spills or Hazardous Materials - Potential soil contamination is a possibility resulting from poorly managed fuels, oils and other hazardous liquids used during the project works.
- Contaminated Land - Soil samples taken to the north of the GAA plant have indicated that this area does not comprise levels of soil contamination above Dutch Intervention Levels or Italian standards for residential areas. Arsenic and Lead were identified in the samples above the current national limits, but within the proposed new national limits. However, only two soil samples were taken in this location and it is possible that soil contamination could still exist in the area north of the GAA. The Project road runs parallel to the GAA plant for approximately 1.3 kilometers, but the potential for pollution is considered to be confined to a smaller area, around 500 meters in length, and is focused around large two piles of waste material sited on the northern boundary of the GAA (see **Figure F-13**). In this portion of the Project road the road level will be raised on an embankment. An average of 50 cm of topsoil will be stripped from an area more than 40 meters wide over this 500 meter section, that equates to around 10,000 m^3 of top soil to be removed.

Figure F-13: Location of Potentially Contaminated Land (spoil heaps in blue)



Although the two soil samples taken as part of this EIA did not show significant levels of contamination it is considered prudent to undertake additional sampling of these soils prior to their disposal to ensure that they are not contaminated and can be disposed of as non-hazardous waste.

Mitigation Actions

Pre-construction phase

489. Loss of Soil for Agricultural Production - Before the commencement of the construction works of the Project, the RD must prepare the LARP. **Section F.7.2** – Land Use, discusses this issue in more detail.

490. Borrow Pits – Mitigation relating to borrow pits is discussed under **Section F.7.5** – Borrow Pits.

491. Contaminated Land - An additional four samples will be taken as part of this EIA and the results presented as an addendum to this report. Two of the samples will be taken in the area identified in **Figure F-13** and two within the alignment to the east and west of this area. If the results show that the monitored parameters are within the proposed national limits of outlined in **Table E-13**, **Table E14** and **Table E-15** and the Dutch target values no further soil sampling will be considered necessary. Should the results of the monitoring indicate any elevated levels of contamination further testing of the excavated soils in this area will be required during the construction phase by the Contractor. The procedure for any construction phase testing is as follows:

- The Contractor shall identify a temporary storage area for material excavated from the area identified in **Figure F-13**. The area should be fenced and signposted. The area shall comprise an impermeable surface to prevent leachate from the stockpiles potentially contaminating soils and groundwater in the area of the storage area.
- The Contractor shall strip the topsoil in the area of **Figure F-13** in batches of 5,000 m^2 and store the mixed material in the temporary storage area (the stockpile). The height of the stockpile shall be no more than 2 meters. The Contractor may choose to have more than one stockpile, depending upon the rates of excavation in this area.
- The Contractor shall then divide the stockpile into quadrants of 250m^3. The Engineer will hire a certified laboratory to take a soil sample from each of the quadrants for further chemical analysis (a stockpile of 2,500m^3 would require 10 samples). Sampling should be uniformly distributed throughout the stockpile, including sampling at depth. The Engineer will be present during the sampling to confirm that the correct number of samples were taken and that the sampling was undertaken in line with the relevant national legislative requirements.
- If the results show the all of the samples are within the proposed national limits of outlined in **Table E-13**, **Table E14** and **Table E-15** and the Dutch target values the material can be removed from the stockpile area and disposed of as non-hazardous material.
- If any of the ten samples show elevated levels of contamination the material from the respective contaminated quadrants of 250 m^3 will be disposed of as hazardous waste. Any other non-contaminated quadrants may be disposed of as non-hazardous waste. Final disposal of any contaminated soil must be undertaken at a waste management facility licensed to handle such wastes. As with normal waste materials, the Contractor will be obliged to keep records of any hazardous materials removed from the site, including:

  - Volume of soil removed;
  - Details of any identified contamination;
  - Soil stockpile (and/or storage container) unique identifier;
  - Date excess soil was excavated from each location and subsequently transported to a disposal facility;
  - Details of the vehicle transporting the soil to a disposal facility;
  - Details of the disposal facility; and
  - Date the excess soil arrived at the disposal facility.
- The Contractor will also provide a copy of the licensed waste management contractors contract to the Engineer before any contaminated soil is removed from the site. The Engineer will also be responsible for undertaking an additional due diligence review of the waste management contractors disposal site.

492. Alternatively, the Contractor may wish to explore alternative methods to treat the contaminated waste so that it can be disposed of as non-hazardous waste. If the Contractor chooses this option he will be responsible for the preparation of a Contaminated Spoil Treatment Plan that will outline the procedures and methods for treating the waste. The plan will be submitted to the Engineer for approval.

493. In many countries the concept of 'the polluter pays' is attributed to issues such soil contamination. It is likely that any contamination found in this area would have originated from the GAA, but the GAA has changed ownership several times during its life and it may be difficult to apportion liability to the current owners of the site. Accordingly, if any elevated levels of contamination are found that need to be removed during construction works the costs of removal and disposal should be bourn by the RD. The Contractor will be responsible for implementation of the Contaminated Soil Management Plan.

Construction Phase

494. Potential adverse impacts will be avoided or otherwise mitigated by ensuring the Contractor complies with the following:

- Erosion - During construction, the Contractor will be responsible for ensuing material that is less susceptible to erosion will be selected for placement around bridges and culverts. In addition, he will ensure re-vegetation of exposed areas including; (i) selection of fast growing and grazing resistant species of local grasses and shrubs; (ii) immediate re-vegetation of all slopes and embankments if not covered with gabion baskets; (iii) placement of fiber mats to encourage vegetation growth. The Engineer and the Contractor will both be responsible for ensuring that embankments are monitored continuously during construction for signs of erosion.
- Topsoil – To reduce impacts to topsoil the following measures will be employed by the Contractor; locate topsoil stockpiles outside drainage lines and protect stockpiles from erosion; construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil; rip ground surface prior to the spreading of topsoil; and remove unwanted materials from topsoil such as roots of trees, rubble and waste etc. Specifically regarding soil compaction, the Contractor will confine operation of heavy equipment within the ROW, as much as possible, to avoid soil compaction and damage to privately owned land. If in case private lands are disturbed, the contractor should promptly inform the owner and agree on the ways to remedy the situation.
- Borrow Pits – Mitigation relating to borrow pits is discussed under **Item F.7.5 – Borrow Pits**.

- Conversion of Agricultural Soils Due to Indirect/Induced Impacts - Although the EMP contains provisions controlling direct impacts of land takings for both the road and ancillary functions (asphalt plants, construction camps, etc.), control of the induced impacts is largely beyond the scope of the Project.
- Contamination Due to Spills or Hazardous Materials. The Contractor, with oversight from the Engineer, will ensure that:
    - All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund).
    - The construction camp maintenance yard will be constructed on impervious hardstanding with adequate drainage to collect spills, there will be no vehicle maintenance activities on open ground.
    - Filling and refueling will be strictly controlled and subject to formal procedures. Drip pans will be placed under all filling and fueling areas. Waste oils will be stored and disposed of by a licensed contractor.
    - All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
    - The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any soils.
    - No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hardstanding.
    - Areas using bitumen will be constructed on impervious hardstanding to prevent seepage of oils into the soils.
    - No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hard standing.
    - Areas using bitumen will be constructed on impervious hard standing to prevent seepage of oils into the soils.

F.5.5 Hydrology

Potential Impacts

Pre-construction Phase

495. The following potential impacts to hydrological conditions exist within the Project corridor:

- Drainage & Flooding - Inadequate assessment of the hydrological conditions in the Project Area and poor design could result in damage to Project structures, including bridges and culverts. This in turn would result in several impacts including cost to rebuild the structures, potential flooding of agricultural land and property and impacts to surface water quality.
- Construction Camps – Improper siting and design of construction camps can have negative impacts to hydrology, both surface and groundwater, through improper disposal of liquid waste and spills of hazardous liquids.

Construction Phase

496. Bridge Construction - Bridge construction activities may increase silt load in the river during construction at bridge sites and may result in accidental spillage of concrete and liquid waste into the river. This may impact upon the biodiversity of the rivers. Excavation of river bed materials will be required during the construction of the bridge piers (only around 5 piers will be constructed within the river itself). Surface

water monitoring did not indicate any elevated levels of contamination in the groundwater of both the Dzirula or the Kvirila rivers as such it is considered highly unlikely that the river bed silt is contaminated by manganese or any other pollutant and will therefore not need to be disposed of as hazardous waste. No other pollution of riverbed sedimentation is anticipated as a result of the construction activities in the river.

497. Hazardous Liquids - From the construction activities, there will be significant use of fuel and lubricant and other hazardous liquids such as paints. Without standardized materials handling and storage protocol in place, spills and contamination of groundwater and soils is possible. Other impacts to groundwater could occur from the washing out of concrete mixers onto bare soils and a lack of oil and grease interceptor tanks in camp drainage systems.

498. Water Use – Technical water may be sourced from the Dzirula and Kvirila rivers. The required amounts, potentially 200 m^3 per day (0.002 m^3/s) are insignificant given the flow rates of these major rivers.

499. Tunnel Construction – Impacts associated with tunnel construction are discussed under **Section F.7.6** below.

500. No fisheries have been identified within the Project area, or residents that rely on fishing as a livelihood. As such no impacts to livelihoods or fisheries or activities downstream are anticipated.

Operational Phase

501. Drainage of run-off from bridge decks could flow directly to the rivers if correct drainage is not installed on the bridges. This could be a problem if the bridges have accumulated oils and grease during dry periods and they are suddenly washed out during heavy rainfall.

Mitigation Actions

Pre-construction Phase

502. Drainage and Flooding - Consideration in the design phase has be given to the issue of drainage and culverts to ensure that drainage patterns are improved from the existing conditions and that increased run-off does not occur or result in flooding of areas previously undisturbed. During design, all drainage works have been designed based on the historical flood data and flood forecasting. A design discharge of 50 years return period is considered for culverts, and 100 years of bridges. If, during the operational phase of the Project, the rehabilitated road does result in increased run-off and flooding, the RD will be responsible for rectifying this issue.

503. Bridges - All bridges will be designed for the life expectancy of 100 years. The design loading and design of all structural components will conform to the bridge design standards provided in the Employer's Special Requirements. Bridge designs will ensure that drainage from bridge decks over 50 meters does not discharge directly to the watercourses beneath the bridges. The bridge run-off waters will lead to an interceptor tank, or filter pond adjacent to the bridge in order to trap oil and grease run-off. The bridge design and layout must also be aesthetically pleasing and in harmony with the existing environment. Finally, the Contractor, through his

Environmental Manager, will be responsible for consulting with MoENRP to establish the fish spawning period in relation to the bridge construction works to ensure that all works are undertaken in periods least likely to affect the fish spawning period.

504. Construction Camps – In the first instance, no construction camp, permanent or temporary, will be located within 500 meters of any river, or irrigation channel (not including drainage channels) identified in this report, including the Dzirula, Kvirila and Borimela rivers. The Contractor will also be responsible for the preparation of a Construction Camp Site Plan which will form part of the SSEMP. The Plan will indicate the system proposed and the locations of related facilities in the site, including latrines, holding areas, septic tanks, etc. The Contractor will ensure the following conditions are met within the Plan:

- Wastewater arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a way that will cause neither pollution nor nuisance.
- There will be no direct discharge of sanitary or wash water to surface water, including the surface water courses identified in this report, including the Dzirula, Kvirila and Borimela rivers. Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies will be prohibited.
- Liquid material storage containment areas will not drain directly to surface water (including wetlands).
- Lubricating and fuel oil spills will be cleaned up immediately and spill cleanup materials will be maintained (including spill kits) across the Contractors construction camp and ancillary facilities, e.g. asphalt plant.
- Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters.
- Discharge of sediment-laden construction water directly into surface watercourses or wetlands will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge.
- Spill cleanup equipment will be maintained on site. The following conditions to avoid adverse impacts due to improper fuel and chemical storage:
- Fueling operations will occur only within containment areas.
- All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tanks.
- Filling and refueling will be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids.
- All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
- The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any drain or watercourses.
- Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited.
- Should any accidental spills occur immediate cleanup will be undertaken and all cleanup materials stored in a secure area for disposal. Disposal of such was will be undertaken by a waste management company contracted by the Contractor. The waste management company must have the required licenses to transport and dispose of hazardous waste before any such waste is removed from the site. The Contractor will keep copies of the company's licenses and provide waste transfer manifests at his camp site for routine inspection by the Engineer.

505. Site plans will be devised to ensure that, insofar as possible, all temporary construction facilities are located at least 100 meters away from any surface water course. If determined warranted by the Engineer, the Contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the Contractors camp sites. If so requested, the Contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. The Contractor will provide necessary cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site.

Construction Phase

506. Construction Camps and Storage Areas – The Engineer will undertake regular monitoring of the Contractors construction camp and storage areas to ensure compliance with the SSEMP and the Contractors Construction Camp Site Plan.

507. Water supply – If groundwater is to be used as potable water it will be tested weekly to ensure that the water quality meets the GoG drinking water standards specified in **Section 2**.

508. Bridge Construction - Concerning bridge construction works, the Contractor will:

- Divert the water flow near the bridge piers.
- Provide coffer dams, silt fences, sediment barriers or other devices to prevent migration of silt during construction within streams.
- Perform dewatering and cleaning of cofferdams to prevent siltation by pumping from cofferdams to a settling basin or a containment unit.
- Carry out bridge construction works without interrupting the traffic on the Project Road with the provision of suitable diversions.
- Ensure no waste materials are dumped in the river, including re-enforced concrete debris.
- Place generators more than 20 meters from the river.
- Ensure that no concrete waste is dumped in the river.
- Carefully collect all polystyrene (from expansion joints) so that it does not litter the local environment.
- Ensure that no hazardous liquids are placed within 10 meters of the river.
- Provide portable toilets at bridge construction sites to prevent defecation by workers into the river.
- Ensure that workers are provided with correct PPE including harnesses.
- During piling works ensure that pumped water is filtered through a silt trap before being discharged to the river.
- Provide areas where concrete mixers can wash out leftover concrete without polluting the environment. This may be in the form of a lined settling pond at each bridge site. Drivers will be informed of these locations and the requirements to use these settling ponds on a routine basis by the Engineer. Dried waste from the settling ponds can be used as backfill for culverts, etc.

509. Drainage and Flooding - During the construction phase the Contractor will be required to construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage to properties and land by flooding and silt washed down from the works. Should any operation being performed by the Contractor interrupt existing irrigation systems, the Contractors will restore the irrigation appurtenances to their original working conditions within 24 hours of being notified of the interruption. The

Contractor will also be responsible for ensuring that no construction materials or construction waste block existing drainage channels within the Project corridor. The Engineer will be responsible for routine monitoring of drainage channels to ensure they remain free of waste and debris.

510. Tunnel Construction - Mitigation associated with tunnel construction are discussed under **Section F.7.6** below.

F.5.6 Natural Hazards

Potential Impacts

511. Potential flood events are discussed above under **Section F.5.5 - Hydrology**) and increased precipitation is discussed above under **Section F.5.3 Climate Change.**

512. Generally, landslides in the Project area do not affect the project alignment, except for the mass movements identified above around KM 0.6 affecting TUN 4.0.01-TA/AT and its eastern and western portals. The impacts from the landslides are not considered significant enough to warrant major mitigation measures as part of the detailed design. However, minor mitigation measures e.g. safety nets have been included in the design.

513. The project is located in a seismically active area. The Detailed Design Consultants have experience of designing roads in seismically active areas and have ensured that all designs are compliant with the relevant seismic standards of the GoG.

Mitigation Actions

514. None required.

F.6 Ecological Resources

F.6.1 Flora

Potential Impacts

515. Flora within the Project corridor has been classified as either low or high quality mainly dependent on the presence of Georgian red list species of trees which have been identified in the State Forest Fund areas.

516. A number of trees will need to be cut within the Project area, both on private land and within State Forest Fund areas. Other trees (potentially including Georgian red-listed species) are located adjacent to the boundary of the site and may be damaged accidentally by construction works.

517. Private Land - Trees that will be cut located on private land will require compensation to be paid to the landowners. The compensation will be made according to the Project LARP.

518. State Forest Fund – A total of 7,232 trees have been identified in State Forest Fund areas. Of these, 204 are Georgian Red-listed species greater than 8cm in diameter and 411 are Georgian Red-listed species less than 8cm in diameter. The

trees cut in these areas will need to follow the procedures for de-listing, cutting and removal as described below.

Mitigation Actions

519. General Tree Protection - Prior to the commencement of works the Contractor shall stake the boundary of the entire work site, including intersections and areas under bridges (this excludes within rivers and tunnels, but not tunnel portals). The Contractor shall then identify through a site survey if any Georgian Red-listed tree species are located within 5 meters of the site boundary. This survey will form part of the Contractors Clearance, Re-vegetation and Restoration Management Plan. If any of these trees are identified the contractor will be required to place wood fencing around the tree in order to protect the tree during construction works, including its root zones. The Engineer will inspect all of the tree protection measures on a regular basis.

520. Private Land - Compensation shall be paid to all affected tree owners as per the Project LARP.

521. State Forest Fund – An inventory of the species to be de-listed has been prepared as part of this EIA and is provided in **Appendix G**. The RD is responsible for supplying this information to the National Forest Agency in writing in order to complete the de-listing process. The RD shall also apply to the MoENRP in writing regarding the identified Red-List species in the project area so that they may also be de-listed from the SFF.

522. The RD have estimated that a compensation payment of approximately 10,400 GEL (4,200 USD) will be made for the trees cut as part of the Project. This payment is based on the criteria of Table 2 of Appendix 7 of The Resolution No.242 of Government of Georgia on Approval of Rules for Forest Use taking into account the area of used land. The payment shall be made before beginning of forest usage.

523. The National Forest Agency provides free service for special marking and issuing timber origin certificate for transportation of timber resources. The timber resources obtained as a result of cutting of the trees from the SFF, shall be sorted out according to species by the Contractor and collected at the area indicated by National Forest Agency and transferred to the National Forest Agency by the Contractor to a specified state property land plot.

524. No compensation in the form of re-planting is required under this resolution unless specified by the MoENRP in the Conclusion of Ecological Expertise. Not withstanding the above, it is recommended that re-planting of the 615 red-list species is undertaken as an additional compensation measure. The Contractor should coordinate with the National Forest Agency to identify a site, or sites, within the Project area where these trees can be re-planted. The Red-Listed seedlings are available at the following nursery-gardens: (a) Gori nursery- garden, (b) LEPL Sartichala nursery-garden, and (c) nursery-garden Green Service Ltd. Plant maintenance will be carried out for at least two years. The Contractor will be responsible for the maintenance. If the maintenance period extends after the completion of the Contractors contract period the RD will be responsible for contracting an operator to maintain the trees for the remaining period. During the Construction phase the Engineer will undertake monthly monitoring of the re-planted areas and report on the success rate of the re-planted trees, which should be above 80%. If the success rate falls below 80% the Contractor will re-plant on a 1:1 basis to

compensate for losses. The Contractor will be responsible for paying for any compensational re-planting.

F.6.2 Fauna

Potential Impacts

525. Impacts during the construction phase may occur, including:

- As a result of vegetation cover removal and earthworks habitats (nests, holes) may be lost. Tree and vegetation cutting will also affect the food base;
- Small-sized animals may fall in trenches and pits and may be injured;
- During the movement of construction vehicles and construction equipment, collision with animals may be expected;
- Emission of noise, dust and combustion products, as well as human intensive activities will cause animal disturbance and migration to other places;
- Unsystematic spread of waste, improper management of waste (change in environmental quality indicators) will cause a further deterioration of the living conditions of terrestrial and aquatic animals;
- Night lighting systems at construction camps may cause disturbance of animals and disorientation of birds;
- There may be the cases of poaching by staff;
- Street lighting impacting birds;
- Temporary impacts on fish may include direct contact by construction equipment with, sedimentation and water turbidity in the immediate vicinity of the construction work area, and the potential for minor introduction of pollutants from construction operations; and
- Bridge works could impact upon the habitat of otters.

526. Road kill – During the operational phase of the Project there may be greater risk of accidents involving cattle due to the increased number of vehicles on the road and increased speeds.

Mitigation Actions

527. The following mitigation measures shall be applied relating to Fauna:

- The Contractor shall consult with the MoENRP to determine when works in rivers should be suspended in order to limit impacts to fish spawning periods. In addition, mitigation measures outlined in **Section F.5.5 – Hydrology**, will reduce the potential for impacts in surface waters.
- Mitigation measures outlined in **Section F.5.1 – Air Quality**, **F.7.3 – Waste Management** and **F.8.6 – Noise** will mitigate impacts relating to these issues.
- Prior to the start of construction in river beds, or close to river embankments (within 10 meters), the Contractor shall undertake a site survey (using a local ecologist) to ensure that there are no otter burrows in these areas. If burrows are found in these areas the Contractor will prepare a method statement for the management of these areas which will be sent to the Engineer for review and approval.
- Poaching of wildlife shall be strictly prohibited.
- Ensure that lower wattage lamps are used in street lights which direct light downwards to reduce glare.
- Tree cutting shall not occur during bird nesting seasons.

F.6.3 Forests and Protected areas

Potential Impacts

528. No protected areas or forest reserves are located within the Project area. The nearest protected area to the Project road is the Ajameti Managed Reserve, which is located approximately 5 kilometers south west of the end point of the road and is unlikely to be impacted by Project works.

Mitigation Actions

529. No construction activities, including camps, borrow pits, haul routes, etc will be allowed within, or through protected areas, or reserves.

F.7 Economic Development

F.7.1 Transportation Facilities & Utilities

Potential Impacts

Transportation Facilities

530. The main impacts resulting from Project works will be road diversions and some temporary blocking of access routes. However, the road has been designed in a way so that it has relatively little impact upon the existing road, or other local roads due to the fact that it is a new alignment often passing through tunnels and over bridges. The main area that is likely to be impacted is portion around KM 5.5 close to Shorapani.

531. In some locations road closure will be needed and may occur for periods between one and two hours and as such is not a significant issue as long as the local population are given notice of the delays and suitable detours are provided. Blocking of access routes will be temporary while structures, such as side drains and culverts, are constructed, however access via diversions or temporary access routes must be provided at all times.

532. The new alignment also crosses above and adjacent to the existing railway line at a number of locations. The bridge works above the railway line at KM 13.1 may cause specific issues due to its close proximity to railway. Specific attention needs to be paid by construction workers in this area to ensure that they are not involved with an accident on the line. In addition, the Contractor needs to take care to ensure that any construction equipment interferes with passing trains. Special care will also need to be undertaken when excavating the tunnel portal in this area to avoid rock falling on the tracks. Vibration from bridge piling may also affect the railways tracks.

533. Notwithstanding the above, the potential beneficial impacts to transport are significant. The road, when complete, will offer reduced travel times, smoother ride (resulting in less vehicle maintenance and less damage to perishable goods) and safer driving conditions.

Utilities

534. Medium and low voltage power lines, water supply and gas pipes are located within the Project corridor. It is possible that these utilities will need to be temporarily removed during construction.

Mitigation Actions

Transportation

535. To mitigate the potential impacts the Contractor will:
- Submit a Traffic Management Plan to local traffic authorities prior to mobilization and include the plan as part of his SSEMP;
- Provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions;
- Allow for adequate traffic flow around construction areas via diversions or temporary access roads;
- If temporary access roads are to be constructed with a gravel surface they shall be routinely watered by the Contractor during dry weather to reduce dust impacts; and
- Provide adequate traffic signs, appropriate lighting, well-designed traffic safety signs, barriers and flag persons for traffic control.
- Access roads for borrow pits, batching plants, etc, should be maintained during the construction phase and rehabilitated at the end of construction.

536. The volume of construction traffic is considered to be intensive truck traffic and will need to be managed both in terms of surface damage. A road condition survey will need to be conducted by the Engineer prior to construction in order to gauge the damage to the road as a result of the intensive heavy traffic. Before completion of the Project the Engineer shall repeat the survey to determine which, if any roads need to be repaired by the Contractor.

537. To prevent potential environmental, health and safety issues arising whilst working in the area above the railway line at KM 6.3 and at Bridge BR 4.0.1.AT/TA, the Contractor will be responsible for the preparation of an Environmental, Health and Safety Method Statement for working in these areas. The statement shall address issues relating to:
- Restrictions relating to blasting;
- Excavation of the tunnel portal;
- Vibration impacts on tracks;
- Working above live tracks; and
- Coordination with GR.

Utilities

538. During construction all utilities in the Project area shall be kept operational, particularly during the winter months. Facilities may require temporary relocation during the construction phase and as such the Contractor will be responsible for liaising with the relevant utilities operators to ensure they remain operational. Should utilities need relocating in a different location the Contractor will consult with the relevant utilities and local community to ensure that there is no change in supply as a result of these changes.

F.7.2 Land use

Potential Impacts

539. As the road involves construction of an almost entirely new alignment land acquisition and resettlement could be anticipated to be extensive. However, the approach to design the road bypassing to the north of Zestaphoni and the fact that large portions of the road run beneath ground reduces the level of resettlement and compensation.

Mitigation Actions

540. Under JICA Guidelines for Environmental and Social Considerations (April, 2010), the Employer must prepare the Land Acquisition and Resettlement Plan (the LARP) before dispatching the appraisal mission of JICA. Then, the Employer will implement the plan and acquire the land before the commencement of the construction works at any part of the site.

F.7.3 Waste Management

Potential Impacts

541. General Construction Waste - Road construction will inevitably generate solid and liquid waste products including:

- Inert waste – for example, concrete, metal, wood and plastics.
- Hazardous waste – acids and alkaline solutions, waste oils and oily sludge, batteries, and bitumen.

542. In addition, uncontrolled discharges of sewage and 'grey water' (e.g. from washrooms and canteens) from construction sites and worker's camps may also cause odors and pollute local water resources. As well as being a cause of complaints by the local population, this may lead to contravention of local regulations and fines being imposed on the Contractor.

543. The main construction waste produced will waste concrete (solid and sludge) and possible asphalt, depending upon how much can be re-used as sub-base material. **Table F-11** indicates the main types of waste and an estimate of volumes (based on similar road construction projects).

Table F-11: Waste Types and Estimated Volumes

#	Waste Type	Hazardous	Estimated Volume
1	Concrete	No	200 m^3
2	Asphalt	No	Currently unknown
3	Bituminous Mixtures	Yes	1 t
4	Wood	No	1 t
5	Uncontaminated Metal	No	5 t
6	Uncontaminated Plastic	No	1 t
7	Contaminated metal (paint tins, etc.)	Yes	2 t
8	Contaminated plastic (oil containers)	Yes	3 t
9	Domestic waste (food stuffs)	No	5 t
10	Domestic Waste (non-foodstuff)	No	40 t
11	Sewage Water	Yes	150 m^3
12	Tyres	Yes	150 t
13	Hazardous liquid waste	Yes	20 m^3
14	Hazardous solid waste	Yes	10 t

544. It is noted that the waste management situation in Georgia is still developing, and that the waste management facilities in the Project area have been closed. Accordingly, the Contractor needs to ensure that waste materials are disposed of in a manner that does not cause pollution to the environmental or result in potential health impacts.

545. Tunnel and Other Spoil Material – a large volume of spoil material will be generated from the tunneling works. Estimates provided by the Projects Tunnel experts indicate that as around 1,027,200 m^3 of spoil material will be generated from the tunneling. Another 1,184,100 m^3 of cut will be generated from excavation works on slopes, etc. Where practical the spoil will be re-used as embankment material. Estimates indicate that approximately 1,519,800 m^3 can be re-used as embankment material, which would leave approximately 691,500 m^3 as static balance.

546. Assuming that the most of the embankments are located in the bypass area to the north of Zestaphoni, the average journey distance to transport the spoil material from tunnels to the embankment areas may be around 8 kilometers. To transport material to the embankment areas approximately 250,000 truck journeys will be required, or an average of 277 a day over the 30 month construction period.

547. Disposal of the static balance would require an area of 82,980 m^2 with a height of 10 meters if they were to be disposed of in one spoil disposal location. Preliminary investigations with the RD indicate that the spoil material could be re-used as embankment material at the Kutaisi Bypass where material is required to construct a further two lanes of the bypass. A field visit to the Kutaisi area did not indicate any sensitive land uses in this area which has already been acquired by the RD for the future construction works in this area. Disposal of spoil material in this location will require close coordination between the contractors of both projects and the RD. To transport this volume of material to Kutaisi Bypass over 115,250 truck journeys will be required, or an average of 128 per day over the 30 month construction period. The distance to the Kutaisi site is around 35.5 kilometers.

Mitigation Actions

548. To ensure waste management is adequately controlled during both the construction and operational phase of the Project, the Contractor shall be responsible for a range of measures including:

1. Waste Management Plan (WMP) – The WMP shall include items relating to the safe handling and management of:

- Domestic waste
- Food waste
- Recycled Waste
- Plastic
- Metals
- Wood
- Construction Waste
- Hazardous Waste
- Liquid Waste

2. Recycling and Reuse – Where possible, surplus materials will be reused or recycled – this should include asphalt, concrete, wood, plastic, metal and glass. A

plan for the recycling of materials should be included in the WMP. As noted above, approximately 1,519,000 m^3 of spoil material will be re-used for embankments.

3. Storage of Hazardous Wastes – Oils, fuels and chemicals are substances which are hazardous to human health. They need to be stored properly in correctly labeled containers, both within the construction camp and also at construction areas. Oil and fuel should be stored in tanks with lined bunds to contain spillage (the bund should be able to contain at least 110% of the volume of the largest storage tank within the bund).

4. Waste Disposal – Waste, both hazardous and non-hazardous, shall be collected and disposed of by a licensed waste management contractor. The Contractor will keep copies of the waste management company's licenses on file at his site office. The Contractor shall also keep a record of the waste volumes and types removed from the site and the waste transfer notes provided by the waste management contractor.

5. Waste Spoil Material - The responsibility for identifying the final disposal areas for tunnel and embankment spoil material identified above, lies with the Contractor. Initial consultations with the RD indicate that the remaining static balance of 691,500 m^3 could be re-used at the Kutaisi Bypass. However, Spoil material from F4 will be generated at different times and in different volumes throughout the construction phase. At this stage of the Project the construction schedule for F4 is not known and as such it is not possible to draw up plans for the disposal of spoil material at Kutaisi bypass. If the Contractors for F4 and Kutaisi can, in coordination with RD, agree to re-use the materials F4 Contractor will be responsible for preparing a Spoil Disposal and Re-use Plan specifically for the Kutaisi site. There are several important steps the Contractor should follow before temporary storage of spoil material can commence:

1. The Georgian EIA regulation states that the spoil storage areas shall be agreed with the local municipality and MoENRP.
2. As soon as the area is identified the MoENRP will request a Spoil Disposal Plan for Arrangement of Spoil Disposal Area and a Re-cultivation Plan from the Contractor. This plan shall be prepared in accordance with regulation N 424 on Approval the Rules for Removal, Storage and Use of Topsoil and Re-cultivation.
3. The plan will indicate:
    a. The location of disposal area (layout, coordinates etc).
    b. Agreement with the land owner.
    c. Category of the land.
    d. Distance from the surface water source.
    e. Provide information on route of spoil transportation and means of transport (including routes avoiding, where possible, sensitive receptors).
    f. Schedule of the timing of material transport (excluding night-time transport on local roads (but not the existing E-60) between 10pm and 6am).
    g. Any necessary improvements to local roads to cater for the increased level and types of trucks using the roads.
    h. The scheme of dumping.
    i. The maximum height of disposed soil and anti erosion measures.
    j. Describe re-cultivation of disposal area.
    k. Provide coordinates of the spoil area.
    l. Provide profile drawings of the spoil area.

m. Provide time stamped photographs of the pre-disposal site conditions.

4. The Plan will also be provided to the RD and the Engineer as part of his SSEMP. No spoil storage will be allowed until the RD and the Engineer have approved the plan.

If there is no agreement between the Contractors of F4 and the Kutaisi Bypass regarding the re-use of the materials the Contractor will be responsible for the preparation of a separate Spoil Disposal Plan for Arrangement of Spoil Disposal Area and a Re-cultivation Plan for a separate site which will be indicated and provided by the employer. The Plan will also be provided to the RD and the Engineer as part of his SSEMP. No spoil storage will be allowed until the RD and the Engineer have approved the plan.

Excavation for tunnels 4.0.01-AT/TA, 4.0.02-AT/TA and 4.0.03-AT/TA shall start at portals located adjacent to the existing road and as such materials can be moved directly from the portals to the disposal areas using the existing road. Tunnels 4.0.04-AT/TA, 4.0.05-AT/TA and 4.0.06-AT/TA are located north of Zestaphoni and Shoropani. Materials from these tunnels will need to be transported along local roads, some of which may need to be upgraded to accommodate the trucks using these roads. The Contractor will be responsible for upgrading any local roads and ensuring that they are maintained to acceptable levels to allow local traffic to continue to use these roads during all weather. If any access roads are gravelled they will be regularly sprayed with water during the construction phase to limit the impacts of dust.

It should be noted that by using Kutaisi bypass as a disposal location for the spoil, all truck journeys will have to pass through the urban centre of Zestafoni.

6. Liquid Waste – The issue of liquid waste, including concrete sludge, camp run-off water, vehicle washing water, batching plant wastewater, etc., is discussed above under item **F.5.5 – Hydrology** and **F.7.4 Construction Camps.**

F.7.4 Construction Camps & Batching Plants

Potential Impacts

549. Construction camps constitute a temporary land use change and raise issues related to activities such as impacts to air quality; poor sanitation arrangement and improper methods used for disposal of solid wastes and effluent; and transmission of communicable diseases to the local people by the construction workers due to inappropriate health monitoring facilities. Specific issues may arise as a result of the following:

550. Design and Siting - Improper siting and design of construction camps can have negative impacts to hydrology through inappropriate disposal of liquid waste and spills of hazardous liquids. Poor management of sanitary waste and accidental spills of hazardous liquids from construction camps can also have negative impacts on ground and surface water. Rock crushing plants and concrete batching plants can also have impacts on sensitive receptors located downwind of the sites if the plants are too close to the urban areas.

551. Concrete Batching Plants - Potential pollutants in batching plant wastewater include cement, sand, aggregates and petroleum products. The main sources of wastewater at batching plants are; contaminated storm water runoff, dust control

sprinklers, the agitator washout station, the agitator charging station, the slumping station, and cleaning and washing areas. These substances can adversely affect the environment by:

- Increasing water pH.
- Increasing the turbidity of waterways (turbidity is a measure of the cloudiness of a suspension).

552. Asphalt Plants – Several impacts are associated with asphalt plants:

- Emissions – including dust from the transport and handling of aggregates and emissions from the combustion process in the dryer.
- Noise - Noise occurs at different places in the process for examples in the conveyor belts, dryer and mixer drum, internal and external traffic. The noise is estimated to be in the range of 90 to 100 dBA (Leq) at a few metres from the equipment.
- Storage of Bitumen – Drums of bitumen will be stored safely and securely to prevent accidents and pollution.
- Storage and Use of Hazardous Materials – Some materials used during asphalt production, such as Kraton, can be explosive or a fire hazard. These materials need to be stored and managed appropriately.
- Health and Safety - Asphalt Plants can be very dangerous, accidents may occur at any time. Hence it is important to have a proper policy for the Health and Safety Issues.
- Vehicle Movement – a large number of trucks will be required to transport the hot asphalt from the plant to the work site, this may be a distance of up to 25 kilometers.

Mitigation Actions

553. Construction Camps – Prior to commencement of works, the contractor must identify the location of the camp, with approval from the Engineer, and then agree on/receive a permit for its use from the state or the land owner. No construction camp will be located within one kilometer of an urban area and at least 50 m from any surface water course.

554. The Contractor will be responsible for the preparation of a Construction Camp Site Plan which will form part of the SSEMP. The Plan will indicate the system proposed and the locations of related facilities in the site, including latrines, holding areas, etc. The Contractor will ensure the following conditions are met within the Plan:

- Rain-water run-off arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage system will be fitted with oil and grease interceptors.
- There will be no direct discharge of sanitary or wash water to surface water.
- In the absence of functioning sewerage and sewage treatment facilities it is recommended that the Contractor provides his own on-site wastewater treatment facilities. For sites servicing a small number of employees (less than 150), septic tanks may be used. For larger sites, liquid wastes will as a minimum receive primary treatment in anaerobic tank or pond preceded by a bar screen to remove large solid objects (e.g. sticks, rags). Primary treatment (also referred to as clarification, sedimentation or settling) is the process where wastewater is allowed to settle for a period (around 2 hours) in a settling tank. This leads to separation of a liquid effluent which includes oils and grease and a liquid-solid

sludge. Primary treatment leads to reduction in suspended solids, biological oxygen demand and removal of floating material (e.g. faeces). There will be no direct discharge of untreated sanitary or oily wastewater to surface water bodies.

- Licensed contractors will be required to collect and disposal of liquid waste from the septic tanks on regular basis.
- Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies will be prohibited.
- Liquid material storage containment areas will not drain directly to surface water.
- Waste water from vehicle washing bays will be free of pollutants if the wash bay has been constructed correctly.
- Lubricating and fuel oil spills will be cleaned up immediately and spill cleanup materials will be maintained at the storage area.
- Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters and are connected to septic tanks, or waste water treatment facilities.
- Discharge of sediment-laden construction water directly into surface watercourses will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge.
- Washing out concrete trucks at construction sites will be prohibited unless specific concrete washout areas are provided for this purpose at the construction site (e.g. a bridge site). The washouts will be impermeable and emptied when 75% full.
- Spill cleanup equipment will be maintained on site (including at the site maintenance yard and vehicle fueling areas). The following conditions to avoid adverse impacts due to improper fuel and chemical storage:
    - Fueling operations will occur only within containment areas.
    - All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tanks.
    - Filling and refueling will be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids.
    - All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
    - The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any drain or watercourses.
    - Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited.
    - Should any accidental spills occur immediate cleanup will be undertaken and all cleanup materials stored in a secure area for disposal to a site authorized to dispose of hazardous waste.

555. If determined warranted by the Engineer, the Contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the sites. If so requested, the Contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. The Contractor will provide necessary cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site. The Engineer will undertake regular monitoring of the construction camps to ensure compliance with the SSEMP and the Construction Camp Site Plan.

556. The Contractor will be responsible to maintain and cleanup campsites and respect the rights of local landowners. If located outside the ROW, written agreements with local landowners for temporary use of the property will be required and sites must be restored to a level acceptable to the owner within a predetermined time period.

557. The Contractor will also ensure that potable water for construction camps and workers meets the necessary water quality standards of the GoG. If groundwater is to be used it will be tested weekly to ensure that the water quality meets the GoG drinking water standards specified in **Section 2**.

558. Concrete Batching Plants – The following measures will be followed to limit the potential for pollution from batching plants:

- To limit impacts from dust, the following conditions will apply:
    - Batching plants will be located downwind of urban areas and not within one kilometer of any urban area.
    - The entire batching area traversed by vehicles – including driveways leading into and out of the area – will be paved with a hard, impervious material.
    - Sand and aggregates will be delivered in a dampened state, using covered trucks. If the materials have dried out during transit they will be re-wetted before being dumped into the storage bunker.
    - Sand and aggregates will be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls should extend one metre above the height of the maximum quantity of raw material kept on site, and extend two metres beyond the front of the stockpile.
    - The hopper or bunker will be fitted with water sprays, which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition.
    - Overhead storage bins will be totally enclosed. The swivel chute area and transfer point from the conveyor will also be enclosed.
    - Rubber curtain seals may be needed to protect the opening of the overhead bin from winds.
    - Conveyor belts which are exposed to the wind and used for raw material transfer will be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas will be fully enclosed.
    - Conveyor belts will be fitted with belt cleaners on the return side of the belt.
    - Weigh hoppers at front-end loader plants will be roofed and have weigh hoppers shrouded on three sides, to protect the contents from the wind. The raw materials transferred by the front end loader should be damp, as they are taken from a dampened stockpile.
    - Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work will be dust-tight.
    - Silos will be equipped with a high-level sensor alarm and an automatic delivery shut-down switch to prevent overfilling.
    - Cement dust emissions from the silo during filling operations must be minimised. The minimum acceptable performance is obtained using a fabric filter dust collector.
    - Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere.

  - An inspection of all dust control components will be performed routinely – for example, at least weekly.
- All contaminated storm water and process wastewater will be collected and retained on site.
- All sources of wastewater will be paved and bunded. The specific areas that will be paved and bunded include; the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues.
- Contaminated storm water and process wastewater will be captured and recycled by a system with the following specifications:
  - The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain.
  - Water captured by the bunds will be diverted to a collection pit and then pumped to a storage tank for recycling.
  - An outlet (overflow drain) in the bund, one metre upstream of the collection pit, will divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours).
  - Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments.
  - Wastewater will be pumped from the collection pit to a recycling tank. The pit will have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails.
  - Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity. This will restore the system's storage capacity, ready to deal with wastewater generated by the next rainfall event. Uses for recycling tank water include concrete batching, spraying over stockpiles for dust control and washing out agitators.

559. Asphalt Plants – the following measures will be applied by the Contractor:

- Emissions & Noise:
  - Asphalt plants will be located downwind of urban areas and not within one kilometer of any urban area.
  - Adequate Personal Protective Equipment (PPE) will be provided to staff working in areas of high noise and emissions.
- Storage and Use of Hazardous Materials (including bitumen):
  - Ensure all hazardous materials are stored (including within suitable sized bunds for liquids), handled and disposed of according to their Material Safety Data Sheet (MSDS).
  - Copies of MSDS will be kept on site with all hazardous materials.
  - The Contractor will keep a log of the type and volume of all hazardous wastes on site.
  - The Contractor will keep a plan of site indicating where all hazardous materials are stored.
- Vehicle Movement:
  - The Contractor will include the asphalt plant in his Traffic Management Plan, including haul routes from the plant.
- Health and Safety:
  - To prevent bitumen burns it will be compulsory for the workers handling hot bitumen to wear full-body protection.
  - All transportation, handling and storage of bitumen will be handled safely by experienced personnel.

- The dust from the manufacturing process may pose respiratory hazards, hence protective air mask will be provided to the operators for the loading and unloading of aggregates.
- Ear-muffs will be provided those working on the plant.
- First Aid kit will be available on site for the workers in case of emergency.
- The MSDS for each chemical product will be made accessible onsite and displayed.

F.7.5 Borrow Pits

Potential Impacts

560. Opening and operating of borrow pits can result in multiple environmental and social impacts, including degradation of productive soils, elevated levels of noise, degradation of air quality, etc.

Mitigation Measures

561. Several mitigation measures are recommended for borrow pits:

- If the Contractor intends to use borrow pits operated by an independent organization then a due diligence review will be carried out by the Engineer to confirm that the new site identified for use by the Contractor is indeed operating or operable in an appropriate manner. This will include review of the borrow pits operational license and its potential environmental impacts, such as its proximity to sensitive receptors. A copy of the agreement between the operator and the Contractor will also be provided to the Engineer.
- For any new borrow pit to be opened and operated by the Contractor, the Contractor will be responsible for the preparation of a Borrow Pit Action Plan (BAP). The BAP will be submitted to the Engineer prior to the start of construction. The plan will identify the locations of all proposed borrow pits which will also be approved by both the Engineer, MoENRP and the RD. The plan will ensure that:
  - Pit restoration will follow the completion of works in full compliance with all applicable standards and specifications.
  - Arrangements for opening and using material borrow pits will contain enforceable provisions.
  - The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the Engineer will be required before final acceptance and payment under the terms of contracts.
  - Additional borrow pits will not be opened without the restoration of those areas no longer in use.

562. While operational, the Contractor will ensure that the following conditions are met at his borrow pits:

- Loss of top soil - Before the materials extraction the layer of top soil (about 20 cm) will be removed to the side of excavation area and kept until the area works will be finalized. Top soil stockpiles will be located at least 50 meters distance from any watercourses to avoid water siltation and obstruction. The height of stockpiles will not exceed three meters to avoid wind erosion and dust emissions.
- Fencing – if the Engineer deems the site to be hazardous to the local community (for example a pit could fill with water and people and animals could drown in it) he will request the Contractor to fence the site to prevent access and provide warning signs on the fencing.

- Soil compaction and disturbance to local flora and fauna species at access roads - The Contractor will take responsibility to provide an access road to the borrow site and all drivers will be instructed to use only this officially designated road. This will help to avoid additional soil compaction and disturbance to the local fauna species.
- Reinstatement - Full site reinstatement will be undertaken by the Contractor to avoid landscape damage and habitat loss. Rehabilitation measures will include: removing of all types of equipment from the site; removing of all types of waste or/and polluted soil and materials if any exist; slops grade reduction with use of unsuitable stockpiles and uncrushed rocks and; slope stabilization measure such as re-covering with top soil, and further seeding, grassing and planting of appropriate bushes or/and trees if reasonable.
- Haul Routes - Due to the sensitivity of the borrow pit locations, the Borrow haul routes will follow established transport corridors/rights-of-way, to the extent that is practicable. The routes will be indicated in the Contractors TMP. Haul routes shall not pass within protected areas or reserves.

F.7.6 Tunnels

Potential Impacts

563. The main typical environmental problems linked to the construction of underground works are listed below:

- Triggering of surface settlements, structures collapses and slope instabilities
- Drying up of springs and groundwater alterations
- Storage and use of excavated materials (Addressed in **Section F.7.3 – Waste Management** above).
- Noise (Addressed in **Section F.8.6 – Noise and Vibration** below).
- Vibrations (Addressed in **Section F.8.6 – Noise and Vibration** below).
- Pollution of groundwater, mainly after the realization of stabilization works by injections.

564. Surface Settlements & Slope Instabilities - The opening of underground works can lead to a deformation of the soils and rocks around the excavation area in some instances. Such deformations may trigger sudden collapses, subsidence and sinking that can damage both the work under construction and pre-existing nearby structures. The extent of settlements depends on the following elements:

- Excavation technique.
- Dimension and geometry of the excavation.
- Type of excavated material.

565. Geotechnical investigations for F4 have indicated that significant surface settlement will not occur as a result of Project works. Slope instabilities are discussed under the topic of landslides.

566. Dewatering - A key aspect of dewatering systems for tunnel and shaft construction is that they will generate water from pumped wells or from sumps and drains within the tunnel. Some of this water, particularly from sumps, will be ‘dirty water’ and will require some form of treatment (most commonly to remove suspended solids) before it can be disposed of. Some of the water may be ‘clean water’ (particularly from dewatering wells or tunnel drains) that may require little or no treatment.

567. Drying up of Springs and Groundwater – Tunnels located below the water table can seep into excavations that are below the water table, which can result in groundwater drawdown around the structures during construction and operation. This in turn may impact upon water levels in wells and natural springs (or artesian wells). Drawdown can also potential impact the flow of rivers and groundwater dependent trees. These phenomena can persist even after the tunnel construction if the final alignment is not completely waterproof.

Mitigation Measures

568. Drying up of Springs and Groundwater – The Contractor will develop a ground water management plan for each tunnel which shall be submitted for approval by the Engineer at least four weeks prior to the start of tunnelling works. The plan shall include routine monitoring of the groundwater levels in wells against baseline water levels (measured by the Contractor before the start of tunnel works) in the Project area which will be undertaken on a weekly basis by the Engineer within the vicinity of each tunnel he is excavating. If drawdown levels in wells are significant the Contractor will provide a temporary source of potable water to the affected persons until the construction works are finished. The Contractor shall continue to monitor the water levels in the affected wells for a period of two months after construction is completed at the tunnel sites. If the wells begin to recharge to their pre-construction levels no further actions will be necessary. However, if the water fails to re-charge to pre-construction levels new boreholes will be constructed for the affected persons.

569. Dewatering – The Contractor will pass all drainage water from the tunnel through a settlement tank. Weekly monitoring of the water quality from the tank will be undertaken by the Contractor to assess for any pollution. If the drainage water meets drinking water standards it can be considered for re-use in any potentially depleted wells during the construction phase.

F.8 Social and Cultural Aspects

F.8.1 Employment Creation, Skills Enhancement and Local Business Opportunities

570. The Project is expected to generate positive impacts on the local economy and livelihoods in terms of employment and skills enhancement and local business opportunities through the procurement of goods and services.

571. Positive impacts will be primarily associated with the construction phase and therefore temporary in nature. The termination of construction contracts will occur once construction activities are completed. Workers who have relocated to the area for the Project are likely to leave the area in search of other opportunities, especially if they are permanent employees of Contractors and subcontractors.

572. Those who have worked on the Project will have an advantage when seeking alternative jobs on similar projects due to the experience and any training received through this Project.

573. The construction phase will last approximately 24 months and it is expected that approximately 400 direct employment opportunities will be available during the peak of construction. The breakdown of skills required during the construction phase will be as follows:

- Skilled labour: 58%;
- Semi-skilled labour: 20%; and
- Unskilled labour: 22%.

574. Local procurement is going to benefit the hospitality and service industries primarily, such as accommodation, catering, cleaning, transport and security services. Local businesses will benefit during the construction phase as there will be increased spending within the area by the wage labor who will have improved buying power while employed by the Project.

F.8.2 Community Health and Safety

Potential Impacts

575. The presence of the Project could affect the health, safety and security of the communities in the area of influence as a result of worker-community interactions, in-migration to the area, increased incomes in the local community that may be used for drugs, alcohol and prostitution, the risk of injury associated with construction and operational activities, increased pressure on health care resources and changes to the environment.

Construction Phase Impacts

576. Potential impacts due to the proposed construction can be identified as follows:

- Workforce, Jobseekers and Social Conflict. In some instances the local population may not be able to provide the necessary skilled workers for the Project. In such cases workers from other regions, or other countries may be employed by the Contractor. This could lead to social tensions and potential conflict if these workers are not aware of local customs and practices. An increase in disposable income within the Project area (among Project workers, both local and external) may also result in a change in spending habits and behavior resulting in increase in alcohol and drug abuse, increased incidences of prostitution and casual sexual relations, which poses a threat to community health and safety.
- Pressure on Social Infrastructure and Services. During the construction phase workers will be accommodated on-site and as such there will be no pressure on local housing stock. In addition, the Contractor will also have his own on-site medical facilities. Any serious injuries will be treated in Zestaphoni.
- Road Safety. Construction of the Project Road will require a large amount of vehicle movements, locally and regionally. These may result in a slight increase in the total number of road traffic accidents between vehicles, pedestrians and vehicles and livestock and vehicles.
- Air quality and noise. Potential air and noise issues and their impacts to the local population are discussed above under items **F.5.1 – Air Quality**, **Item F.7.4 – Construction Camps and Batching Plants** and **Item F.10.6 – Noise.**
- Blasting - Depending in the rock type and explosive strength, rocks can go up to 50 m and can potentially damage structures. For the above reason, surface blasting or blasting near the mouth of the tunnel is not recommended.

Operational Phase Impacts

577. Road Safety. Pedestrian overpasses and underpasses have been proposed as part of the Detailed Design. This will help reduce road accidents involving

pedestrians crossing the road. The improved road condition is also likely to lead to a reduction in traffic accidents.

578. Air Quality & Noise – These issues are discussed in detail under items **F.5.1 – Air Quality** and **Item F.10.6 – Noise.**

Mitigation Measures

Construction Phase Mitigation

579. Mitigation measures to limit community health and safety impacts include:

580. Road Safety – The Contractor will be responsible for preparing a traffic management plan (TMP) for the construction phase of the Project. The TMP will include specific conditions for traffic management around Shorapani and Zestaphoni.

581. Blasting - The Project will conduct construction blasting consistent with Georgian and international safety standards. Blasting will be conducted using standard mining industry practices and procedures to ensure safety of personnel and equipment. This includes establishing a safety zone around the blast area, say to a distance of 500 m (actual distance will be established by the Contractor and approved by the Engineer based on the safety standards) and evacuating it.

582. Social Conflicts. The Contractor shall provide regular health and safety training to their workers which will include sessions on social and cultural awareness. The Contractor will also sub-contract an organization to develop and implement an HIV/AIDS policy and information document for all workers directly related to the Project. The information document will address factual health issues as well as behavior change issues around the transmission and infection of HIV/AIDS. In addition, the Contractor shall develop an induction program, including a Code of Conduct, for all workers directly related to the Project. A copy of the Code of Conduct is to be presented to all workers and signed by each person. The Code of Conduct must address the following aspects:

- Respect for local residents and customs;
- Zero tolerance of bribery or corruption;
- Zero tolerance of illegal activities by construction personnel including:
    - unlicensed prostitution;
    - illegal sale or purchase of alcohol;
    - sale, purchase or consumption of drugs; and
    - illegal gambling or fighting.
- No alcohol and drugs policy during working time or at times that will affect ability to work; and
- Description of disciplinary measures for infringement of the Code and company rules. If workers are found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, they will face disciplinary procedures that could result in dismissal.
- In addition, Project security guards shall not to violate the safety of local residents or other individuals involved in the project.

  In addition, the Contractor will be responsible for holding monthly community meetings within the Project area throughout the construction period. The monthly meetings will be held in the villages along the alignment and will provide a forum for locals to discuss specific issues, such as noise and dust, with the Contractor before making complaints formal through the Grievance Redress Mechanism. The

minutes of meetings shall be recorded and a list of participants prepared (including signatures). Photos of each event shall be taken (with timestamps). The Contractor shall prepare a short monthly summary of the meetings including all of the above information and submit it for review to the Engineer and RD within a week of the meeting.

F.8.3 Workers' Rights & Occupational Health and Safety

583. Occupational Health and Safety - Accidents are common during a project of this size and scale. Accidents can occur if workers are not adequately trained or qualified for the job or if they have incorrect safety equipment and clothing.

584. Sexually Transmitted Diseases – See **Section F.8.2** above for impacts and mitigation relating to STDs.

585. Worker Rights - Workers' rights including occupational health and safety need to be considered to avoid accidents and injuries, loss of man-hours, labor abuses and to ensure fair treatment, remuneration and working and living conditions. These issues need to be considered not only for workers who are directly employed by the Project but also sub-contractors.

Potential Impacts

586. The Project is expected create more than 400 direct employment opportunities during the peak of the construction period, which will be approximately 30 months in duration. The majority of workers will be engaged by the Contractor and will consist of a semi-skilled to skilled workforce.

587. The expected impacts on worker rights and H&S as a result of construction, activities and Project operation are as follows:

- Risk to workers H&S due to hazardous construction activities; and
- Violation of workers' rights.

588. Construction activities will involve the operation of heavy equipment and trucks, working at height, construction traffic, use of electric devices, handling of hazardous materials and other hazardous activities. Due to the nature of the activities being undertaken during construction, worker H&S is a key risk with the potential for accidents that may result in injuries and fatalities as well as lost man-hours.

Mitigation Actions

589. An OHS Plan will be prepared by the Contractor to manage worker safety. The Plan will include the following items:

- Safety Training Program. A Safety Training Program is required and will consist of:
  - Initial Safety Induction Course: All workmen will be required to attend a safety induction course before they are allowed access to the Site.
  - Periodic Safety Training Courses: Period safety course will be conducted not less than once every six months. All Contractor (and any sub-contractor) employees will be required to participate in relevant training courses appropriate to the nature, scale and duration of the subcontract works. Training courses for all workmen on the Site and at all levels of supervision

and management. A list of training participants names and time-stamped photographic evidence of the training will be provided by the Contractor to the Engineer for his records.
  - Safety Meetings. Regular safety meetings will be conducted on a monthly basis. The Engineer will be notified of all safety meetings in advance. The Engineer may attend in person or by representative at his discretion. The minutes of all safety meetings will be taken and sent to the Engineer within seven (7) days of the meeting and will include a list of participants names and time-stamped photographic evidence of the training.
  - Safety Inspections. The Contractor will regularly inspect, test and maintain all safety equipment (including firefighting equipment), scaffolds, guardrails, working platforms, hoists, ladders and other means of access, lifting, lighting, signing and guarding equipment. Lights and signs will be kept clear of obstructions and legible to read. Equipment, which is damaged, dirty, incorrectly positioned or not in working order, will be repaired or replaced immediately by the Contractor.
  - PPE – Workers will be provided (before they commence works) with of appropriate PPE suitable for electrical work such as safety boots, helmets, gloves, protective clothes, goggles, and ear protection at no cost to the workers.
- All construction plant and equipment used on or around the Site will be fitted with appropriate safety devices. These will include but not be limited to:
  - Effective safety catches for crane hooks and other lifting devices, and
  - Functioning automatic warning devices and, where applicable, an up-to-date test certificate, for cranes and hoists.
- Zones with noise level above 80 dBA must be marked with safety signs and appropriate PPE must be worn by workers.

590. In addition, all Project sub-contractors will be supplied with copies of the SSEMP. Provisions will be incorporated into all sub-contracts to ensure the compliance with the SSEMP at all tiers of the sub-contracting. All subcontractors will be required to appoint a safety representative who will be available on the Site throughout the operational period of the respective sub-contract unless the Engineers approval to the contrary is given in writing. In the event of the Engineers approval being given, the Engineer, without prejudice to their other duties and responsibilities, will ensure, as far as is practically possible, that employees of sub-contractors of all tiers are conversant with appropriate parts of the SSEMP. To implement the above items the Contractor will designate a qualified environmental, health and safety personnel.

F.8.4 Emergency Response Planning

Potential Impacts

591. Emergency situations may arise during the construction phase of the Project, for example, fires and explosions (through poor management and storage of fuels and chemicals).

Mitigation Measures

Construction Phase

592. The Contractor will be responsible for preparation of an Emergency Response Plan (ERP) which will include sections relating to:

- Containment of hazardous materials;
- Oil and fuel spills;
- Fire, gas leaks and explosions;
- Work-site accidents; and
- Earthquake and other natural hazards.

593. The plan will detail the process for handling, and subsequently reporting, emergencies, and specify the organizational structure (including responsibilities of nominated personnel). The plan will be submitted to the Engineer for approval. Implementation of the plan will be monitored by the Engineer. Any emergencies, and how they were handled, will be reported in monthly progress reports by the Contractor to the Engineer. The Engineer will also provide periodic monitoring of the Contractors works throughout construction to ensure the ERP is implemented effectively.

F.8.5 Physical and Cultural Resources

Potential Impacts

594. As noted by **Section E.4.4** and **Figure E-44**, no physical cultural resources have been identified within the Project corridor that are likely to be significantly impacted by Project works with the exception of one cemetery identified approximately 50 meters south of tunnel TUN 4.0.06-AT/TA and a small natural spring located to the north of the GAA.

595. In addition to the above, it is possible, given the rich cultural heritage of Georgia, that chance finds could occur during excavation works, particularly to the north of Zestafoni.

Mitigation Actions

596. The cemetery identified above is unlikely to be impacted by construction works, however, it is required that during the construction phase the northern boundary of the cemetery be fenced off to ensure that there is no encroachment into this area by construction workers or equipment.

597. According to the detailed design, the road at KM10.1 will pass within 15 meters of the natural spring. However, the road will be elevated in this area and a high embankment will be constructed that will extend out almost adjacent to the spring. A short section of noise barrier, around 20 meters is recommended in this area so that people may continue to use this spring. In addition, during the construction works the spring shall be fenced on the northern side to prevent construction works impacting upon the spring.

598. In the event of any chance finds during the construction works procedures shall apply that are governed by GoG legislation and guidelines. A chance finds procedure shall also be developed by the Contractor. **Appendix E** provides a sample chance find procedure which the Contractor could adopt.

F.8.6 Noise & Vibration

Potential Construction Noise Impacts

599. The potential noise related issue during construction of the project is disturbance to sensitive receptors in the Project area.

600. Noise levels within the Project area range depending upon the location. Baseline noise monitoring undertaken for this EIA indicates that noise levels range from between 35 in the rural locations to 72 dBA adjacent to the existing road.

601. The noise during the construction phase depends on the stage of construction work and equipment used at the site. The construction activities generating significant levels of noise can be divided as follows:

- Site clearing and preparation;
- Excavation and tunnel construction;
- Bored piling and concrete placement; and
- Erection of bridges.

602. The main sources of noise and vibration during construction of the project are as follows:

- Construction machinery;
- Drilling activities;
- Haulage and general vehicle movements;
- Concrete mixing and aggregate production systems; and
- Construction Camps / Ancillary Facilities.

603. The criteria for Determining Significance is the World Bank guidelines for noise require that the sound level in residential areas (and other sensitive receptors, such as schools and hospitals) should not exceed 55 dB(A) during the day and 45 dB(A) during the night. During construction period, it is possible that these standards will be exceeded for short duration during the day.

604. Construction noise levels at receptors would fluctuate depending on the type and number of equipment, their duration of use and the distance from receptor. In this analysis, first the noise level due to each piece of equipment, which is likely to be used in the construction, is calculated. The peak noise levels of construction equipment mainly used at a typical construction site, are shown in **Table F-12**. The list includes all equipment except vehicles and some minor pieces of equipment.

Table F-12: Typical Noise Levels from Construction Equipment

Equipment	dBA
Pavement	
Dozer	81.7
Excavator	80.7
Grader	85
Roller	80.0
Rock Drill	81.0
Dump Truck	76.5
Paver	77.2
Concrete Mixer Truck	78.8
Tunnel Mouth	
Jackhammer	88.9
Dozer	81.7
Dump Truck	76.5
Tunnel	
Blasting	94.0
Bridge	

Equipment	dBA
Piling	90.0
Dozer	81.7
Dump Truck	76.5
Paver	77.2
Boring Jack Power Unit	83.0

605. Assuming considering that not all pieces of equipment will be used at the same time in the same location the following maximum cumulative noise levels can be estimated:

- Pavement: 89 dBA
- Tunnel Mouth: 89.8 dBA
- Tunnel: 94 dBA
- Bridge: 91.6 dBA

606. In addition to work sites, an estimate of noise at construction camps have been made based on other road projects as follows:

- Construction Camp: 75 dBA
- Asphalt Plant: 80 dBA
- Rock Crushing Plant: 90 dBA
- Concrete Batching Plant: 80 dBA

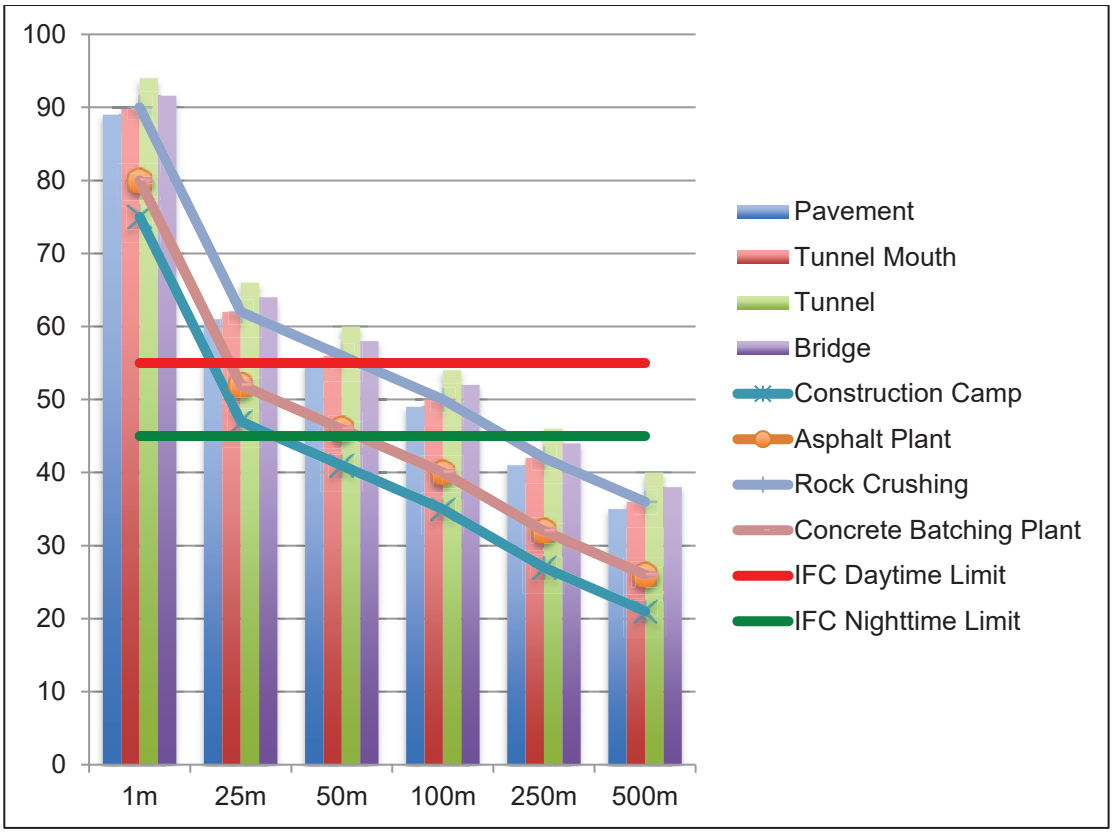
607. **Table F-13** assesses these cumulative noise levels at a range of distances from the source of noise.

Table F-13: Cumulative Noise Levels from Construction Equipment at a Range of Distances

Activity / Site	Average Estimated Noise Level (dBA)	25m	50m	100m	250m	500m
Pavement	89	61	55	49	41	35
Tunnel Mouth	89.8	62	56	50	42	36
Tunnel	94	66	60	54	46	40
Bridge	91.6	64	58	52	44	38
Construction Camp	75	47	41	35	27	21
Asphalt Plant	80	52	46	40	32	26
Rock Crushing	90	62	56	50	42	36
Concrete Batching Plant	80	52	46	40	32	26

608. **Figure F-15** shows these predicted noise levels against IFC daytime and nighttime standards.

Figure F-15: Estimated Construction Phase Noise



609. **Figure F-15** shows that construction activities within 25 – 50 meters of sensitive receptors will, in all instances, result in noise levels elevated above IFC daytime and nighttime guideline limits. At a distance greater than 100 meters all construction noise will be lower than IFC daytime limits, but still higher than IFC nighttime limits. At a distance of more than 250 meters construction noise levels are below both daytime and nighttime IFC limits.

610. Regarding camp sites and ancillary facilities, **Figure F-15** shows that the noise generated from concrete batching plant, asphalt plant and general construction camp noise levels will be below IFC nighttime and daytime limits at a distance of more than 250 meters.

Potential Operational Noise Impacts

611. The operational noise impacts have been assessed as part of a noise model, see **Section F-8.7** below.

Potential Construction Vibration & Settlement Impacts

612. Vibration from construction activities is a cause concern to the community. The effects of vibration varies and depends on the magnitude of the vibration source, the particular ground conditions between the source and receiver, presence of rocks or other large structures in the area. The intensity, duration, frequency and number of occurrences of a vibration all play an important role in both the annoyance levels caused and the strains induced in structures.

613. The effects of vibration can be assessed as:

- General annoyance, sleep disturbance, etc;
- Potential cosmetic damage to properties; and
- Potential structural damage to properties.

614. The sources of vibration can broadly divided into two parts:
1. Vibration Impact of Construction Activities on the Surface (General construction works including construction equipment movement, pile driving, compaction, hammering (hydraulic or pneumatic), operation of batching plant and generators, etc).; and
2. Vibration Impact of Tunnel Construction.

615. The propagation of vibration from construction activities are different in nature from the vibration from tunneling. The construction activities are undertaken essentially on ground surface and spreads basically as two-dimensional waves. In contrast, the tunneling is undertaken below the surface and spreads in three-dimension. For this reason, the impact of the two is assessed separately.

616. The Georgian Standards for vibration are provided in **Table D-11**. The proposed criteria for damage to buildings are shown in **Table F-14**. These are derived from British Standard BS 6472 and are German Standards DIN 4150-3:1999.

Table F-14: Criteria for Structural Damage Due to Vibration

No Damage Likely	PPV < 5 mm/s
Cosmetic Damage Risk	PPV 5 to 15 mm/s
Structural Damage Risk	PPV > 15 mm/s

617. Vibration Impact of Construction Activities on the Surface – **Table F-15** provides an indication of the approximate vibration levels that may be expected for various vibration sources.

Table F-15: Approximate Vibration Levels for Various Sources [20]

Activity	Typical Levels of Ground Vibration
Vibratory Rollers	Up to 1.5 mm/s at distances of 25 m Higher levels could occur at closer distances; however, no damage would be expected for any building at distances greater than approximately 12 m (for a medium to heavy roller)
Hydraulic rock breakers (levels typical of a large rock breaker operating in hard sandstone)	4.50 mm/s at 5 m 1.30 mm/s at 10 m 0.4 mm/s at 20 m 0.10 mm/s at 50 m
Compactor	20 mm/s at distances of approximately 5 m, 2 mm/s at distances of 15m. at distances greater than 30 m, vibration is usually below 0.3 mm/s
Pile driving/removal	1 to 3 mm/s at distances of 25 m to 50 m depending on soil conditions and the energy of the pile driving hammer
Bulldozers	1 to 2 mm/s at distances of approximately 5 m. at distances greater than 20 m. vibration is usually below 0.32 mm/s
Air track drill	4 to 5 mm/s at a distance of approximately 5 m, and 1.5

[20] Northern Expressway Environmental Report: Noise and Vibration technical Paper. 2007. http://www.southroad.sa.gov.au/__data/assets/file/0019/13780/Noise_and_Vibration_Technical_Pa per.pdf

Activity	Typical Levels of Ground Vibration
	mm/s at 10 m. at distances greater than 25 m, vibration is usually below 0.6 mm/s and at 50 m or more, vibration is usually below 0.1 mms
Truck traffic (smooth road surfaces)	0.01 to 0.2 mm/s at the footing of buildings located 10 to 20 m from a roadway
Truck traffic (over irregular surfaces)	0.1 to 2.0 mm/s at the footings of buildings located 10 m to 20 m from a roadway

618. These levels are well below the threshold of any possibility of damage to structures due to vibrations from typical construction activities related to roller, compactors, and movement of construction equipment.

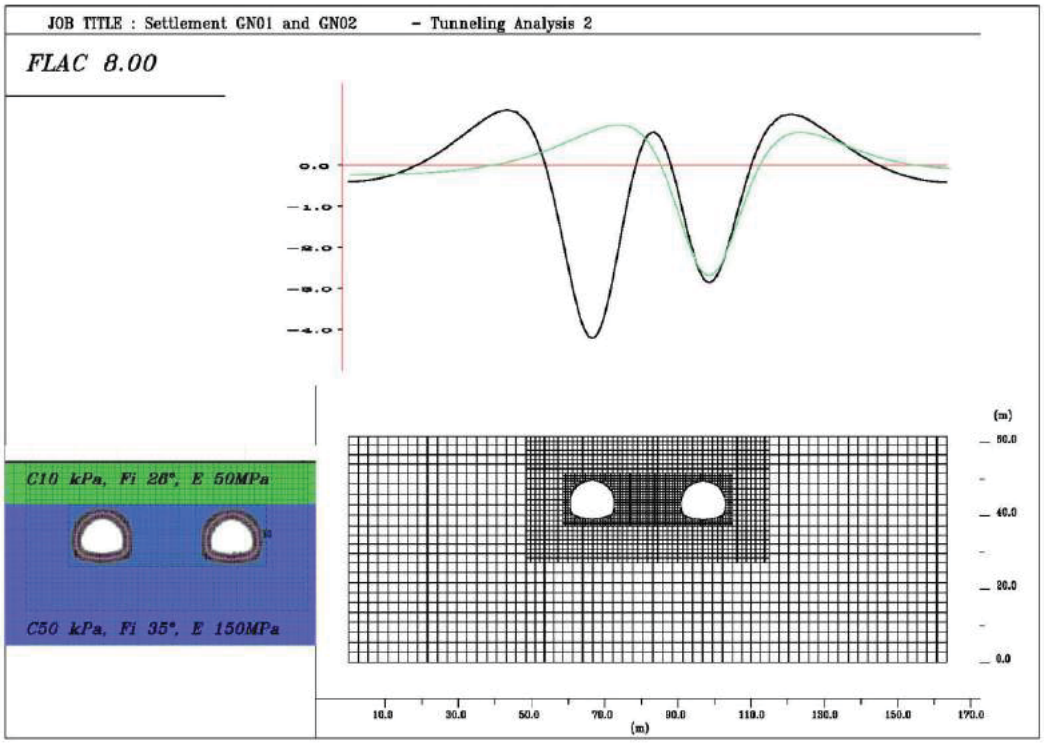
619. The piling for the bridge piers are likely to generate relatively more vibrations which depends on soil condition. However, even under extreme conditions, the vibration is unlikely to exceed 10 mm/s beyond 25 m. The following presents a summary of the properties within 25 meters of each bridge:

- BRI 4.1.01-AT/TA – No properties.
- BRI 4.1.02-AT/TA - Potentially one residential property and a road side restaurant are located within 25 meters. The restaurant will most likely be demolished to accommodate the bridge.
- BRI 4.1.03-AT/TA - No properties.
- BRI 4.1.04-AT/TA – No residential properties are located within 25 meters of the piers. However, several commercial and light industrial properties are located beneath the bridge. These may be need to be removed to accommodate the bridge.
- BRI 4.1.05-AT/TA – Four properties identified.

620. Settlement Impact of Tunnel Construction –There are six double tube tunnels in the F4 section. Analysis undertaken by the Design Team indicates that settlement of no more than 4.5mm will occur above all tunnels. **Figure F-16** illustrates the anticipated settlement for Tunnel TUN 4.0.06 AT/TA, the least overburden.

622. This analysis indicates that settlement will not impact upon structures above these tunnels and structural damage is not to be expected unless some unforeseen situation occurs or unless the Contractor doesn't work properly. It is however possible that cosmetic damage could occur such as small cracks in plaster in wall joints and broken glass in windows as a result of vibration which is discussed below.

Figure F-16: Settlement Analysis for Tunnel TUN 4.0.06 AT/TA



623. Vibration Impact of Tunnel Construction - The main cause for concern in these tunnel areas is vibration nuisance for residents. In these tunnels (hard rock: porfirites) two tunneling techniques could potentially be used, blasting, or hydraulic hammering. Blasting is intermittent, with pauses between each blast to remove rock and set charges for the next blast. On the other hand hydraulic hammering is continuous causing uninterrupted vibration.

624. Tunnels TUN 4.0.06 AT/TA (and the last portion of TUN 4.0.05 AT/TA have less overburden and the potential vibration impacts could be greater than at the other tunnels. As such the use of the rod header which is the technology that minimize the vibrations during excavation is recommended. This technique is possible because the rock is softer in this area than in the other portions of the road (calcarenites).

625. In addition to the above, a basic analysis of the vibration impacts around the end portion of TUN 4.0.05 AT/TA and all of TUN 4.0.06 AT/TA was undertaken by the design team. The analysis indicated that levels of impact in these areas was reduced for standard buildings due to the proposed excavation technique and the attenuation provided by the cushion of weathered rock and arable/vegetal soil in this area. In addition the type of foundations of the buildings, shallow and small, will be an additional damping factor. On the other hand, the quality of the buildings in this area is poor, there are frequent “voluntary additions” such as terraces, and patios which are not properly built; these elements could be more sensitive to vibrations. However, the basic analysis suggests that the level of threshold, above 5 mm/s should not be reached for long periods and the peak energy of excavation should not produce vibrations able to reach the buildings with intensity and frequency in the damaging range.

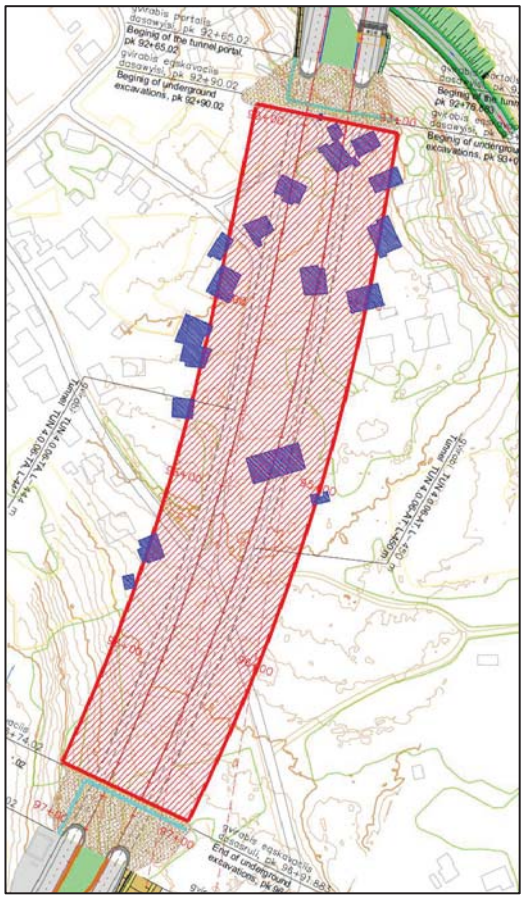
626. The vibration study carried out by the Design Teams vibration expert is provided by **Appendix I** of this EIA Report. The conclusion of this study is summarized below:

- The vibrations generated at the source will propagate with velocity of 10 mm/s;
- The vibration will travel in 2 meters of weathered calcarenite and 5 meters of alluvial soil (which present a much lower stiffness);
- In this superficial layer the vibrations will be strongly attenuated and the expected value at the surface will be 5-4 mm/s;
- At this point the coupling with the foundations will generate a further damping effect whose amount depends on the type of foundation.

For the above consideration an area of influence has to be considered with a distance from the source of 20 meters (total width about 75 meters) also in consideration of the poor quality of the building.

627. Following the conclusions of the vibration study it is recommended to proceed with photo-documentation of the state of the buildings, to avoid conflicts with the population and to set up a couple of monitoring stations to have reference data to provide in case of controversy (see **Figure F-17**).

Figure F-17: Area of influence and buildings potentially affected by excavation of tunnel TUN 4.0.06 AT/TA



628. The Contractor will be in charge of the monitoring of the vibrations in the receptors in the potentially impacted area under supervision by the Engineer and RD. The procedure of initial survey, monitoring during construction and managing of the possible claim of the household, as well as the competence and responsibility is described under paragraph 634 below, points 2, 6 and 7.

Potential Operational Vibration Impacts

629. Highway traffic is not likely to have any measurable impact on the structures or on comfort. The Federal Highway Administration of the USA has determined that "All studies the highway agencies have done to assess the impact of operational traffic induced vibrations have shown that both measured and predicted vibration levels are less than any known criteria for structural damage to buildings. In fact, normal living activities (e.g., closing doors, walking across floors, operating appliances) within a building have been shown to create greater levels of vibration than highway traffic." [21]

Design Phase Noise Mitigation

630. Correct siting of construction camps and ancillary facilities will reduce the potential for elevated noise levels to affect sensitive receptors. As indicated above, locating these facilities more than 250 meters from residential or sensitive receptors will mean that the noise generated by these facilities will be lower than IFC daytime and night-time guideline limits at this distance. Locating these facilities more than 500 meters downwind of sensitive receptors will further limit potential noise impacts.

631. In addition to the above, prior to the start of construction, and as part of his SSEMP, the Contractor will develop a noise management plan that will include the mitigation measures outlined below for the construction phase.

Construction Phase Noise Mitigation

632. During the construction phase the Contractor will be responsible for the following:

- Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the Engineer having due regard for possible noise disturbance to the local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas (within 250 meters) such as residential, nursery, or medical facilities, the Contractor's hours of working shall be limited to 8 AM to 6 PM;
- Give notice as early as possible to sensitive receptors for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress.
- Within normal working hours, where it is reasonable to do so:
  - schedule noisy activities for less sensitive times.
  - provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise).
- The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times.
- All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be

21 http://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/analysis_and_abatem e nt_guidance/polguide09.cfm

maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Maintenance tools, machines and equipment so that they are in good conditions. When some wrong is found, they must be fixed immediately in order to reduce noise from the equipment.
- Fit all pneumatic tools with an effective silencer on their air exhaust port.
- Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed.
- Turn off plant when not being used.
- All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the Engineer.
- Keep good conditions of trucks that use to transport construction materials so they cause no loud noise and control the truck speed, to be not exceeded 40 km/hr when driving through communities, and not exceeded 80 km/hr when driving on highways.
- Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area.
- Provision of noise protection kits such as ear plug, earmuff, for workers who are working in the area with noise level is higher than 85 dB(A). It is designated as a regulation that workers must wear protection kits in case of working in a noisy area.

Operational Phase Noise Mitigation

633. Discussed below under **Section F.8.7 – Noise Model**.

Construction Phase Vibration Mitigation

634. The following phased mitigation measures for construction induced vibration are recommended:

Tunnels - TUN 4.0.01 AT/TA, TUN 4.0.02 AT/TA, TUN 4.0.03 AT/TA, TUN 4.0.04 AT/TA (potentially TUN 4.0.05 AT/TA)

1. The Contractor will develop a detailed Tunnel Blasting Plan (TBP) as part of the overall construction schedule. The TBP shall specify, to a reasonable level of accuracy, the schedule for boring of each tunnel and will include the results of all of the surveys undertaken (see below for survey requirements). The TBP will also include a vibration monitoring plan to monitoring vibration levels and frequency around the blasting sites. The objectives of the monitoring will be to:
    a. Ensure that vibration levels in the communities are within the adopted criteria levels;
    b. Maintain record of vibration to settle any potential conflicts; and
    c. Monitor changes in the vibration levels due to possible changes in the rock formation and take appropriate corrective actions.

    Vibration data will be documented, reviewed, and preserved by the Contractor. It will be regularly shared with the Engineer, RD, JICA, ministry of Environment and the community as part of the monthly progress report.
2. A survey will be undertaken within a 250 meter corridor of tunnel TUN 4.0.02-AT/TA to determine the pre-blasting conditions of all buildings within the corridor. This tunnel is one of the most remote tunnels with a very low number of

properties within 250 meters. The survey will be commissioned by the Contractor at his own charge and will identify and record any existing damage to the structures. The survey will cover the following aspects:

a. Overall condition of the structures, both exterior and interior;
b. Documentation of defects observed in the structure using digital imagery along with notes, measurements and sketches; and
c. Documentation of pre-existing cracks using digital imagery along with notes, measurements and sketches.

The survey will be accompanied with consultations with the affected household to explain the extent and reason for the survey, confirm the findings of the survey (affected households shall sign the survey form saying they agree with the findings) and the process for reporting any grievances regarding vibration impacts. The households will be provided with materials that summarize the grievance redress process. If the households do not allow the survey they shall be informed by the Contractor that they will not be authorized in the future to claim any damage.

3. Tunneling shall then start from tunnel TUN 4.0.02-AT/TA at its western portal. In the initial stages, the blasting induced vibration shall be measured as a function of maximum instantaneous charge and distance from the blasting site. This data shall be then used to define damage risk zones in damage risk maps.
4. Using the damage risk map and the tunnel boring schedule, the Contractor in consultation with the RD and the Engineer, will identify the houses that are likely be affected and the impact duration and schedule. As noted above (and by **Figure E-X**), there is assumed no risk of structural damage for the houses, but the pressure of the blasting could cause some cosmetic damages, mainly relating to the breaking of windows. Before start of blasting, all residents shall be informed of the exact hour of the blasting and they will be invited to open the windows in order to avoid them breaking.
5. With respect to blasting the following are key recommended mitigation measures:
    a. No blasting will be carried out within 100 m of the portal of any tunnel.
    b. Blasting will be scheduled during the day only.
    c. Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.
6. Both during and after the tunnel excavation if any damage to properties is reported by the property owners the survey will be repeated to ascertain that the blasting is the cause of the damage comparing the damage with the previous survey. If this is the case, the Contractor will repair the damage and the cost will be on charge of the RD. If the Contractor has no previous survey to compare the cost of the repairs will be with him.
7. If the damages are significantly more than what expected, the Contractor shall change the method of blasting (decreasing the energy of blasting) or if this is ineffective, cease blasting and employ another less invasive method (rod header).
8. Regarding vibration nuisance it is strongly recommended that hydraulic hammering not be used in order to limit constant vibration nuisance. If the Contractor decides to use this method and substantial complaints are received from the community, the Contractor will be obliged to use an alternative technique.
9. In addition the following measures shall be applied relating to tunnel blasting;
    a. No blasting will be carried out within 100 m of the portal of the tunnel;
    b. Blasting will be scheduled during the day only; and

c. Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.

Tunnels - TUN 4.0.06 AT/TA (potentially TUN 4.0.05 AT/TA)

1. The Contractor will develop a detailed Tunnel Excavation Plan (TEP) for each tunnel as part of the overall construction schedule. The TEP shall follow exactly the same procedures as the TEP for the tunnels mentioned above, but shall include assessment shall include surveys of structural damage.
2. Despite the fact that the basic vibration analysis has indicated that blasting should not have significant impacts in this area, it is recommended that the tunneling technique be limited to the use of the rod header to minimize the vibrations during excavation and ensure no structural damage.

Construction Phase Vibration Mitigation - Bridges

635. It is noted that only a few properties will potentially suffer cosmetic damage from bridge piling works. It is however recommended that the Engineer undertakes cosmetic condition surveys of all properties within 50 meters of bridge piles as per the vibration surveys recommended above for the tunnels. If there are any claims or reports of damage the affected house will be surveyed against the pre-Project survey and repairs will be undertaken as appropriate by the Contractor.

F.8.7 Noise Model

F.8.7.1 Environmental Noise Model

636. To assess the impacts of operational noise within the Project area a noise model has been prepared.

637. The Environmental noise model is based on a specific set of conditions for which the noise is being estimated, it will be a fixed representation or 'snapshot' of a physical environment of interest; in practice the physical environment of the area of interest is constantly and randomly changing; the model intend to represent the most typical or frequently occurring conditions as reconstructed by the input data. Modeling takes into consideration both worse scenario and the average conditions, the latter being a good representation in case of pretty constant traffic conditions. The key conditions for the development of a good noise model are:

- Knowledge of the noise source, or sources, for which associated environmental noise levels are of interest.
- The physical environment through which noise will transmit from the noise source(s) to the location or targets/region of interest. This includes the ground terrain, the built environment, and atmospheric conditions (e.g. wind, temperature, humidity).
- An approximation of the way in which sound will travel from the noise source(s) via the physical environment, to the receiver location or region of interest (building surface).

638. In complex scenarios, the environmental noise model is repetitiously calculated for the distribution of sound source (by using ray – tracing modeling), from the traffic to the receiver location. The total sound level at each position is then calculated by summing the contribution of each source and transmission path. The road will be considered as a linear source of noise, composed by a number of

vehicles considered as single sources moving along a line. Application of these calculations to each point on a uniformly distributed grid enables a noise contour map to be developed to depict regions of equal estimated noise level and depict trends in the spatial pattern of the sound field:

639. Information considered in the development of the model **- Table F-16** shows the requirements for specifying a noisy environment:

Table F-16: Factors in Acoustic Mapping

Stage	Minimum	Other elements to be considered
The noise sources to be investigated	Number of sound sources; Total sound power output of each source; Directional characteristics of each source; Height of each source; Frequency characteristics of each source	Time variations of emissions for example, a worst-case assessment would imply the use of the highest possible value irrespective of how frequently it may occur, whilst an assessment which related to 'typical' conditions could necessitate the use of an averaged value or some typically recurring upper value. (**In our case, impulsive noise from the source should be excluded)**
The physical environment through which noise will transmit to the receivers	Separating distances between all relevant noise sources and receivers Reflecting/ obstructing structures; amount and type of vegetation Height(s) of receiver(s) (Obtained from Maps or field survey of buildings)	Ground terrain profile characteristics of the ground cover Meteorological conditions relevant to the intentions of the including wind direction and speed, temperature, and humidity, (**not so relevant in our case due to the short distances from the source).**

640. To estimate the way in which noise will travel from the noise sources to the receivers, a range of sound propagation methodologies may be employed. Methods vary widely in their complexity and the scope of applications for which they can offer meaningful predictions.

641. In our model a standard hemi-spherical spreading is considered; this method accounts for the reduction in sound intensity as a sound wave front spreads over a larger area, with the consequence of increasing the area of the spherical surface where the energy (sound pressure wave) is distributed.

642. To calculate the propagation the algorithm takes into account:

- The absorption associated with the propagation of noise through the atmosphere ***(very low due to the short distance)***
- The change in noise level that occurs as a result of interactions between the sound wave travelling directly to the receiver and those reflected from the ground, buildings and accounting for influence of the ground cover type ***(calculated from the 3D model of soil and buildings obtained by field survey).***

- The attenuation offered by obstacles that fully or partly obstruct line of sight between a source and a receiver location ***(poor vegetation will not determine any attenuation).***
- The influence of atmospheric conditions that can change the direction of an advancing sound wave front by refracting the wave at points where there are significant changes in wind speed and/or temperature (not considered due to the short distance).
- The influence of reflecting surfaces which re-direct an advancing sound wave front (for the second row of buildings reflection/shielding will be the main factor of attenuation).

F.8.7.2 Variability

643. The noise sources considered in the model exhibit very large variability in space and time and during the construction phase also the background noise from the nearby existing road has to be considered. The following **Table F-17** gives examples of variations considered in the developed model.

Table F-17: Examples of Components Variations

Component	Examples of component variations
Source	Background noise: Changing traffic sound e.g. hourly, daily, and seasonal changes in the general traffic flow volume and composition, as well short term (wet or dry) and long term (road surface degradation) changes in road conditions.
Transmission	Position dependent sound propagation, e.g. varying separation distances due to sound source movement, varying degrees of sound path screening according to source and receiver location, and localized regions affected by reflections (not of capital importance in tour case due to linear modelization of traffic)

F.8.7.3 Algorithms for Outdoor Sound Propagation

644. The ability of mathematical algorithms to accurately represent sound propagation has been the focus of considerable researches, particularly given the role of noise prediction as an integral assessment tool in the fulfillment of the European Noise Directive (i.e. EU Directive 2002/49/EC, which requires member states to produce noise maps and action plans for urban areas and major transport infrastructures, including roads, railways and airports). As mentioned, the applied software fully complies with that and it is updated to the latest EU directives and norms. In particular the used Software SOUND PLAN VER. 7.2 considers the guidelines ISO 3891 e ISO 9613; the sound pressure has been calculated in accordance to the procedures stated in the model “Nouvelle Metode du Presion du Bruit - Routes 2008” and the following norms:

- Industrial Noise
  - ISO 9613 incl. VBUI (International, EC-Interim)
  - CONCAWE (International)
  - VDI 2714, VDI 2720 (Germany)
  - DIN 18005 (Germany)

  - ÖAL Richtlinie Nr. 28 (Austria)
  - BS 5228 (United Kingdom)
  - Nordic General Prediction Method (Scandinavia)
  - NORD 2000 (Scandinavia)
  - Ljud från vindkraftverk (Sweden)
  - Harmonoise, P2P calculation model (International)
  - NMPB08 - Industry (France)
  - CNOSSOS-EU (2014)
- Road Noise
  - NMPB-Routes-96 (France, EC-Interim)
  - RLS-90, VBUS (Germany)
  - DIN 18005 (Germany)
  - RVS 04.02.11 (Austria)
  - STL 86 (Switzerland)
  - SonRoad (Switzerland)
  - CRTN (United Kingdom)
  - TemaNord 1996:525 (Scandinavia)
  - Czech Method (Czech Republic)
  - NMPB-Routes-08 (France)
  - TNM (USA)
  - CNOSSOS-EU (2014) Industrial Noise

F.8.7.4 Standards, regulations and guidance notes

645. The following standards, regulations and guidance notes have been considered as part of the model:

- ISO 9613-2, Acoustics — Attenuation of sound during propagation outdoors Part 2: General method of calculation.
- BS 4142, Method for rating industrial noise affecting mixed residential and industrial areas.
- BS 5228-2, Noise and vibration control on construction and open sites — Part 2:Guide to noise and vibration control legislation for construction and demolition including road construction and maintenance.
- BS 7445, Description and measurement of environmental noise.
- IPPC H3 Horizontal Noise Guidance. Part 1 ‘Regulation and Permitting’ and Part 2 'Noise Assessment and Control'.
- Calculation of Road Traffic Noise 1988, Department of Transport, Welsh Office.
- Calculation of Railway Noise 1995. Department of Transport.
- The CAA Aircraft Noise Contour Model: ANCON Version 1. DORA Report 9120, Civil Aviation Authority 1992.
- PPG 24 Planning Policy Guidance: Planning and Noise. Department of the Environment 1994. TAN11 (Wales); PAN56 (Scotland).
- BS 9142: 2006 Assessment methods for environmental noise — Guide, 2003/01534 12 July 2006.

F.8.7.5 Simulation parameters

646. The modeling of the noise emissions and noise propagation from the new road takes into account that there are many houses very close to road side in certain sectors and others where urbanization is almost absent. The morphology, characterized by hills, and the presence of the river valley and riverbed plays a very important role mostly because this determine the

distribution and type of vegetation which is acting as noise barrier and the absence of obstacles for the propagation across the valley.

647. To model noise, the design study of the new road design and detailed traffic forecasts immediately after construction and for the next 20/25 years have been taken into account.

648. Modelling of noise level was performed using 2037 traffic flow for Day and Night time as provided in the Engineering Design documents package with a difference between day and night of 70% for light vehicles and 30% for trucks (see **Table F-18**).

Table F-18: Daily average vehicles/day (working day) (2017 – 2037)

Year	Car	Mini Buses<15, PickUPs	Buses & Trucks	Trailers & > 3 axels	Total
	65,6%	17,0%	11,9%	5,5%	
2017	13,335	3,448	2,410	1,116	**20,310**
2018	14,002	3,621	2,521	1,167	**21,311**
2019	14,757	3,816	2,645	1,225	**22,443**
2020	15,636	4,043	2,790	1,292	**23,761**
2021	16,663	4,309	2,958	1,369	**25,298**
2022	17,753	4,591	3,135	1,452	**26,930**
2023	18,712	4,838	3,290	1,523	**28,364**
2024	19,722	5,100	3,453	1,599	**29,874**
2025	20,550	5,314	3,586	1,660	**31,111**
2026	21,414	5,537	3,724	1,724	**32,399**
2027	22,313	5,770	3,868	1,791	**33,741**
2028	23,172	5,992	4,010	1,856	**35,030**
2029	24,064	6,222	4,157	1,925	**36,368**
2030	24,858	6,428	4,288	1,985	**37,559**
2031	25,679	6,640	4,423	2,048	**38,790**
2032	26,526	6,859	4,563	2,112	**40,060**
2033	27,401	7,085	4,706	2,179	**41,372**
2034	28,306	7,319	4,855	2,247	**42,727**
2035	29,240	7,561	5,007	2,318	**44,126**
2036	30,205	7,810	5,165	2,391	**45,571**
2037	31,201	8,068	5,328	2,467	**47,064**

649. These traffic fluxes are for ultra-conservative scenario in which full load of the road in year 2037 will occur (peak hour at day and maximum expected load at night) and also for the present day vehicle levels. In reality, it can be said with high probability that vehicle levels in Georgia will change by 2037 with the consequence of having lower emissions than predicted in the project design documents and used in this modelling. This will result from:

- Technological improvement (new models, hybrids, electric cars have and will have less and less noise emissions and the share of these vehicles in the whole vehicle cars will be significant);
- Full amortization of the old vehicles; and
- Possibly also from national regulations to limit the use of old vehicles producing excessive air pollution (the same categories of vehicles happen to be responsible for high noise emissions too).

F.8.7.6 Numeric model

650. The forecast of noise emissions or new urban road has been performed using SOUND PLAN VER. 7.2 ray tracing software. Noise sound pressure results on receiving point are based on method BNPM (Basic Noise Prediction Method) and on German regulation BNPM, which is based on DIN 18005.

F.8.7.7 Receptors to be investigated

651. In order to investigate noise levels in operation field and close to buildings, many receiving points have been ideally set in correspondence of building facades, at proper distance and height according to Georgian and international standard regulations. The model can evaluate not only general noise level in the area but also noise levels close to buildings, in position suggested by international regulations about residential buildings. Due to the absence of tall buildings, maximum height is four floors, and their distance from the source, there is no need to make a multi level computation at different heights.

F.8.7.8 Traffic forecasts

652. Currently last 5 year statistic data is available from Roads Department of Georgia for the main roads; data includes seasonal measurements during the year, specifically in April, July and October from these measurements AADT is derived.

653. According to German regulation BNPM, the vehicle fluxes must be divided in light and heavy means; accordingly the reported data has been divided assigning the class of light vehicles to cars and minibuses, the class of heavy vehicles to buses tracks and trailers. The traffic flux per day at 2017 is shown in **Table F-19**.

Table F-19: Traffic Flux Per Day, 2017

Year	Car	Mini Buses<15, PickUPs	Buses & Trucks	Trailers & > 3 axles	Total
2017	13335	3448	2410	1116	20310

654. This data has been collected in a period of 8 hours in the day reference period, so the average hour flux can be considered 2,540 vehicles per hour. Due to unstable patterns it was considered more reasonable to calculate Compound Annual Growth Rate (CAGR) to apply first year growth rate separately for Passenger and Freight Vehicles based on last few year traffic history. The compound annual growth rate is calculated by taking the root ^{nth} of the total percentage growth rate, where “n” is the number of years in the period being considered.

649. For the reasons above described, in our model as future traffic flux the traffic forecast values at 20 years from now data was the input data; in other words the traffic values after a period of about 18 years after road construction. The future vehicle flux used in calculations is 47,064 total vehicles.

655. To investigate the worst traffic condition for noise levels, this flux, according to BNPM method, has been evenly spread on road lanes, the average per day has been divided in a period of 8 hours, obtaining the above average flux per hour, 5,883 vehicles/hour with about 16% of heavy vehicles; speed has been set to 80 Km/h.

656. As far as regards the night reference time, considering the absence of any directly measured data and lacking of a study as detailed as daytime one, a vehicles flux of 70% of the daytime for cars and 30% for buses trucks and trailers has been chosen (see **Table F-20**). The assumption is based on experience in European countries, and corrected by direct observation of traffic reduction during night time in the investigation area.

Table F-20: Night Traffic

Year	Car (70%)	Mini Buses<15, PickUP (30%)s	Buses & Trucks(30%)	Trailers & >3 axle (30%)s	Total
2017	9334,5	1034,4	723	334,8	11426,7
2018	9801,4	1086,3	756,3	350,1	11994,1
2019	10329,9	1144,8	793,5	367,5	12635,7
2020	10945,2	1212,9	837	387,6	13382,7
2021	11664,1	1292,7	887,4	410,7	14254,9
2022	12427,1	1377,3	940,5	435,6	15180,5
2023	13098,4	1451,4	987	456,9	15993,7
2024	13805,4	1530	1035,9	479,7	16851
2025	14385	1594,2	1075,8	498	17553
2026	14989,8	1661,1	1117,2	517,2	18285,3
2027	15619,1	1731	1160,4	537,3	19047,8
2028	16220,4	1797,6	1203	556,8	19777,8
2029	16844,8	1866,6	1247,1	577,5	20536
2030	17400,6	1928,4	1286,4	595,5	21210,9
2031	17975,3	1992	1326,9	614,4	21908,6
2032	18568,2	2057,7	1368,9	633,6	22628,4
2033	19180,7	2125,5	1411,8	653,7	23371,7
2034	19814,2	2195,7	1456,5	674,1	24140,5
2035	20468	2268,3	1502,1	695,4	24933,8
2036	21143,5	2343	1549,5	717,3	25753,3
2037	21840,7	2420,4	1598,4	740,1	26599,6

F.8.7.9 Modeling Results

657. The results of the noise model are presented below in a series of maps (**Figure F-19** to **Figure F-58**). The Project road has been divided into ten 'portions' to allow a better visual analysis of the maps. **Figure F-18** shows the approximate location of each 'portion'.

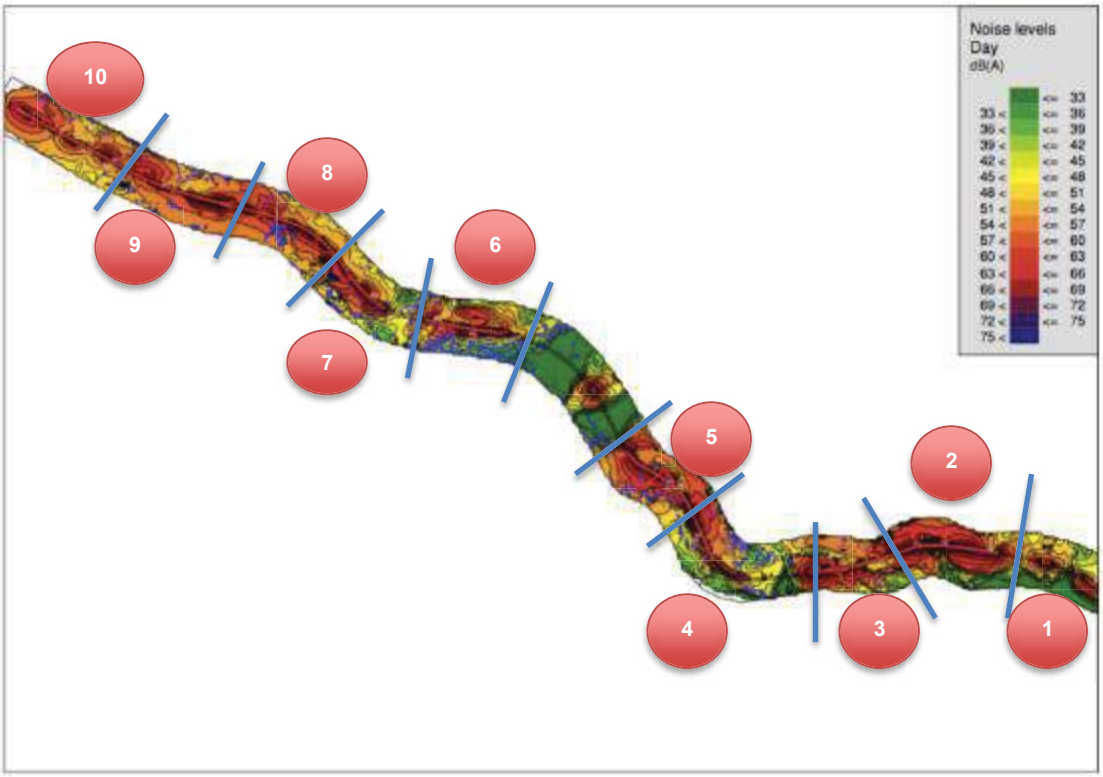
658. Each portion comprises a series of four maps with isolines representing the various predicted noise levels for:
1. Daytime noise – Without noise abatement
2. Daytime noise – With noise barrier
3. Nighttime noise – Without noise abatement
4. Nighttime noise – With noise barrier

659. The noise barrier has been developed based on a generic solid noise barrier type, with a height of 4 meters and is used only to illustrate the types of noise reduction that could be anticipated by employing such abatement measures. The exact locations of the noise barriers can be seen in **Appendix E**.

660. Next to each map a table is provided indicating the predicted noise levels at each identified receptor within the Project corridor (100 meters each side of the

road). The numbers highlighted in green indicate where they meet the IFC Guidelines limits for daytime and nighttime noise.

Figure F-18: Approximate Location of Portion



661. The model shows that there are many locations where IFC guideline limits for daytime and nighttime noise would be exceeded in 2037 given the predicted increase in traffic over this period. Noise abatement, in the form of a 4 meter high solid noise barrier does help reduce noise levels, but in many instances, even with the noise barrier the road noise still exceeds IFC guideline limits, particularly the strict 45 dBA nighttime limit.

662. **Table F-21** below summarizes the findings of the model, with and without noise barriers.

Table F-21: Noise Model Findings

Portion	Findings
1	Only three receptors are located in this portion. R1 and R2 will still be slightly above the nighttime IFC limit even with a noise barrier.
2	Receptor L1 and L2 are not impacted by elevated noise levels in any scenario. R5 will be expropriated and R6 is a commercial property (IFC guidelines of 70 dBA apply here). R4 is the only receptor effected and the noise barrier will not be able to reduce noise levels below IFC guideline limits.
3	All receptors are above the IFC daytime and nighttime limits without noise abatement measures. However, application of the noise barrier does not bring noise levels below the IFC standards especially around the intersection. Receptors R7 to R17 are however within only 3-5 dBA of the limits if noise barrier B5 is employed.
4	Only 5 receptors out of the 21 on the left hand side of the road require noise abatement measures (L9,L10,L13,L14 & L17), all other receptors are below the IFC guideline limits in all scenarios. The situation on the right side is a little

Portion	Findings
	different. Noise abatement has a very positive impact on receptors R23 to R34. However, after the noise barrier is not able to reduce noise levels below IFC guideline limits.
5	All receptors on the right side of the road (except R51 and R52) will be expropriated. Noise levels at R51 and R52 only just exceed IFC guideline limits with the noise barrier having almost no noise reduction impact on these properties. All receptors are subject to noise levels above IFC guideline limits in all scenarios.
6	Noise levels with and without noise abatement are broadly similar with around half of the receptors being exposed to elevated noise levels regardless of the scenario.
7	Most receptors are affected by elevated noise without abatement measures in place. However, the noise barrier scenario provides extremely effective noise reduction reducing noise levels at all receptors below IFC guideline limits.
8	All receptors are impacted by elevated noise levels without noise abatement. Noise barriers have a positive effect in the first half of this portion, but little effect close to the interchange.
9	All receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.
10	As with Portion 9, all receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.

663. Notwithstanding the above, the model is based on a range of variables, including traffic forecasts which may change in the future. Vehicle noise levels may also reduce with the advent of electric cars. Accordingly, while the model is useful in providing an indicator of areas where noise is likely to be an issue, but it is not an end in itself.

F.8.7.11 Operational Phase Noise Mitigation

664. **Figure F-19** to **Figure F-58** illustrate that noise barriers would, in some instances, be effective noise abatement and would help reduce road noise levels below IFC guideline limits. However, in other instances a noise barrier does not seem to have any major benefits and noise levels are still elevated above IFC limits even with the noise abatement.

665. Looking more closely at the results of the model the following comments are made about each portion and the potential for future installation of noise barriers within it.

- Portion 1: Only two receptors are slightly impacted by noise levels. Other noise abatement measures should be considered to replace the 200m noise barrier. This could include fencing around individual properties, planting of vegetation, and installation of noise proof windows.
- Portion 2: Only one receptor will be impacted. Other noise abatement measures should be considered to replace the 500 m of noise barrier. This could include fencing around individual properties, planting of vegetation, and installation of noise proof windows.
- Portion 3: Noise Barrier B6-1 and B6-2 do not have any significant effect on the receptors. However, Barrier B5 does reduce noise levels close to IFC limits and as such could be implemented in addition to other noise abatement measures,

such as fencing around individual properties, planting of vegetation, and installation of noise proof windows.

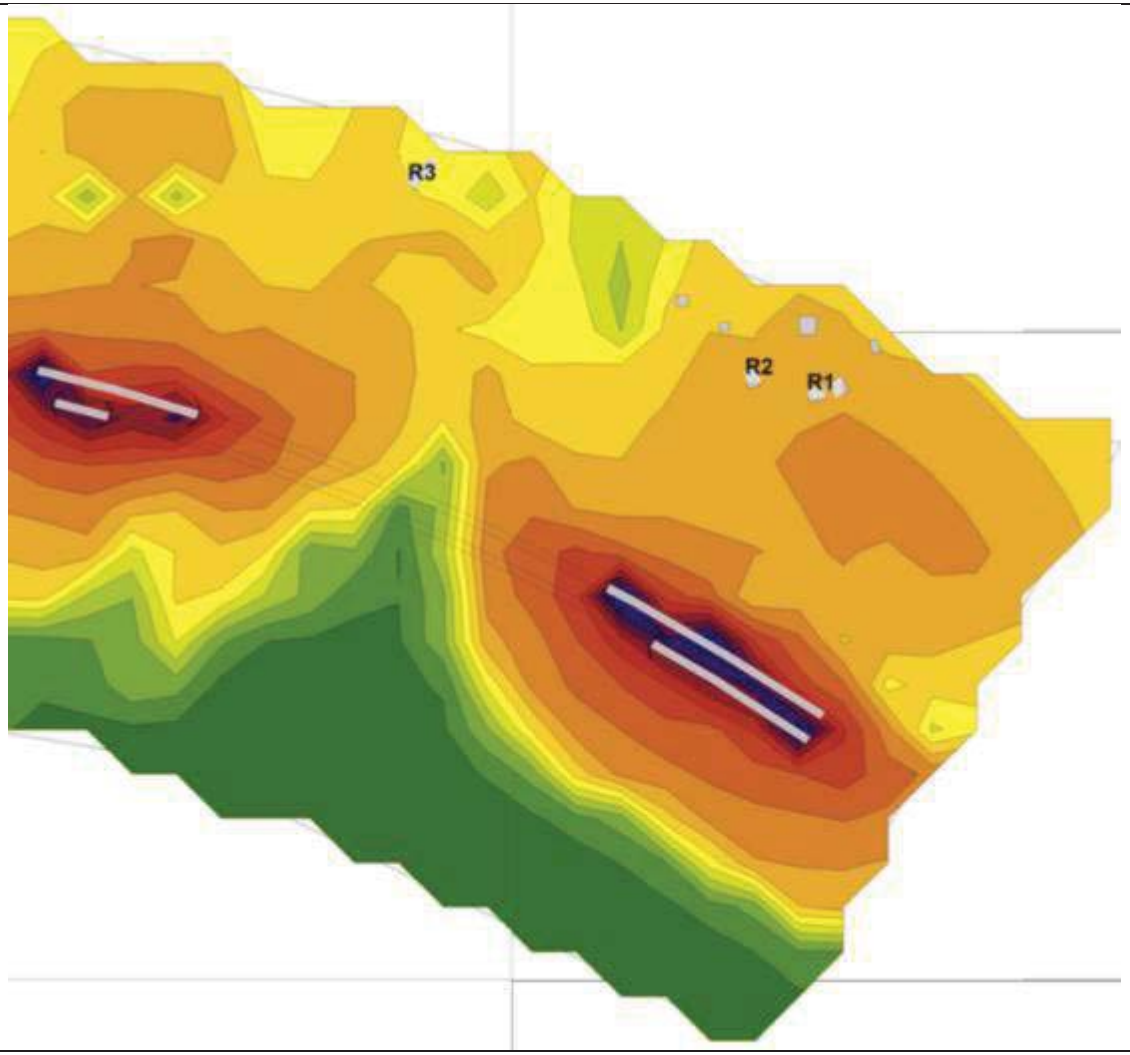
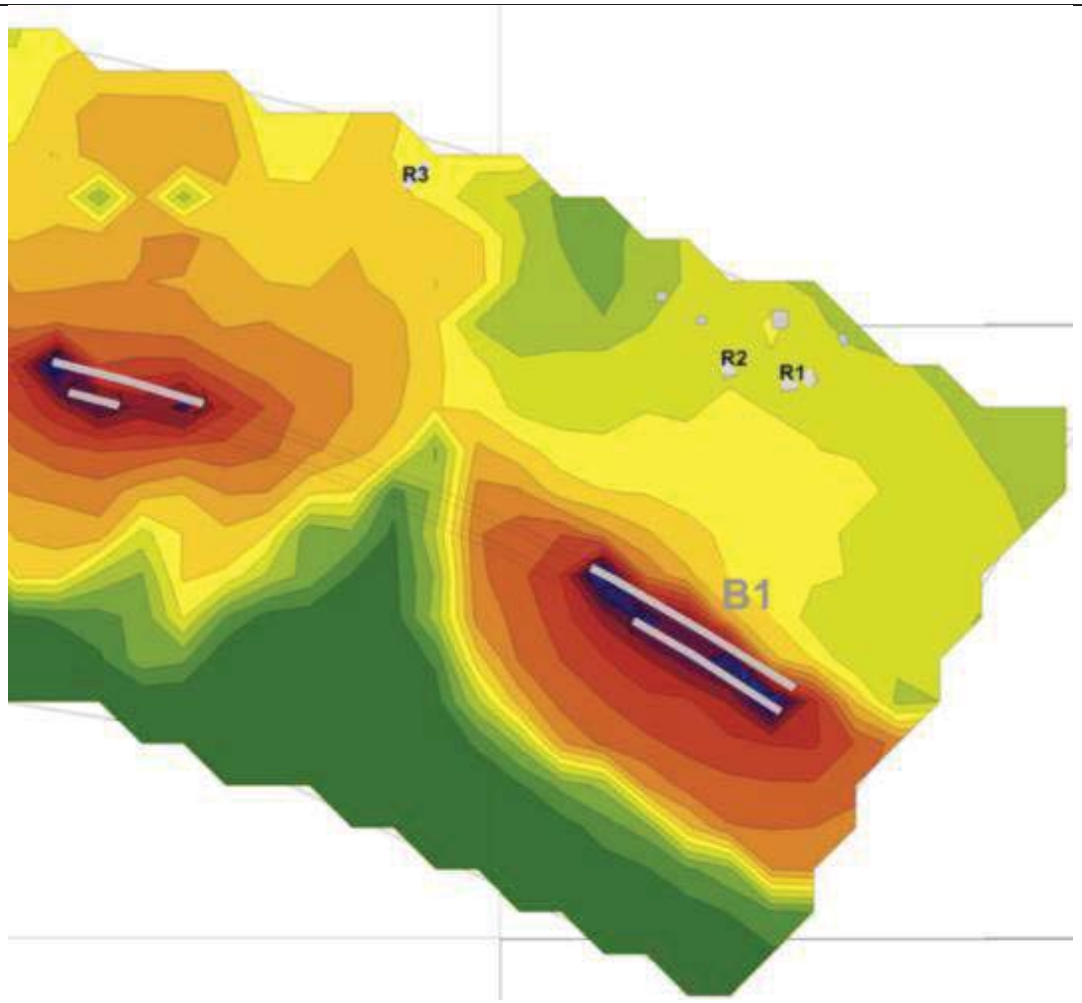


Figure F-19: Portion 1

Without Barrier / Daytime

Receptor	dBA
R1	56.3
R2	54.6
R3	50.4



Barrier B1 – L200m / H4m

Figure F-20: Portion 1

With Barrier / Daytime

Receptor	dBA
R1	47.4
R2	46.9
R3	50.4

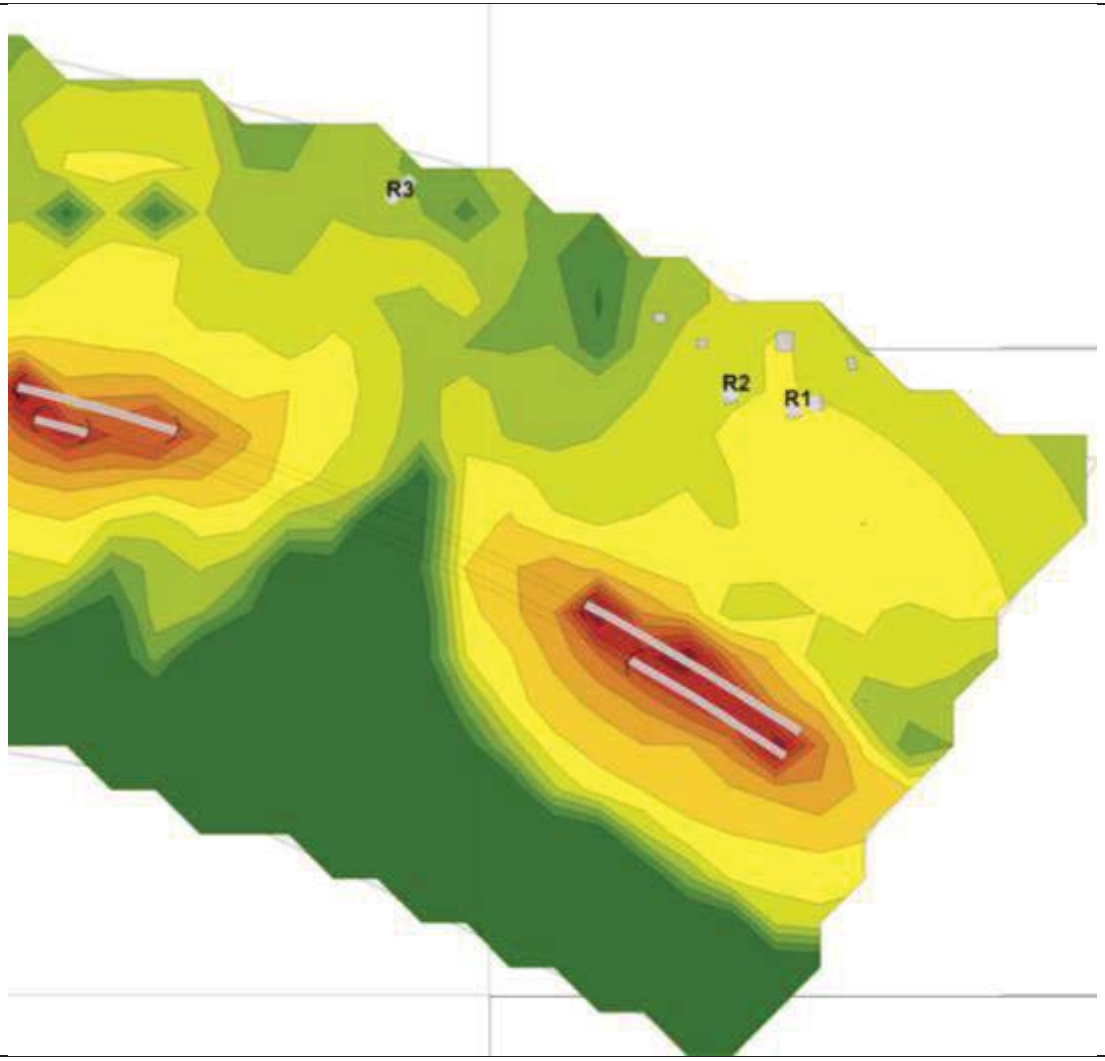
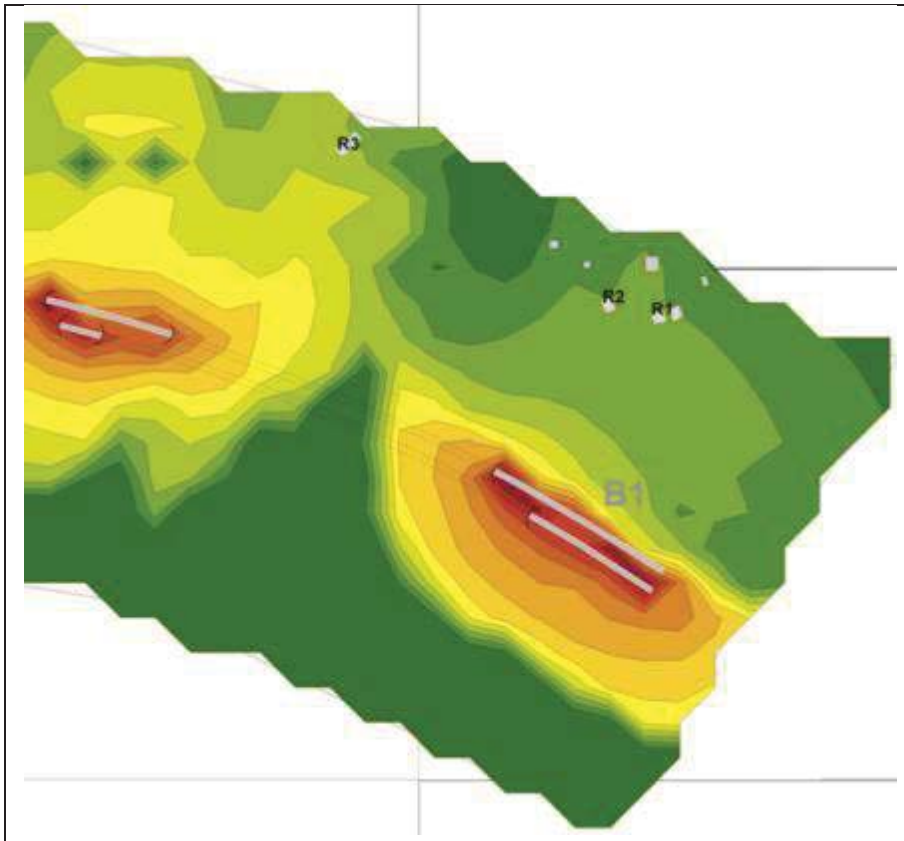


Figure F-21: Portion 1

Without Barrier / Nighttime

Receptor	dBA
R1	48.3
R2	46.6
R3	42.3



Barrier B1 – L200m / H4m

Portion 1 Results: Only three receptors are located in this portion. R1 and R2 will still be slightly above the nighttime IFC limit even with a noise barrier.

Figure F-22: Portion 1

With Barrier / Nighttime

Receptor	dBA
R1	39.3
R2	38.8
R3	42.3

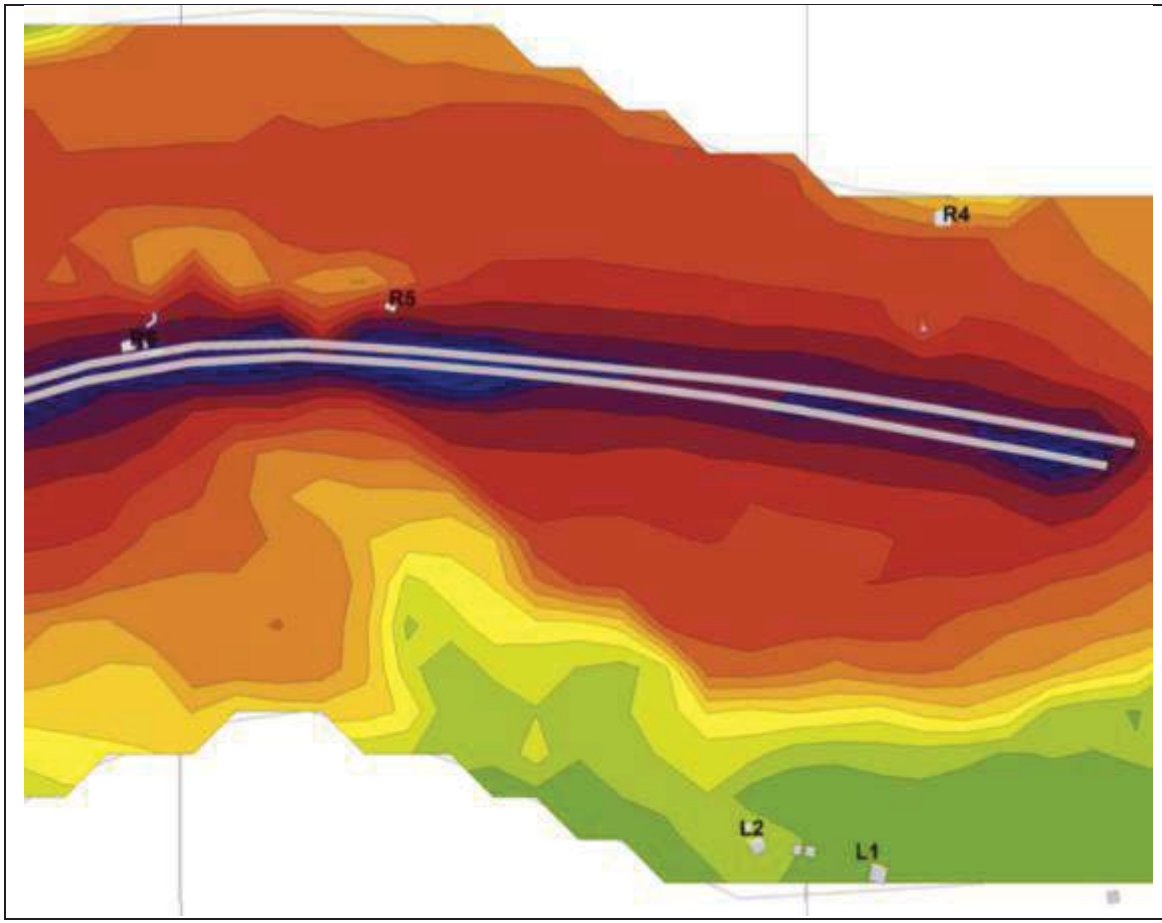
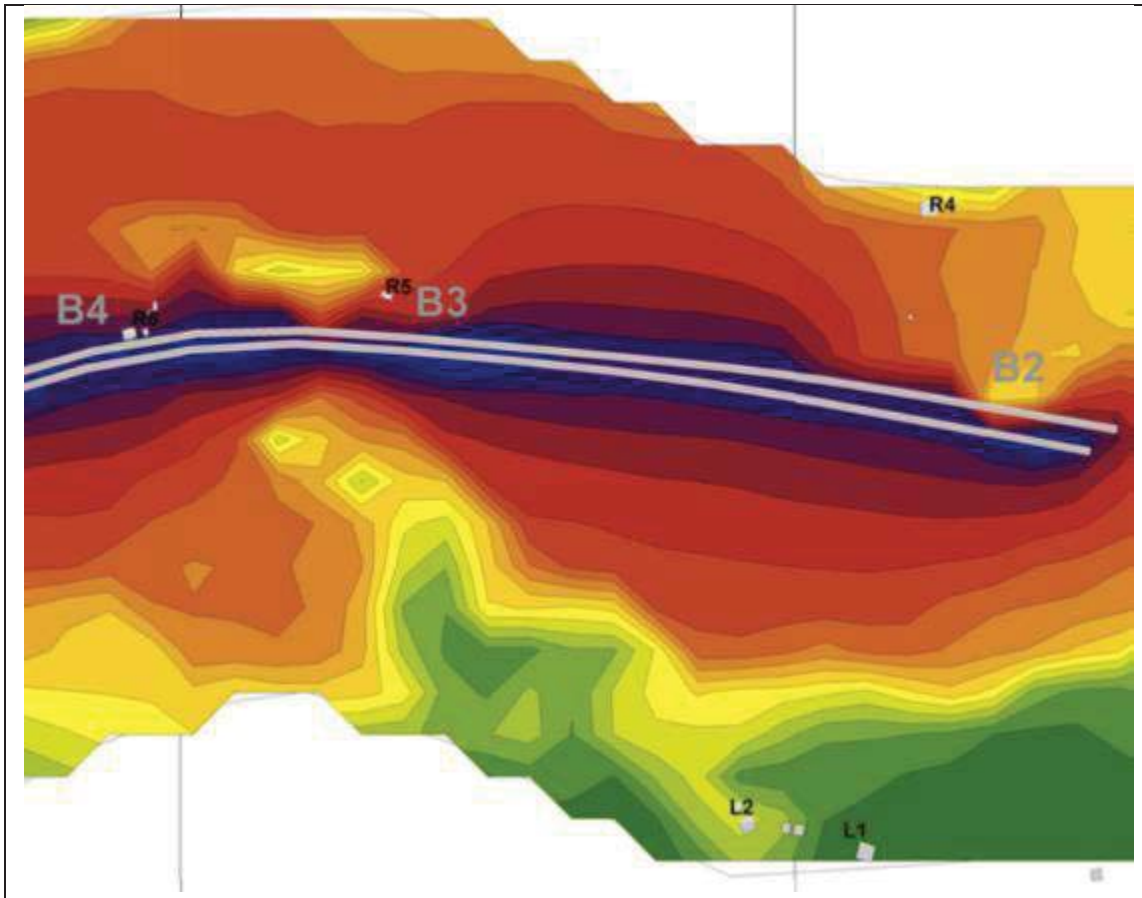


Figure F-23: Portion 2

Without Barrier / Daytime

Receptor	dBA
L1	31.6
L2	33.2
R4	64.5
R5*	71.9
R6**	78.5

*To be expropriated
**Commercial



Barrier B2 – L280m / H4m
Barrier B3 – L170m / H4m
Barrier B4 – L50m / H4m

Figure F-24: Portion 2

With Barrier / Daytime

Receptor	dBA
L1	31.6
L2	33.2
R4	60.0
R5*	67.1
R6**	+75.0

*To be expropriated
**Commercial

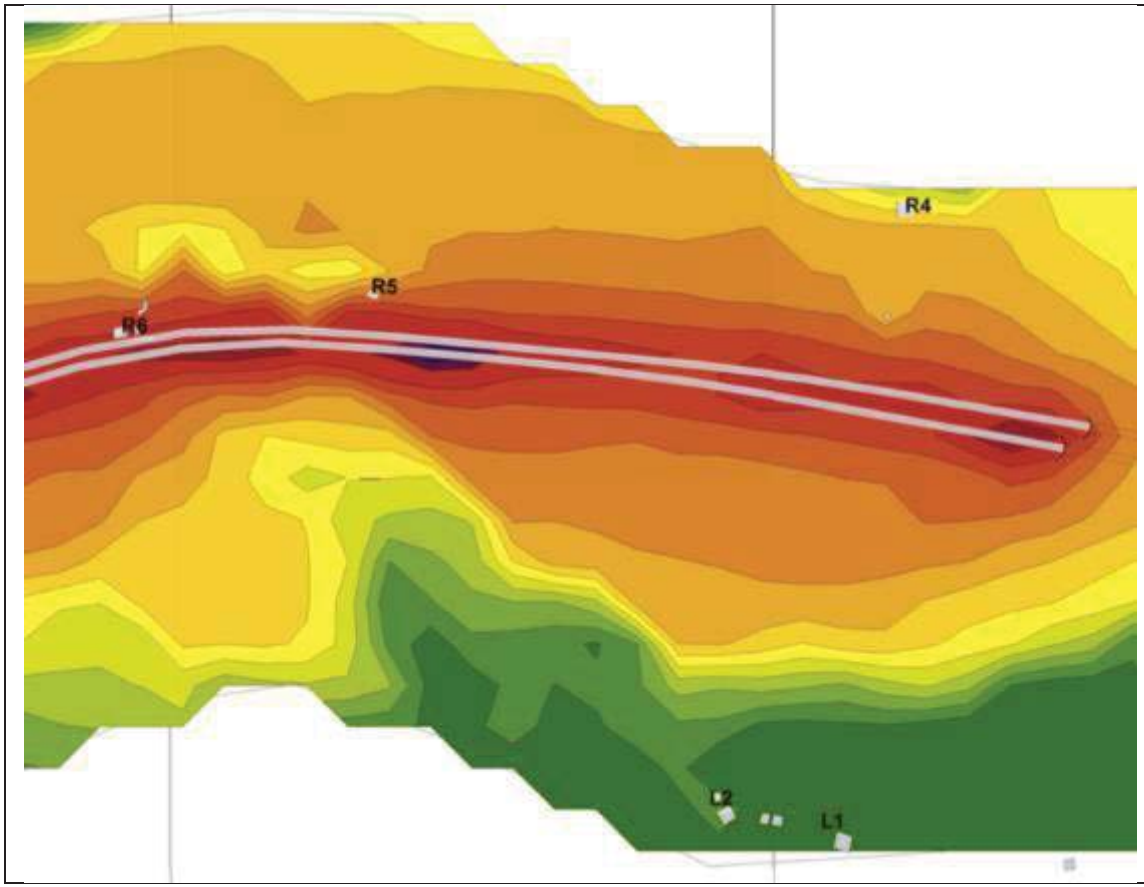
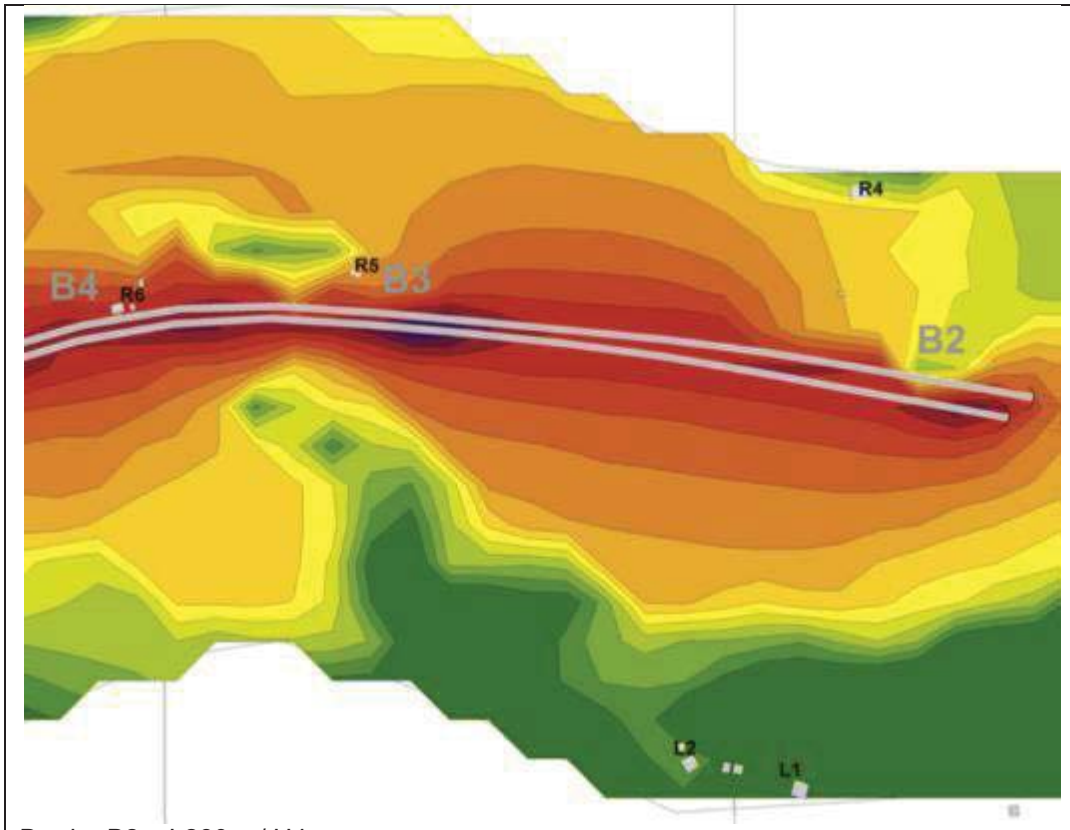


Figure F-25: Portion 2

Without Barrier / Nighttime

Receptor	dBA
L1	23.6
L2	25.2
R4	56.5
R5*	63.9
R6**	70.0

*To be expropriated
**Commercial



Barrier B2 – L280m / H4m
Barrier B3 – L170m / H4m
Barrier B4 – L50m / H4m

Portion 2 Results: Receptor L1 and L2 are not impacted by elevated noise levels in any scenario. R5 will be expropriated and R6 is a commercial property (IFC guidelines of 70 dBA apply here). R4 is the only receptor effected and the noise barrier will not be able to reduce noise levels below IFC guideline limits.

Figure F-26: Portion 2

With Barrier / Nighttime

Receptor	dBA
L1	31.6
L2	33.2
R4	51.9
R5*	59.0
R6**	66.0

*To be expropriated
**Commercial

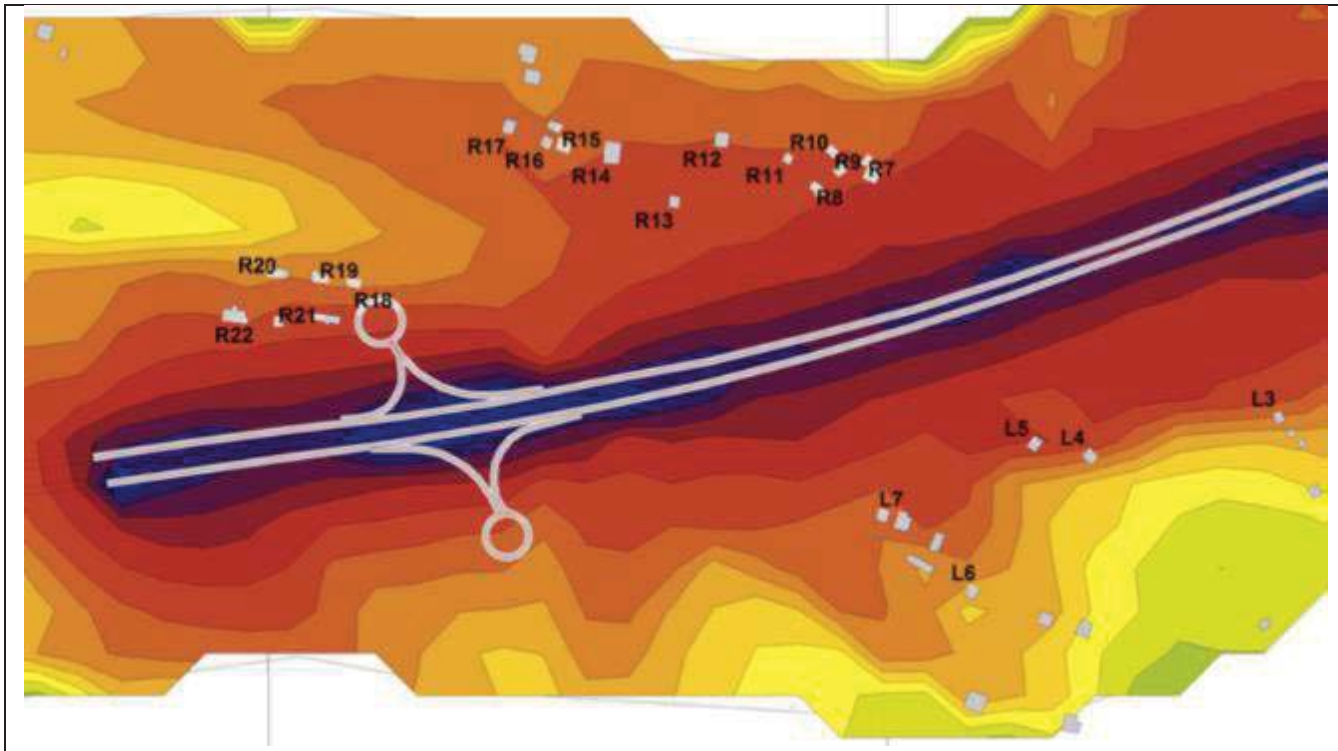
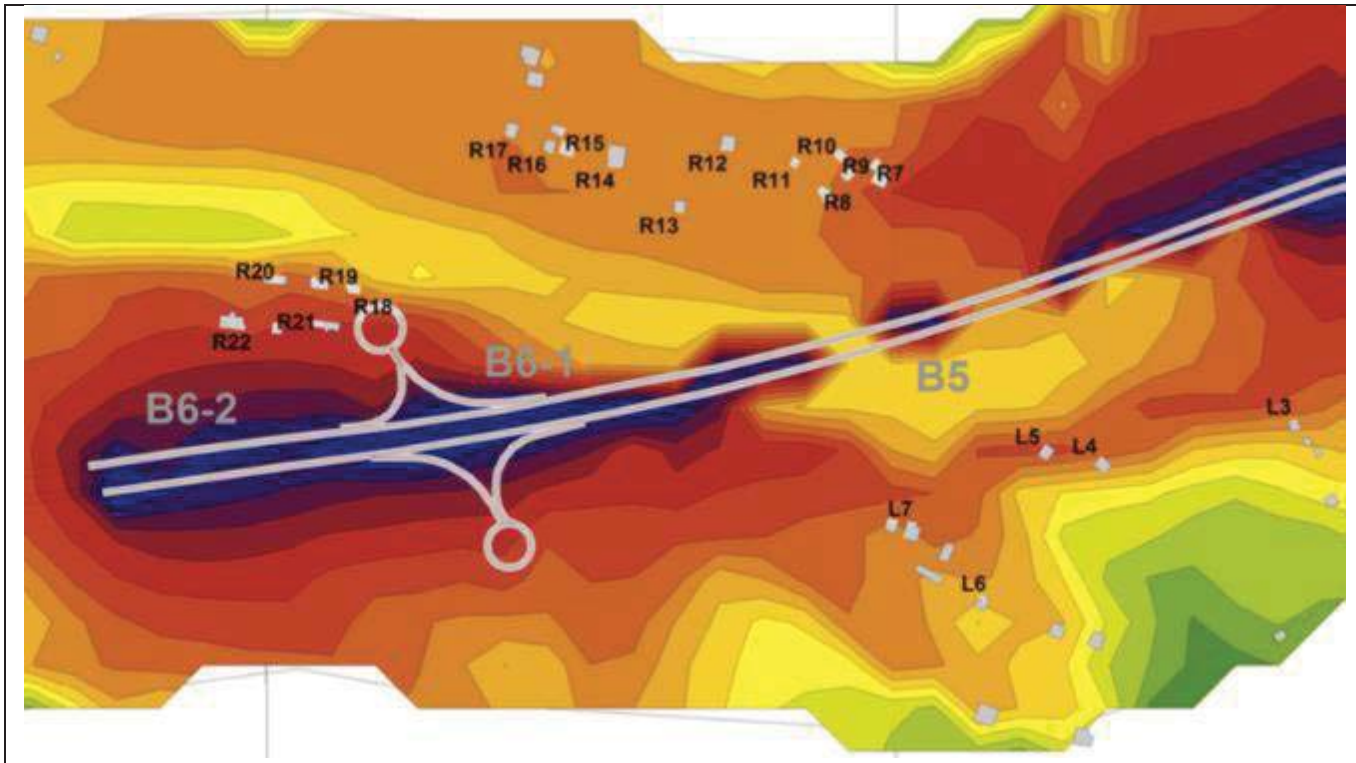


Figure F-27: Portion 3

Without Barrier / Day time

Receptor	dBA
L3	59.1
L4	64.7
L5	65.5
L6	57.9
L7	64.1
R7	66.1
R8	64.4
R8	65.6
R10	62.4
R11	63.7
R12	63.7
R13	65.3
R14	64.1
R15	63.3
R16	62.8
R17	61.9
R18	61.6
R19	58.3
R20	62.0
R21	66.9
R22	65.8



Barrier B5 – L620m / H4m
Barrier B6-1 – L600m / H4m
Barrier B6-2 – L300m / H4m

Figure F-28: Portion 3

With Barrier / Day time

Receptor	dBA
L3	57.4
L4	63.9
L5	64.5
L6	55.9
L7	61.8
R7	63.5
R8	59.1
R8	57.3
R10	57.4
R11	56.4
R12	57.9
R13	58.3
R14	59.2
R15	59.1
R16	59.0
R17	58.7
R18	60.1
R19	57.8
R20	61.5
R21	66.5
R22	65.7

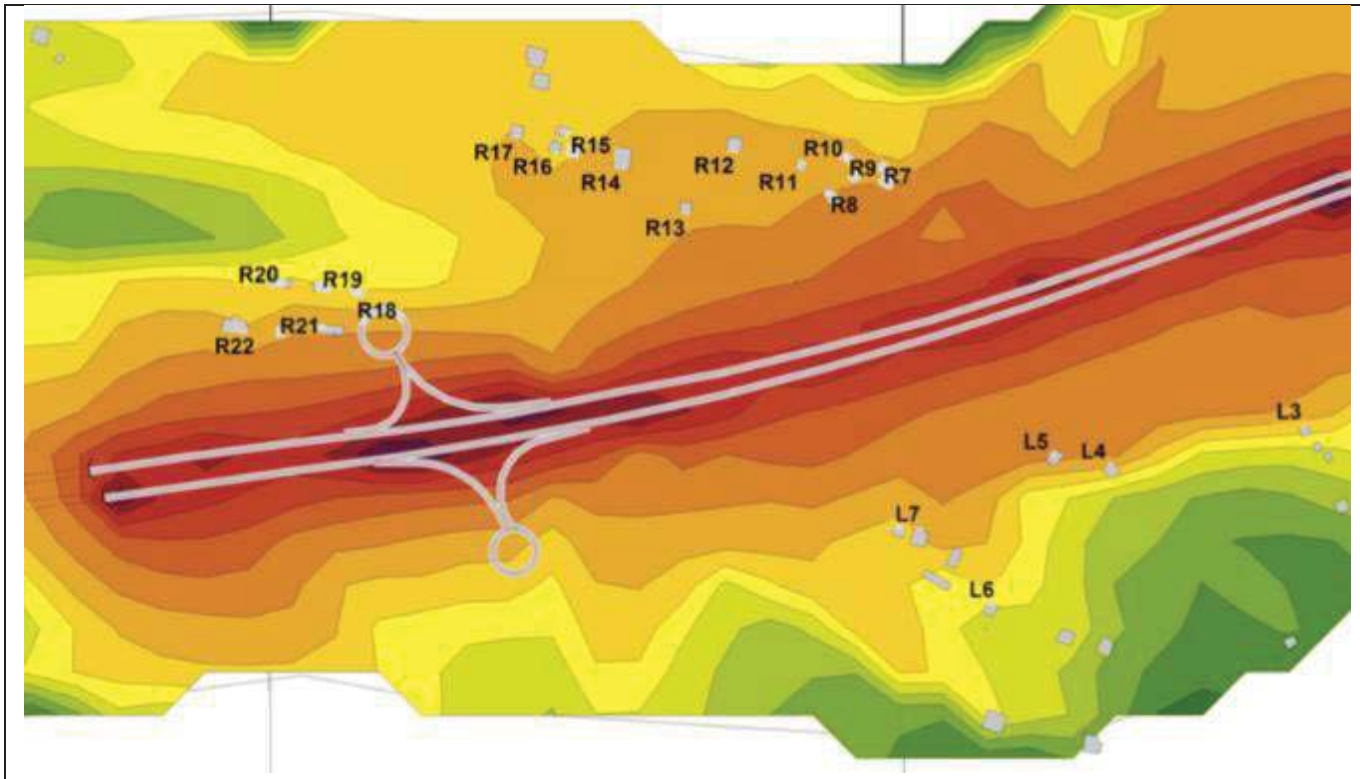
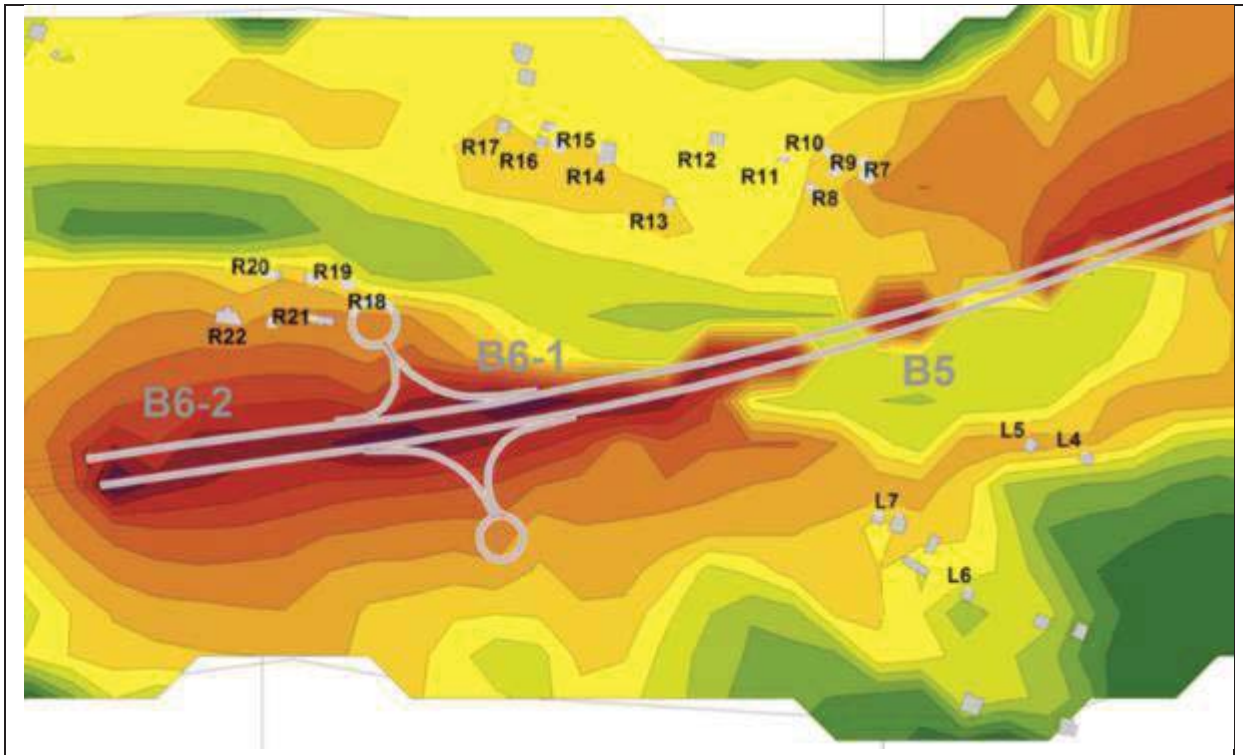


Figure F-29: Portion 3

Without Barrier / Nighttime

Receptor	dBA
L3	51.1
L4	56.7
L5	57.5
L6	49.9
L7	56.1
R7	58.0
R8	56.3
R8	57.6
R10	54.4
R11	55.7
R12	55.7
R13	57.3
R14	56.0
R15	55.3
R16	54.8
R17	53.9
R18	53.6
R19	50.3
R20	53.9
R21	58.8
R22	57.7



Barrier B5 – L620m / H4m
Barrier B6-1 – L600m / H4m
Barrier B6-2 – L300m / H4m

Portion 3 Conclusion: All receptors are above the IFC daytime and nighttime limits without noise abatement measures. However, application of the noise barrier does not bring noise levels below the IFC standards especially around the intersection. Receptors R7 to R17 are however within only 3-5 dBA of the limits if noise barrier B5 is employed.

Figure F-30: Portion 3

With Barrier / Nighttime

Receptor	dBA
L3	49.4
L4	55.9
L5	56.5
L6	47.9
L7	53.7
R7	55.5
R8	51.1
R8	49.2
R10	49.4
R11	48.3
R12	49.8
R13	50.2
R14	51.1
R15	51.0
R16	50.9
R17	50.6
R18	52.0
R19	49.8
R20	53.4
R21	58.4
R22	57.6

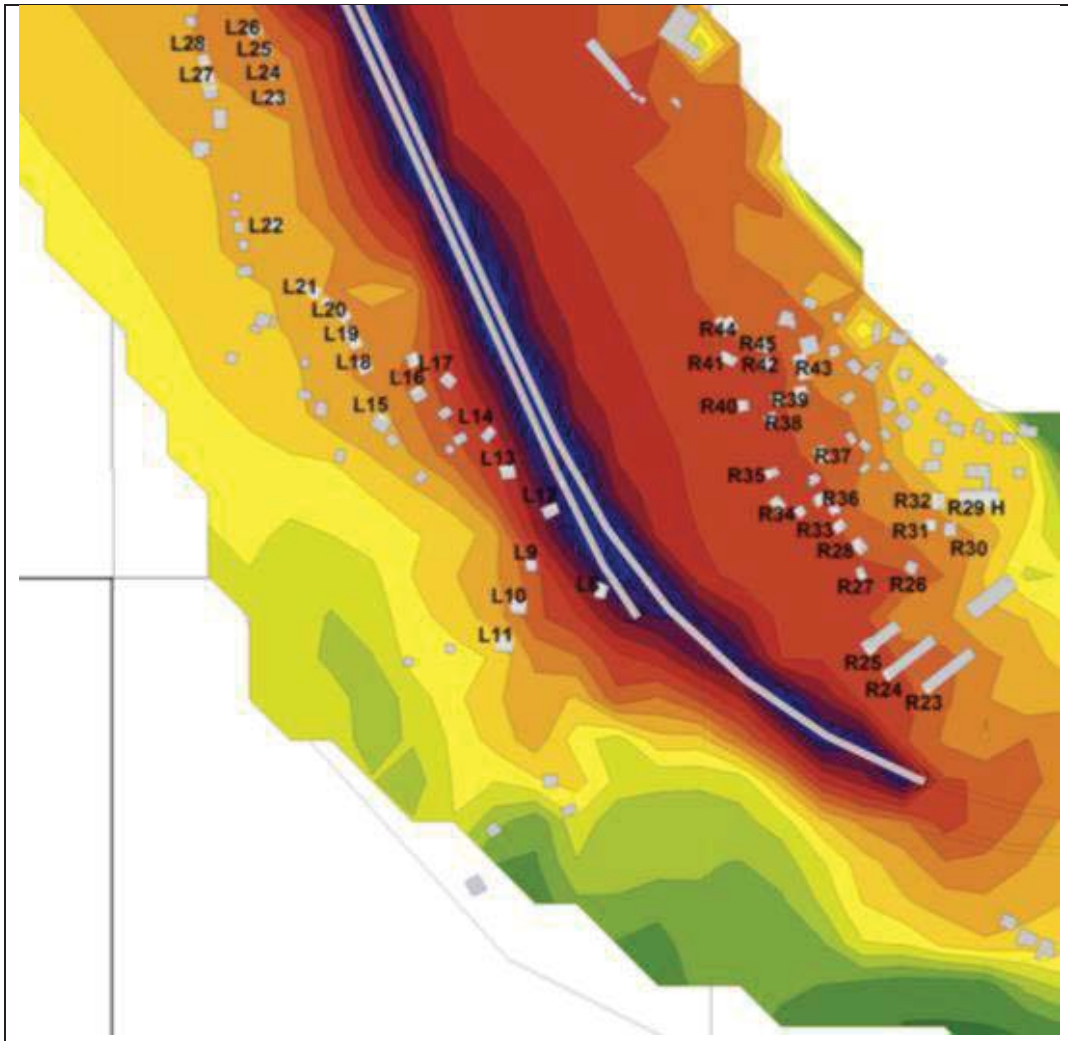


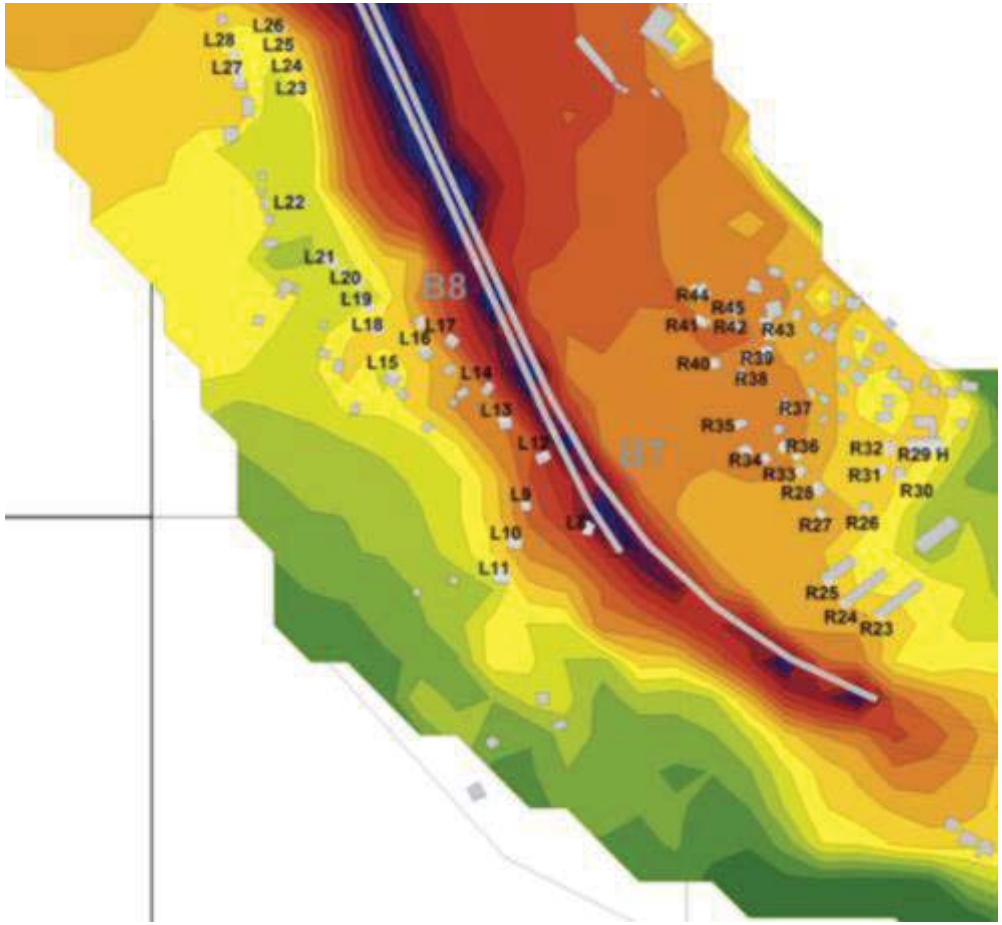
Figure F-31: Portion 4

Without Barrier / Day time

Receptor	dBA
L8*	77.0
L9	60.8
L10	59.7
L11	57.0
L12*	75.9
L13	69.0
L14	65.5
L15	50.2
L16	48.4
L17	58.7
L18	48.4
L19	46.8
L20	44.8
L21	42.9
L22	41.8
L23	47.2
L24	49.8
L25	49.4
L26	51.6
L27	41.3
L28	42.6
R23	61.7
R23	62.0

* To be expropriated

Receptor	dBA
R24	62.5
R24	63.2
R24	63.5
R25	62.3
R25	63.2
R25	63.5
R26	60.6
R27	63.4
R28	62.7
R29 H	52.6
R29 H 1F	54.4
R30	56.0
R31	56.1
R32	51.9
R33	63.6
R34	64.0
R35	64.8
R36	63.6
R37	62.0
R38	63.1
R39	62.2
R40	64.6
R41	63.0
R42	62.4
R43	60.9
R44	64.0



Barrier B7 – L700m / H4m
Barrier B8 – L330m / H4m

Figure F-32: Portion 4

With Barrier / Day time

Receptor	dBA
L8*	57.3
L9	59.1
L10	56.0
L11	52.6
L12*	66.1
L13	61.6
L14	62.5
L15	49.3
L16	47.7
L17	57.6
L18	47.7
L19	45.8
L20	44.2
L21	42.2
L22	41.4
L23	46.6
L24	49.8
L25	49.3
L26	51.6
L27	41.3
L28	42.6
R23	54.4
R23	54.6

Receptor	dBA
R24	53.9
R24	54.6
R24	55.1
R25	53.4
R25	53.9
R25	54.5
R26	50.6
R27	54.1
R28	54.1
R29 H	45.3
R29 H 1F	46.6
R30	46.8
R31	47.6
R32	47.6
R33	56.2
R34	56.2
R35	58.4
R36	57.4
R37	57.1
R38	56.8
R39	58.3
R40	59.4
R41	57.5
R42	58.4
R43	57.9
R44	59.8

* To be expropriated

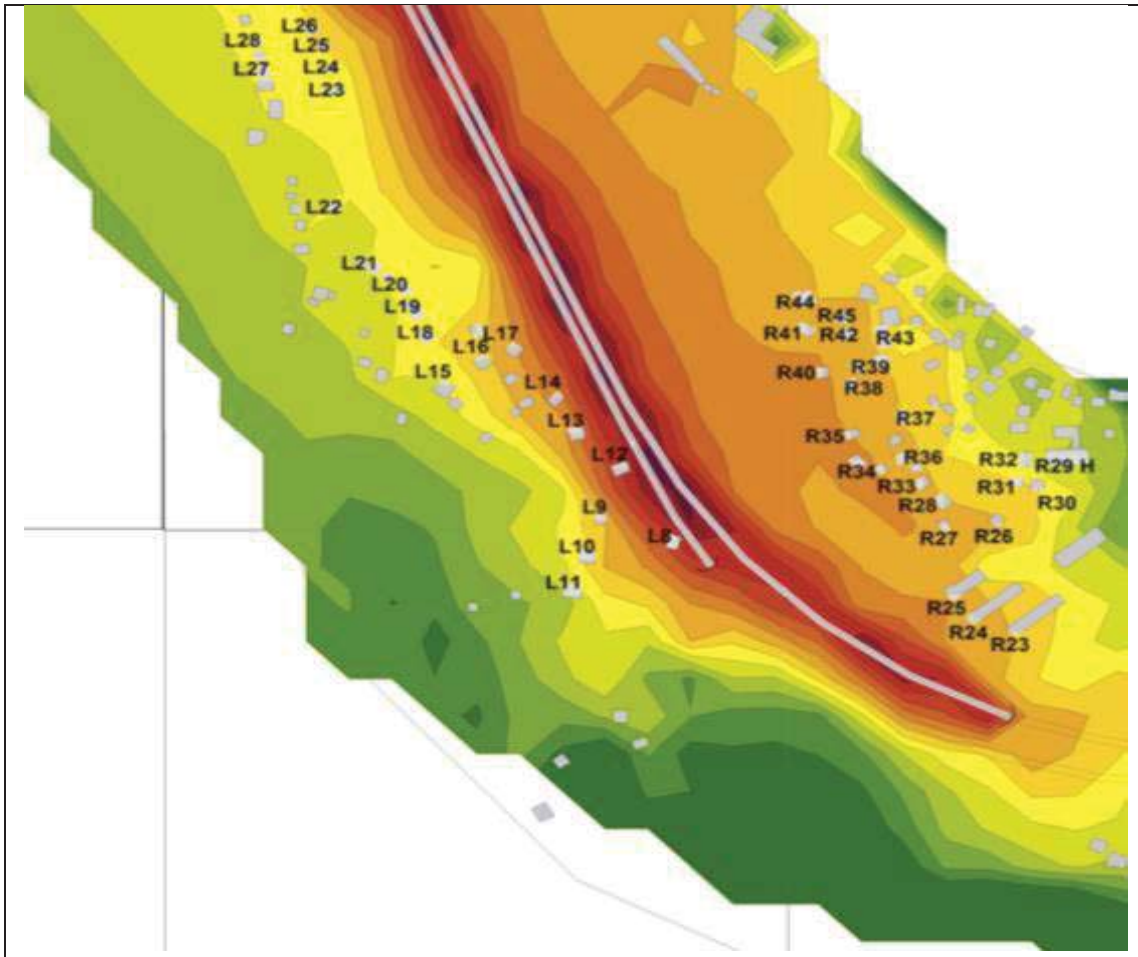


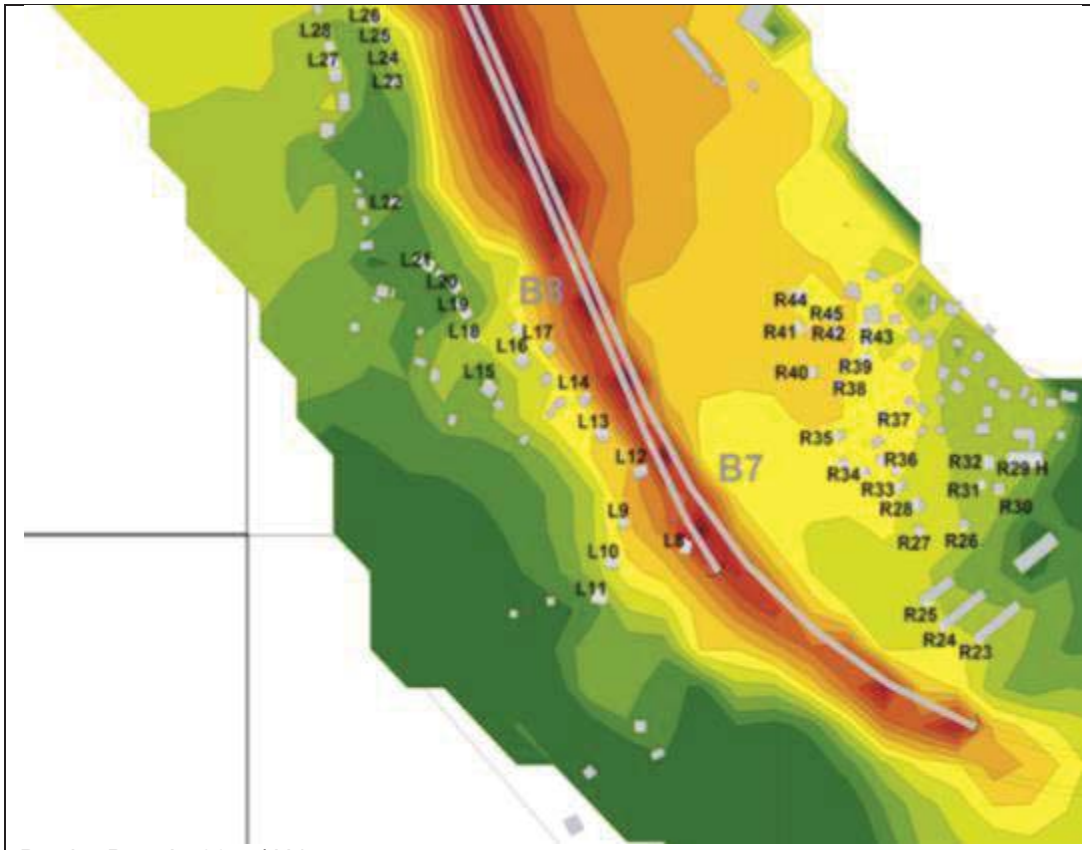
Figure F-33: Portion 4

Without Barrier / Nighttime

Receptor	dBA
L8*	69.0
L9	52.8
L10	51.6
L11	49.0
L12*	67.9
L13	61.0
L14	57.4
L15	42.1
L16	40.3
L17	50.7
L18	40.4
L19	38.8
L20	36.8
L21	34.9
L22	33.7
L23	39.1
L24	41.7
L25	41.4
L26	43.5
L27	33.2
L28	34.5
R23	53.6
R23	53.9

* To be expropriated

Receptor	dBA
R24	54.5
R24	55.1
R24	55.5
R25	54.3
R25	55.1
R25	55.5
R26	52.6
R27	55.4
R28	54.7
R29 H	44.5
R29 H 1F	46.4
R30	47.9
R31	48.1
R32	43.8
R33	55.5
R34	55.9
R35	56.8
R36	55.5
R37	53.9
R38	55.0
R39	54.2
R40	56.6
R41	55.0
R42	54.4
R43	52.9
R44	55.9



Barrier B7 – L700m / H4m
Barrier B8 – L330m / H4m

Portion 4 Conclusion: Only 5 receptors out of the 21 on the left hand side of the road require noise abatement measures (L9,L10,L13,L14 & L17), all other receptors are below the IFC guideline limits in all scenarios. The situation on the right side is a little different. Noise abatement has a very positive impact on receptors R23 to R34. However, after the noise barrier is not able to reduce noise levels below IFC guideline limits.

Figure F-34: Portion 4

With Barrier / Nighttime

Receptor	dBA
L8*	49.3
L9	51.1
L10	48.0
L11	44.6
L12*	58.1
L13	53.5
L14	54.5
L15	41.3
L16	39.6
L17	49.5
L18	39.7
L19	37.8
L20	36.1
L21	34.2
L22	33.3
L23	38.5
L24	41.7
L25	41.3
L26	43.5
L27	33.2
L28	34.5
R23	46.4
R23	46.6

* To be expropriated

Receptor	dBA
R24	45.9
R24	46.5
R24	47.1
R25	45.3
R25	45.9
R25	46.5
R26	42.6
R27	46.0
R28	46.0
R29 H	37.3
R29 H 1F	38.6
R30	38.7
R31	39.5
R32	39.5
R33	48.2
R34	48.2
R35	50.4
R36	49.3
R37	49.1
R38	48.8
R39	50.3
R40	51.4
R41	49.5
R42	50.3
R43	49.9
R44	51.7

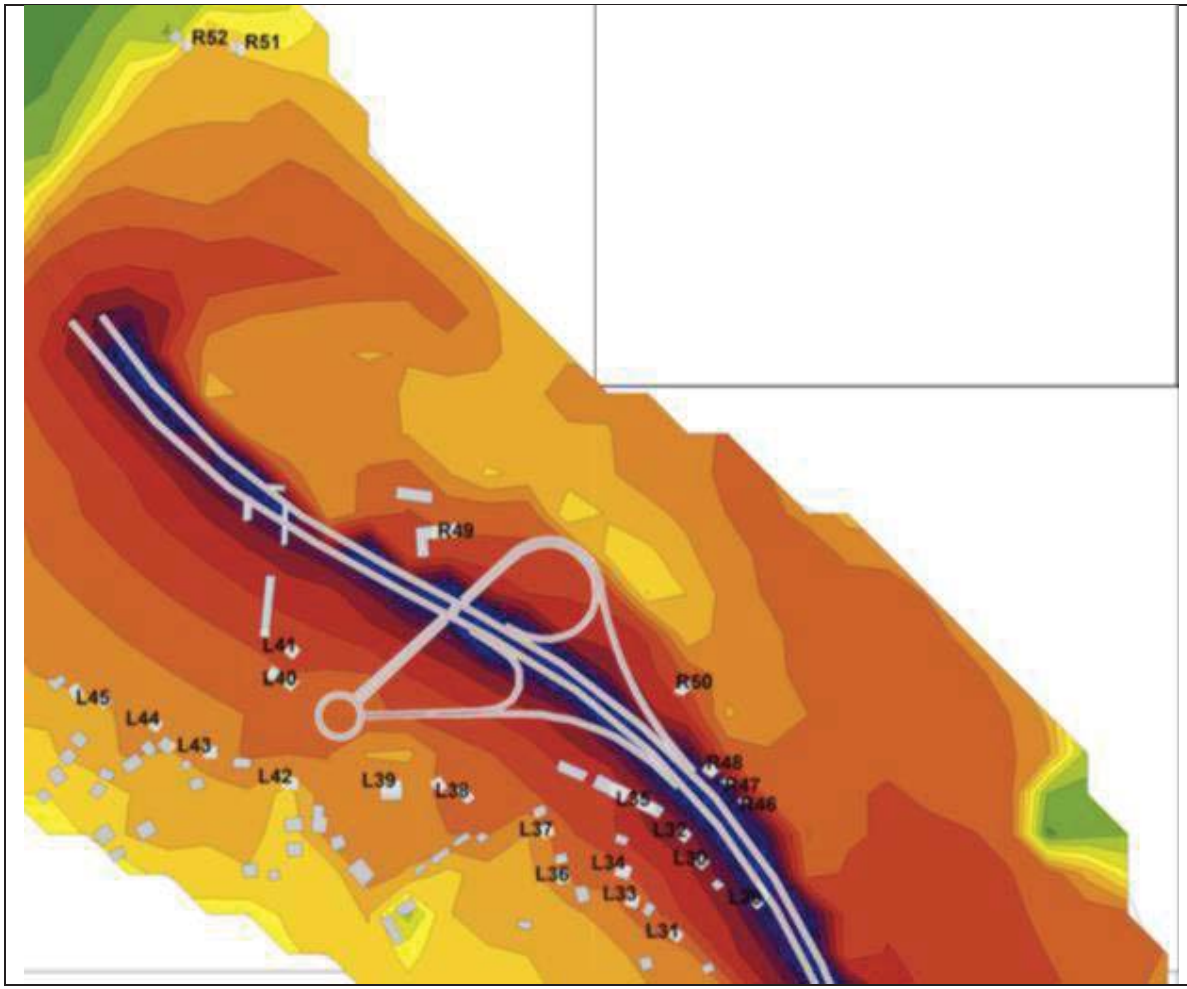


Figure F-35: Portion 5

Without Barrier / Day time

Receptor	dBA
L29	53.2
L30	73.2
L31	60.2
L32	73.9
L33	58.6
L34	60.9
L35	68.2
L36	58.7
L37	60.4
L38	62.4
L39	61.9
L40**	64.7
L41**	66.0
L42	63.3
L43	62.5
L44	61.4
L45	61.9

** Commercial

Receptor	dBA
R46*	73.6
R47*	70.5
R48*	70.4
R49*	60.7
R50*	63.1
R51	55.1
R52	54.7

* Subject to expropriation

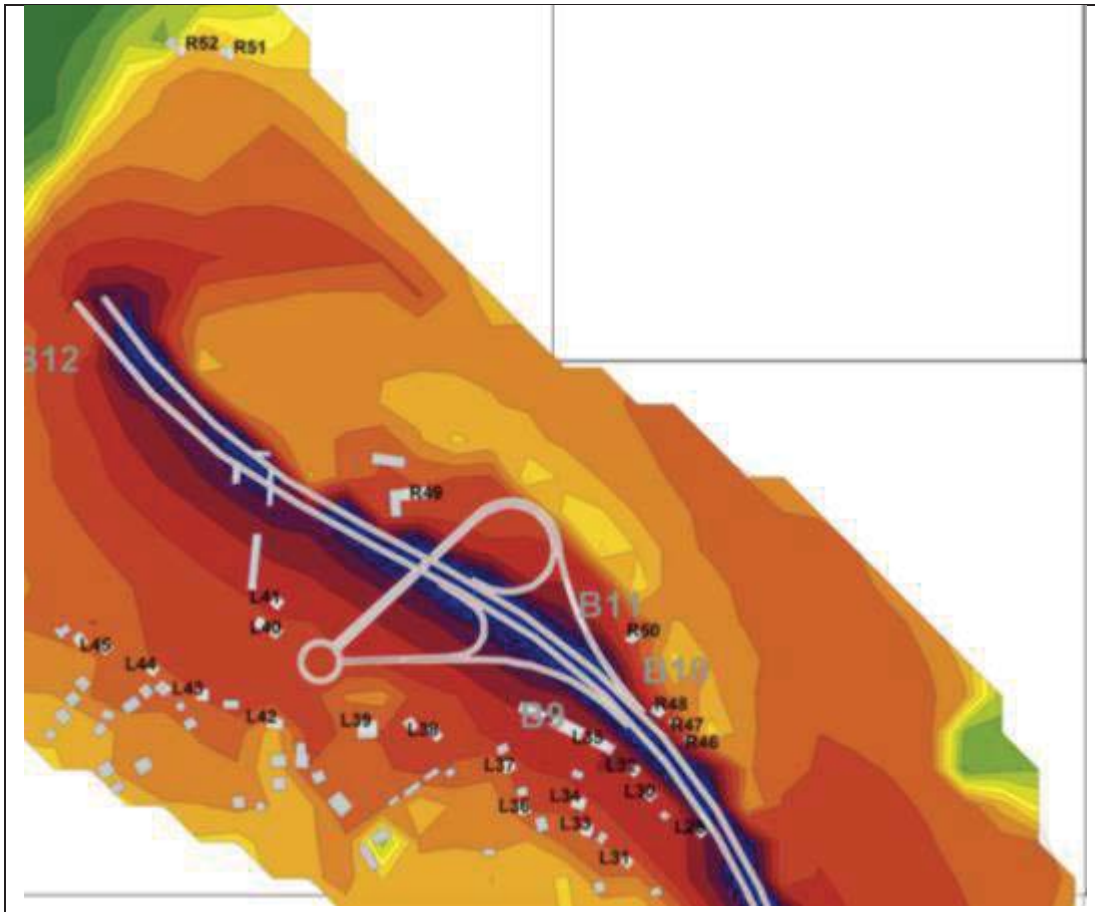


Figure F-36: Portion 5

With Barrier / Day time

Receptor	dBA
L29	52.9
L30	67.8
L31	60.2
L32	67.1
L33	58.6
L34	60.8
L35	61.6
L36	58.7
L37	60.4
L38	62.4
L39	61.9
L40**	64.7
L41**	66.0
L42	63.1
L43	62.4
L44	61.3
L45	61.6

**Commercial

Receptor	dBA
R46*	63.4
R47*	59.2
R48*	59.5
R49*	60.7
R50*	59.3
R51	55.1
R52	54.7

* Subject to expropriation

Barrier B9 – L300m / H4m
Barrier B10 – L110m / H4m
Barrier B11 – L50m / H4m
Barrier 12 – L50m / H4m

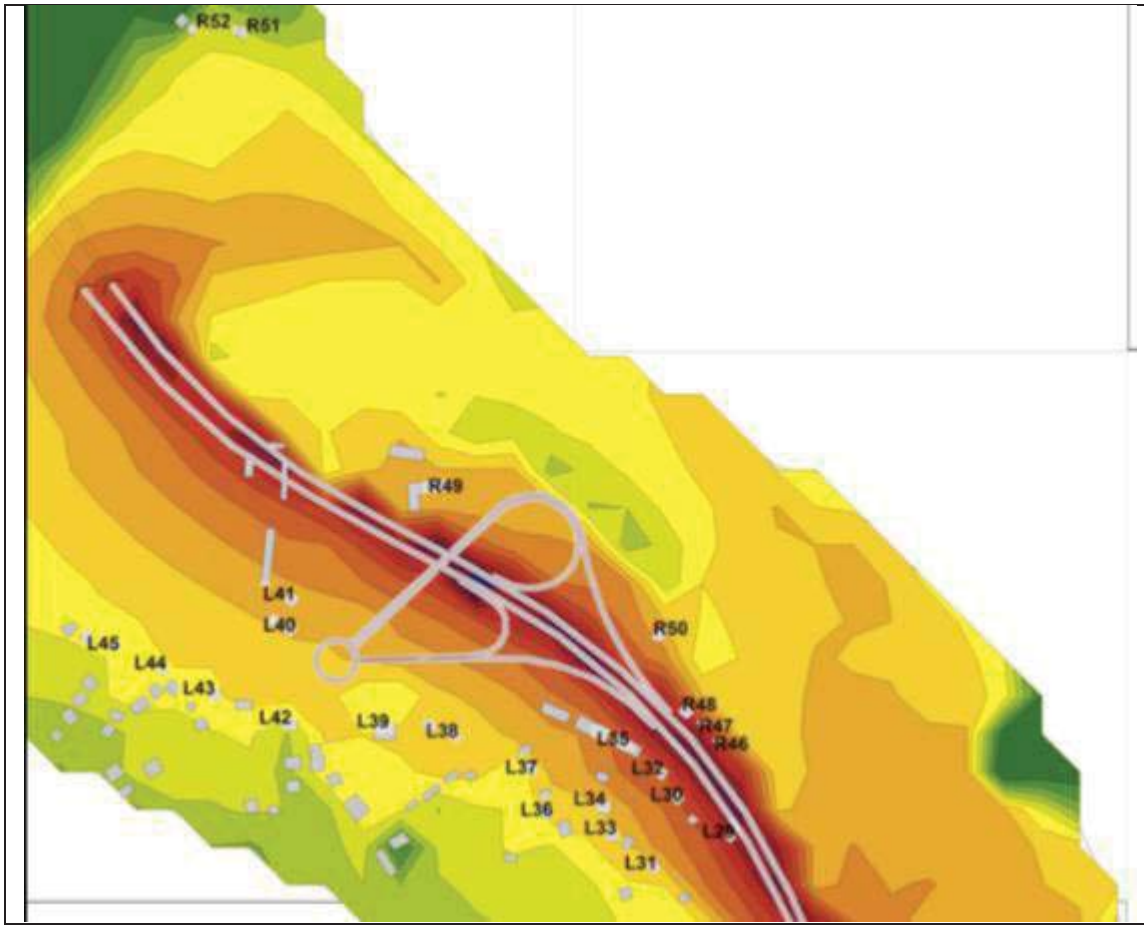


Figure F-37: Portion 5

Without Barrier / Nighttime

Receptor	dBA
L29	45.1
L30	65.2
L31	52.1
L32	65.9
L33	50.6
L34	52.8
L35	60.2
L36	50.6
L37	52.4
L38	54.4
L39	53.9
L40**	56.7
L41**	58.0
L42	55.2
L43	54.4
L44	53.4
L45	53.8

**Commercial

Receptor	dBA
R46*	65.5
R47*	62.5
R48*	62.4
R49*	52.6
R50*	55.1
R51	47.1
R52	46.6

* Subject to expropriation

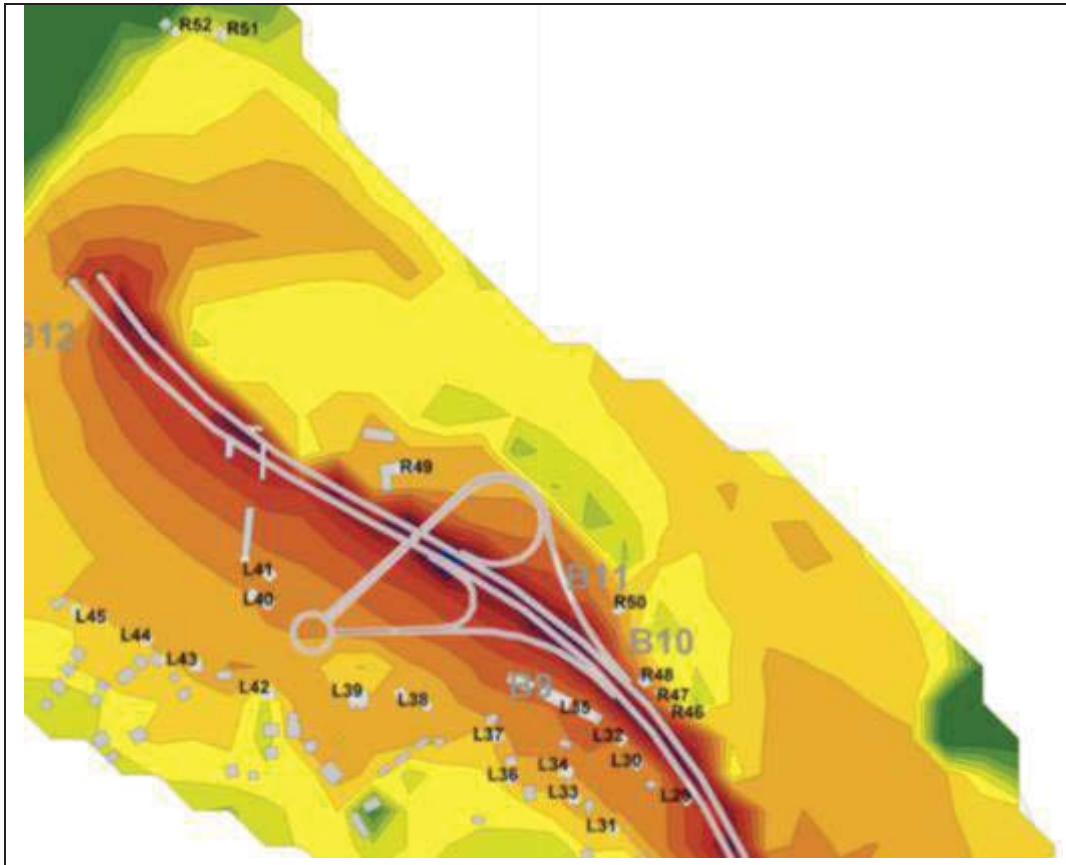


Figure F-38: Portion 5

With Barrier / Nighttime

Receptor	dBA
L29	44.8
L30	59.8
L31	52.1
L32	59.0
L33	50.6
L34	52.8
L35	53.6
L36	50.6
L37	52.4
L38	54.4
L39	53.9
L40**	56.7
L41**	58.0
L42	55.1
L43	54.3
L44	53.2
L45	53.6

**Commercial

Receptor	dBA
R46*	55.4
R47*	51.1
R48*	51.4
R49*	52.6
R50*	51.3
R51	47.0
R52	46.6

* Subject to expropriation

Barrier B9 – L300m / H4m
Barrier B10 – L110m / H4m
Barrier B11 – L50m / H4m
Barrier B12 – L50m / H4m

Portion 5 Conclusion: All receptors on the right side of the road (except R51 and R52) will be expropriated. Noise levels at R51 and R52 only just exceed IFC guideline limits with the noise barrier having almost no noise reduction impact on these properties. All receptors are subject to noise levels above IFC guideline limits in all scenarios.

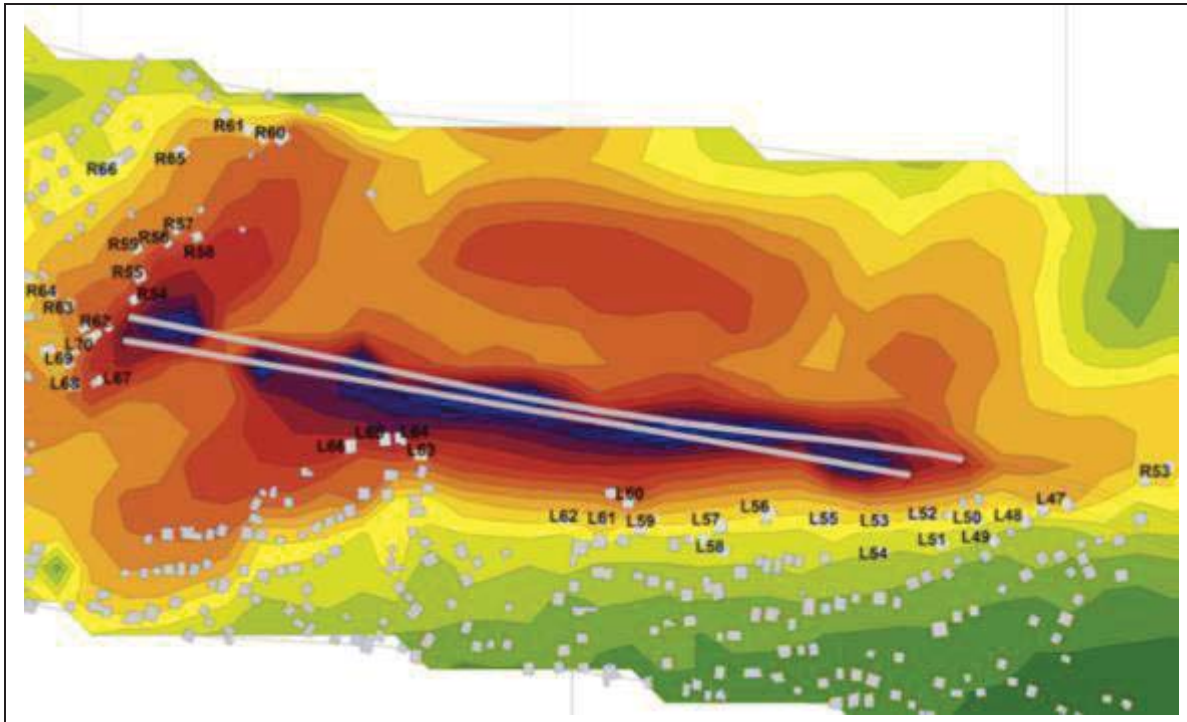
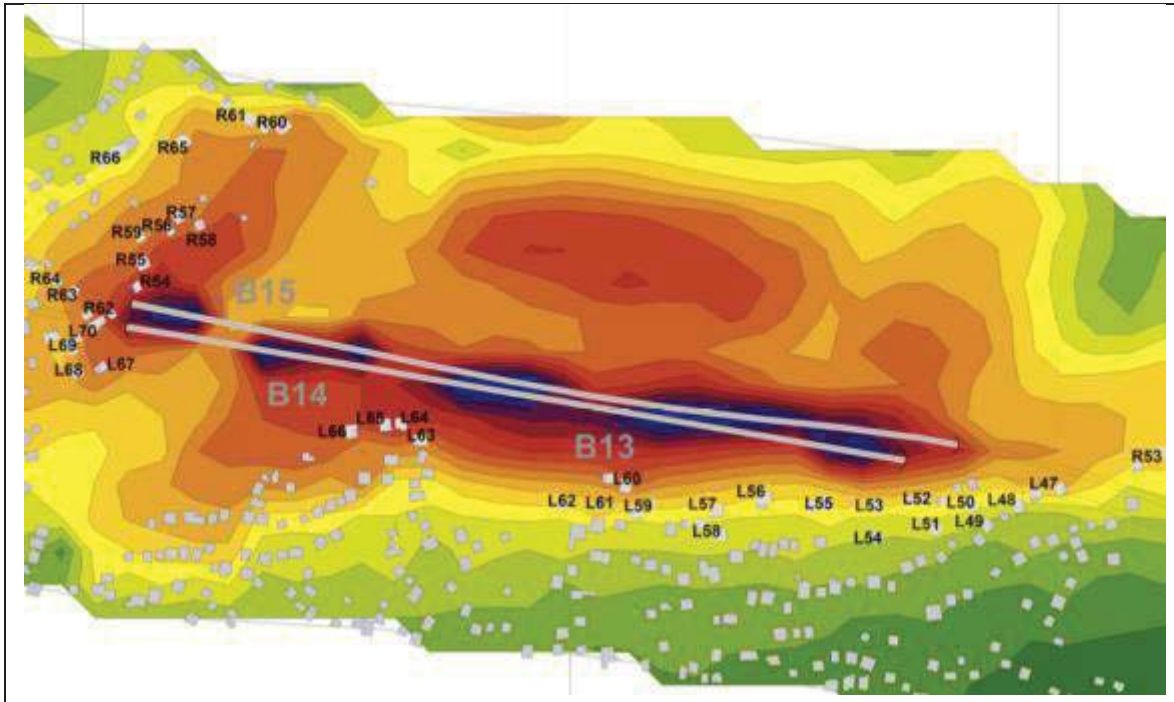


Figure F-39: Portion 6

Without Barrier / Day time

L47	51.0
L48	43.7
L49	41.9
L50	39.0
L51	40.0
L52	44.2
L53	49.1
L54	40.7
L55	49.1
L56	49.3
L57	46.4
L58	44.6
L59	46.6
L60	54.4
L61	47.9
L62	47.6
L63	61.9
L64	68.2
L65	67.5
L66	66.6
L67	64.7
L68	55.3
L69	62.2
L70	64.3

R53	51.7
R54	70.1
R55	66.3
R56	62.6
R57	60.7
R58	64.9
R59	60.4
R60	60.5
R60	58.4
R61	52.9
R61	53.2
R62	67.3
R63	57.4
R64	54.1
R65	51.5
R66	44.8



Barrier B13 – L170m / H4m
Barrier B14 – L280m / H4m
Barrier B15 – L310m / H4m

Figure F-40: Portion 6

With Barrier / Day time

L47	51.0
L48	43.7
L49	41.9
L50	39.0
L51	40.0
L52	44.2
L53	49.1
L54	40.7
L55	49.1
L56	49.1
L57	46.4
L58	44.6
L59	46.6
L60	53.7
L61	47.9
L62	47.5
L63	57.9
L64	63.3
L65	62.7
L66	62.8
L67	57.7
L68	52.0
L69	60.3
L70	63.4

R53	51.6
R54	69.2
R55	64.5
R56	61.6
R57	59.7
R58	63.2
R59	59.9
R60	58.0
R60	56.0
R61	52.9
R61	52.4
R62	67.1
R63	57.4
R64	54.1
R65	51.5
R66	44.8
R66	50.1

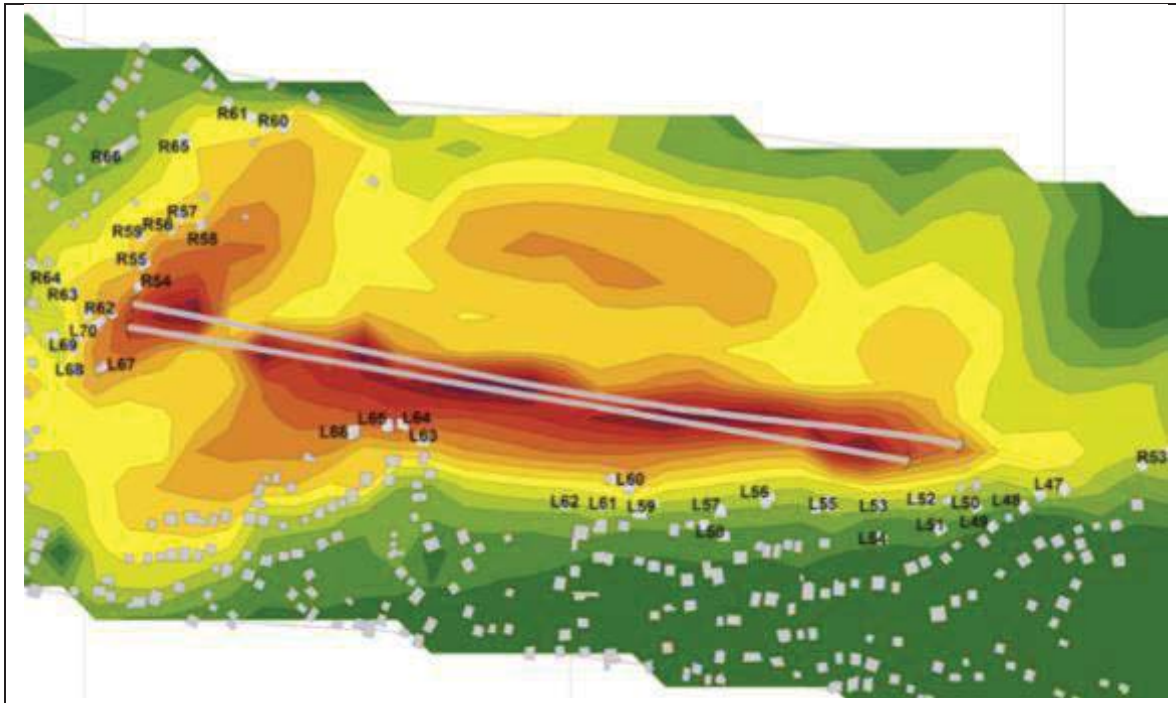
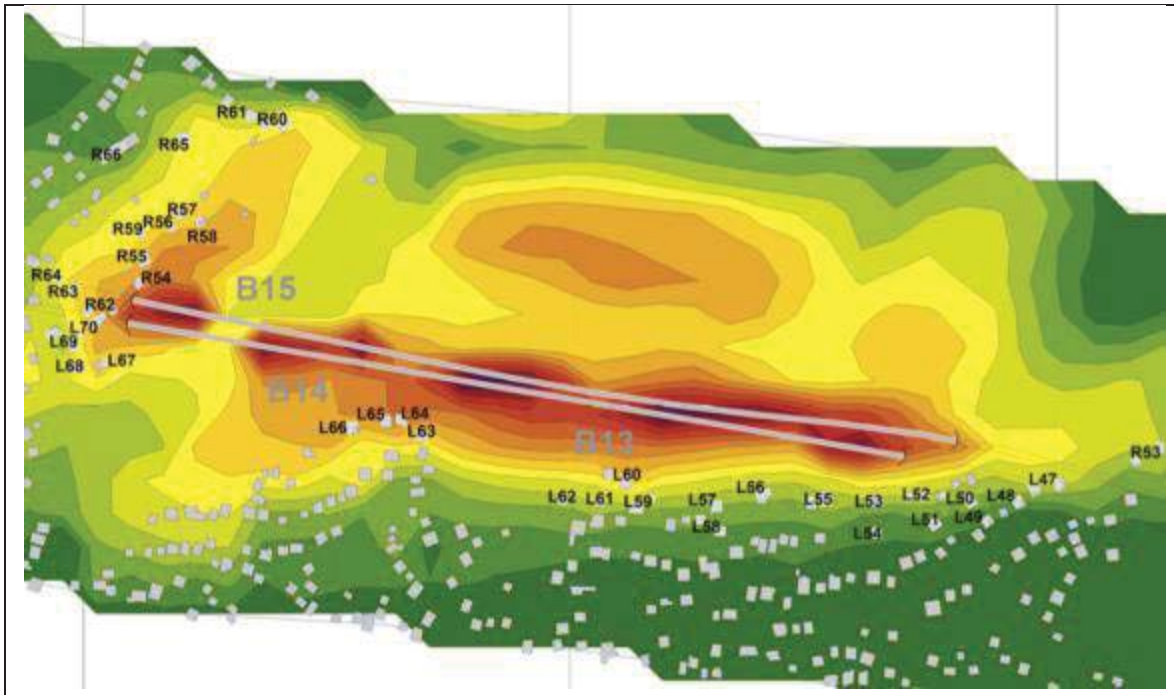


Figure F-41: Portion 6

Without Barrier / Nighttime

L47	42.9
L48	35.7
L49	33.8
L50	30.9
L51	32.0
L52	36.2
L53	41.0
L54	32.7
L55	41.1
L56	41.3
L57	38.3
L58	36.5
L59	38.6
L60	46.4
L61	39.8
L62	39.5
L63	53.9
L64	60.1
L65	59.4
L66	58.5
L67	56.7
L68	47.3
L69	54.1
L70	56.3

R53	43.7
R54	62.1
R55	58.2
R56	54.6
R57	52.7
R58	56.9
R59	52.4
R60	52.5
R60	50.4
R61	44.9
R61	45.1
R62	59.2
R63	49.3
R64	46.0
R65	43.4
R66	36.8



Barrier B13 – L170m / H4m
Barrier B14 – L280m / H4m
Barrier B15 – L310m / H4m

Portion 6 Conclusion: Noise levels with and without noise abatement are broadly similar with around half of the receptors being exposed to elevated noise levels regardless of the scenario.

Figure F-42: Portion 6

With Barrier / Nighttime

L47	42.9
L48	35.7
L49	33.8
L50	30.9
L51	32.0
L52	36.2
L53	41.0
L54	32.7
L55	41.1
L56	41.3
L57	38.3
L58	36.5
L59	38.6
L60	45.6
L61	39.8
L62	39.5
L63	49.9
L64	55.3
L65	54.7
L66	54.7
L67	49.6
L68	43.9
L69	52.3
L70	55.4

R53	43.5
R54	61.1
R55	56.5
R56	53.6
R57	51.7
R58	55.2
R59	51.9
R60	50.0
R60	47.9
R61	44.9
R61	44.3
R62	59.1
R63	49.3
R64	46.0
R65	43.4
R66	36.8
R66	42.1

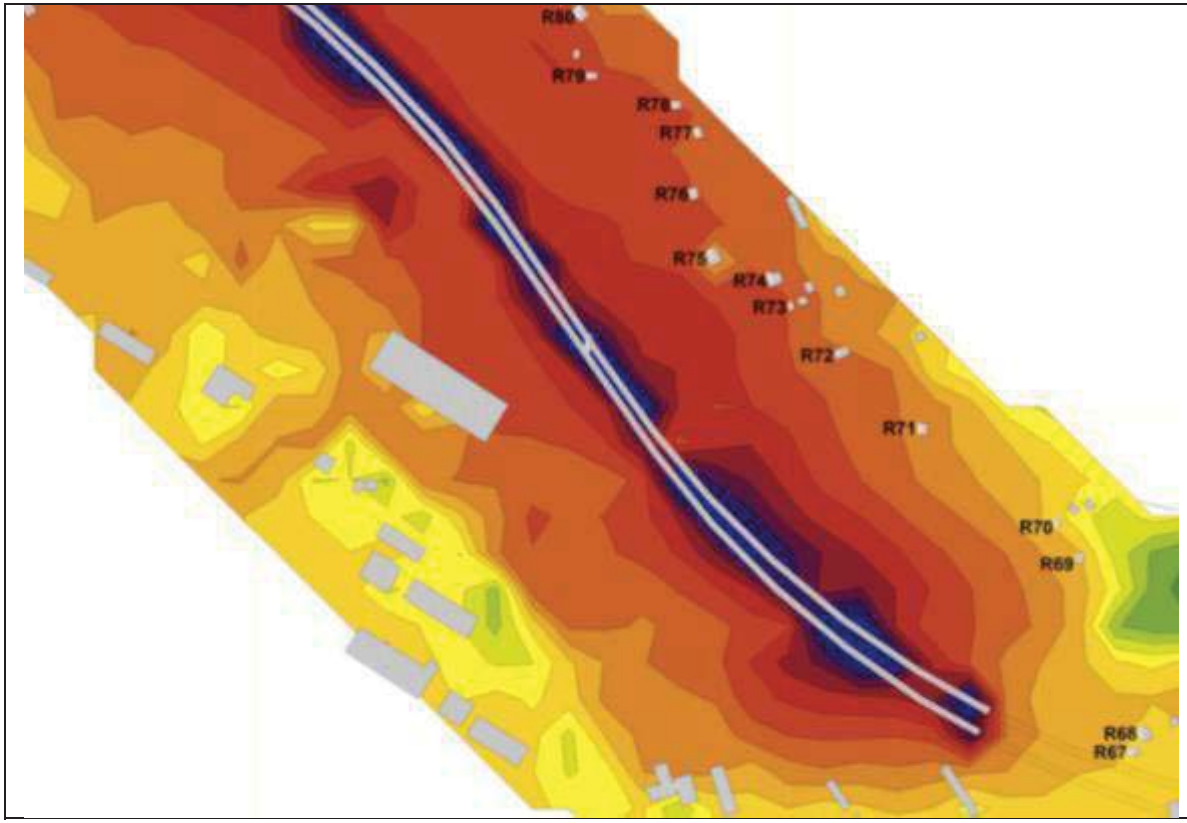


Figure F-43: Portion 7

Without Barrier / Day time

R67	52.0
R68	53.0
R69	49.8
R70	50.3
R71	56.7
R72	59.4
R73	61.4
R74	60.9
R75	63.7
R76	61.8
R77	61.5
R78	61.9
R79	62.8
R80	58.9

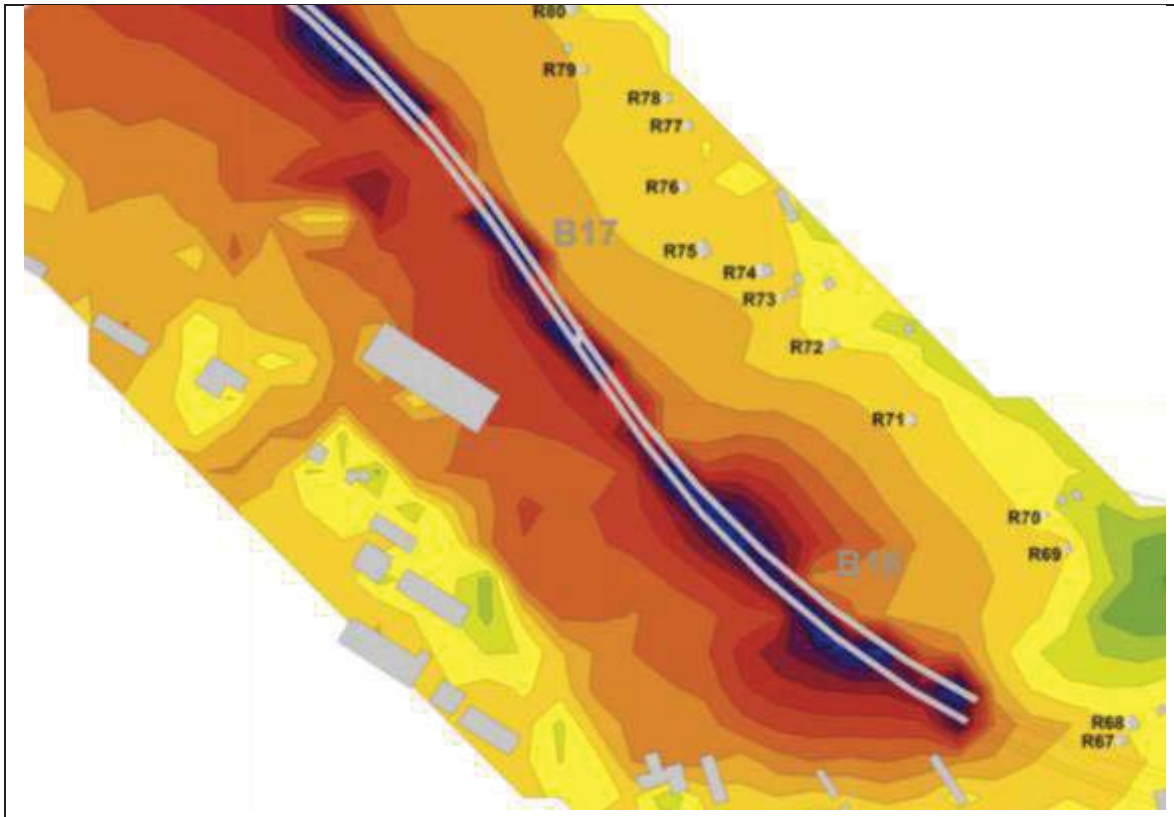


Figure F-44: Portion 7

With Barrier / Day time

R67	49.7
R68	49.2
R69	47.3
R70	48.0
R71	50.5
R72	49.6
R73	51.2
R74	50.2
R75	51.9
R76	50.6
R77	50.7
R78	50.6
R79	52.6
R80	50.6

Barrier B16 – L290m / H4m
Barrier B17 – L680m / H4m

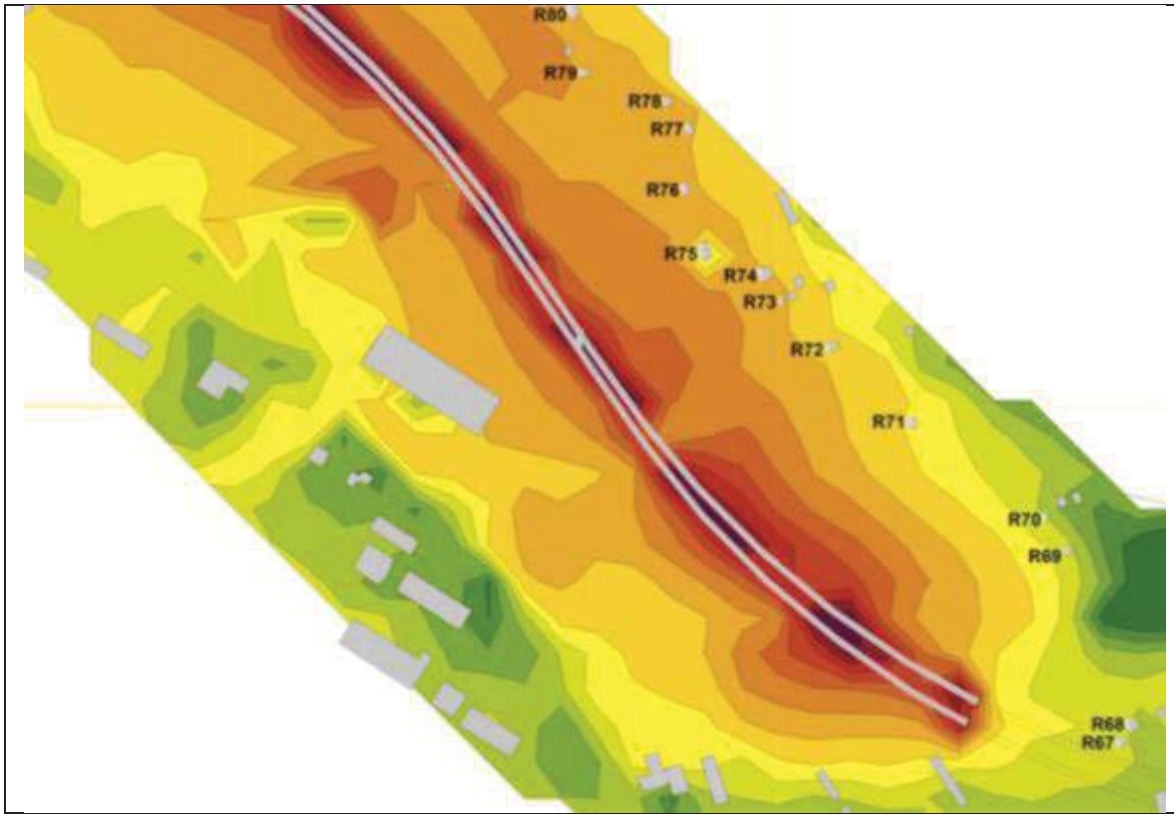


Figure F-45: Portion 7

Without Barrier / Nighttime

R67	52.0
R68	53.0
R69	49.8
R70	50.3
R71	56.7
R72	59.4
R73	61.4
R74	60.9
R75	63.7
R76	61.8
R77	61.5
R78	61.9
R79	62.8
R80	58.9

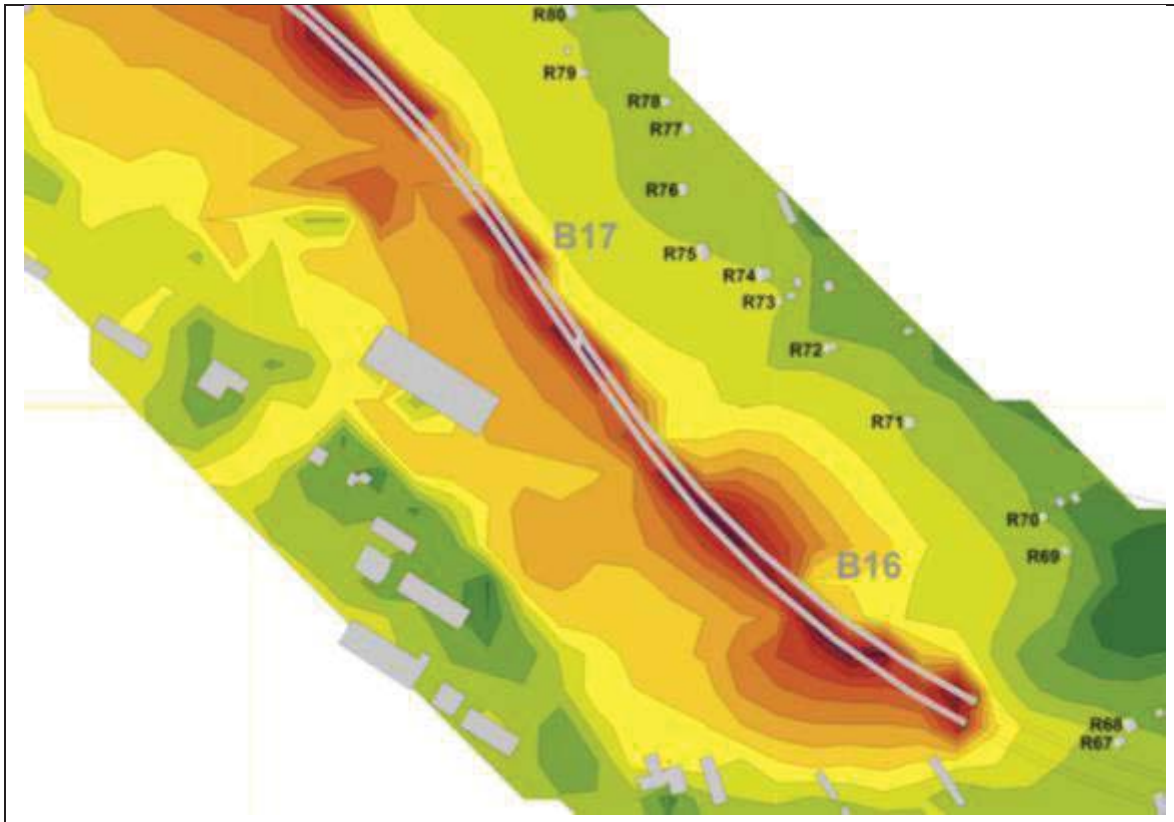


Figure F-46: Portion 7

With Barrier / Nighttime

R67	41.7
R68	41.1
R69	39.3
R70	40.0
R71	42.5
R72	41.5
R73	43.2
R74	42.2
R75	43.8
R76	42.6
R77	42.6
R78	42.5
R79	44.6
R80	42.6

Barrier B16 – L290m / H4m
Barrier B17 – L680m / H4m

Portion 7 Conclusion: Most receptors are affected by elevated noise without abatement measures in place. However, the noise barrier scenario provides extremely effective noise reduction reducing noise levels at all receptors below IFC guideline limits.

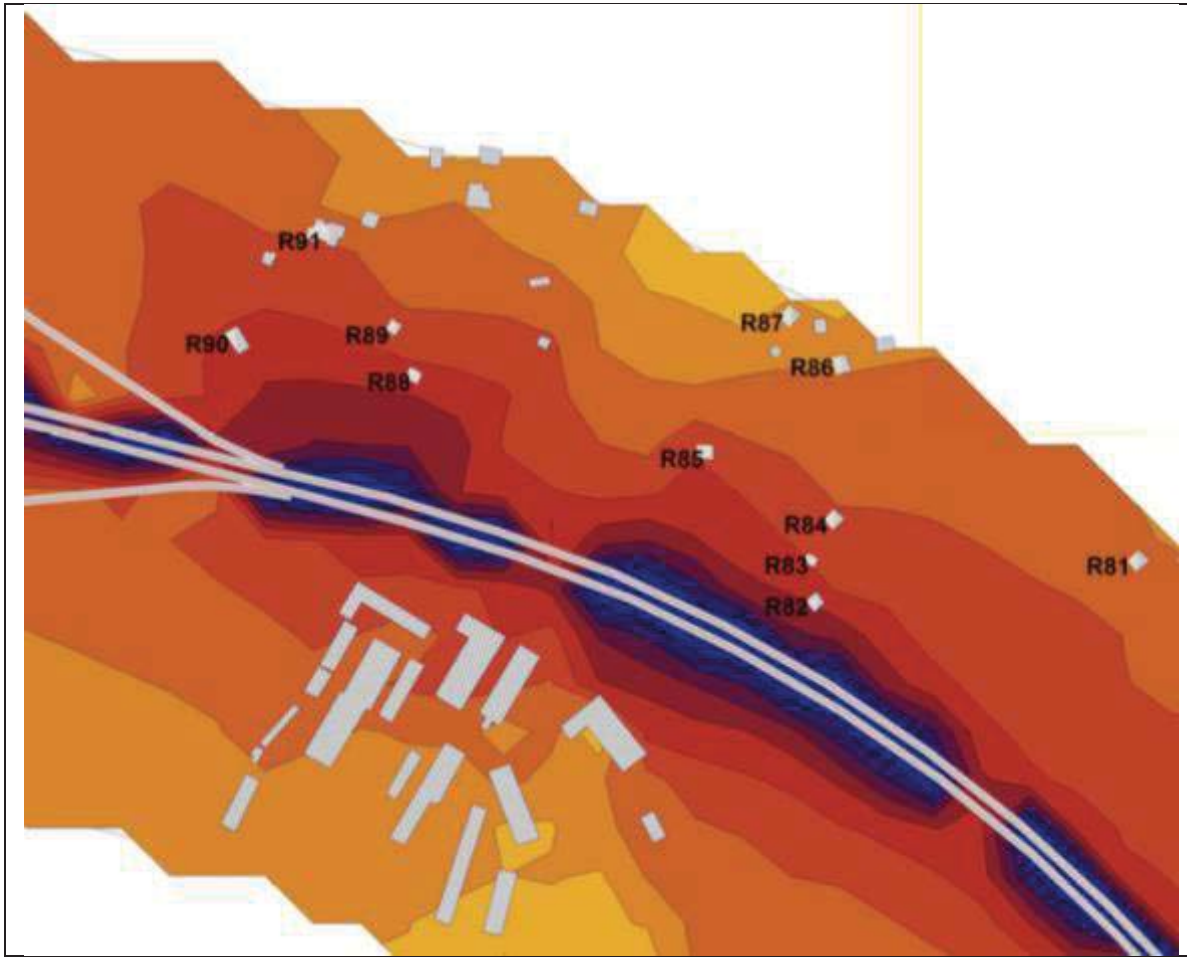
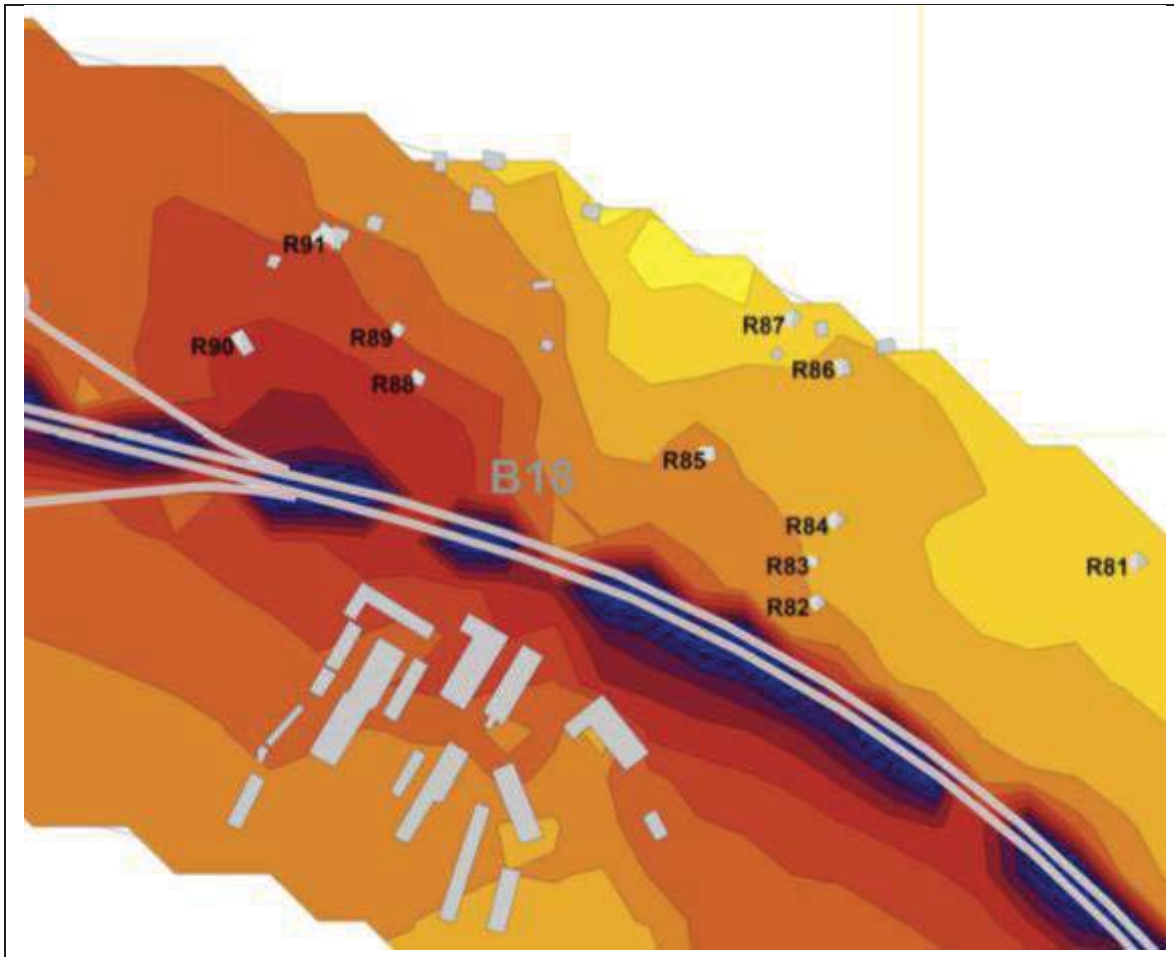


Figure F-47: Portion 8

Without Barrier / Day time

R81	61.2
R82	65.8
R83	63.5
R84	60.9
R85	61.4
R86	58.5
R88	65.8
R89	62.5
R90	64.9
R91	56.8



Barrier B18 – L1000m / H4m

Figure F-48: Portion 8

With Barrier / Day time

R81	51.9
R82	54.8
R83	54.6
R84	53.6
R85	55.2
R86	53.5
R88	63.3
R89	61.5
R90	64.8
R91	56.2

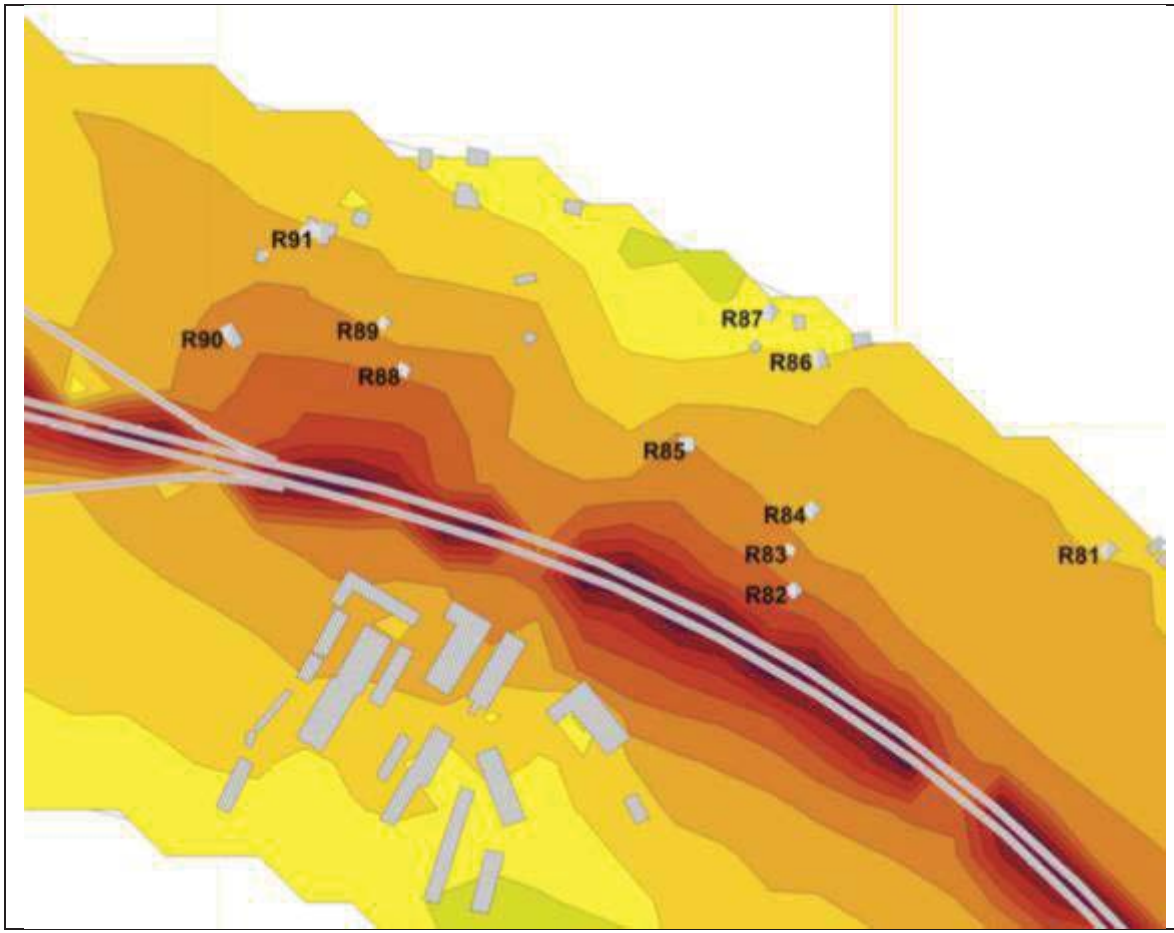


Figure F-49: Portion 8

Without Barrier / Nighttime

R81	53.1
R82	57.7
R83	55.5
R84	52.9
R85	53.3
R86	50.5
R88	57.8
R89	54.5
R90	56.8
R91	48.8

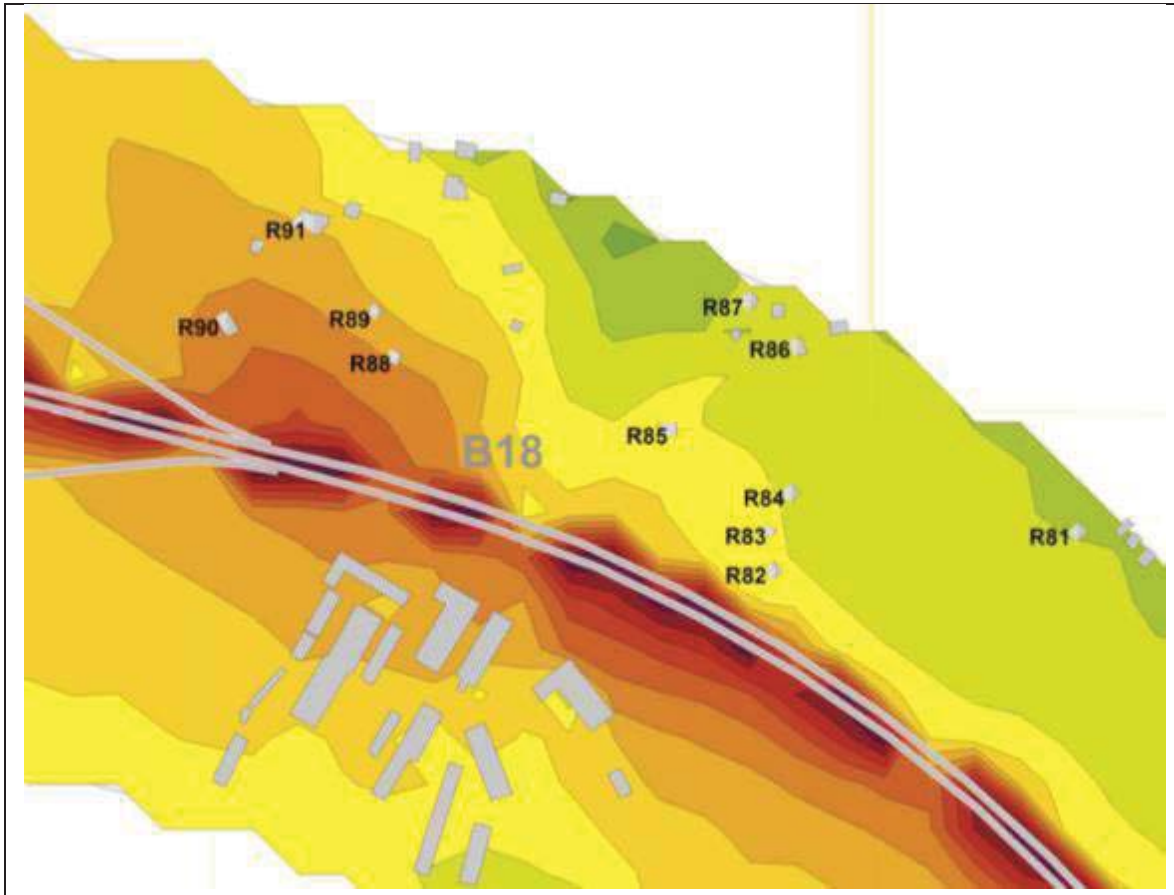


Figure F-50: Portion 8

With Barrier / Nighttime

R81	43.8
R82	46.8
R83	46.6
R84	45.5
R85	47.2
R86	45.5
R88	55.3
R89	53.4
R90	56.8
R91	48.1

Barrier B18 – L1000m / H4m

Portion 8 Conclusion: All receptors are impacted by elevated noise levels without noise abatement. Noise barriers have a positive effect in the first half of this portion, but little effect close to the interchange.

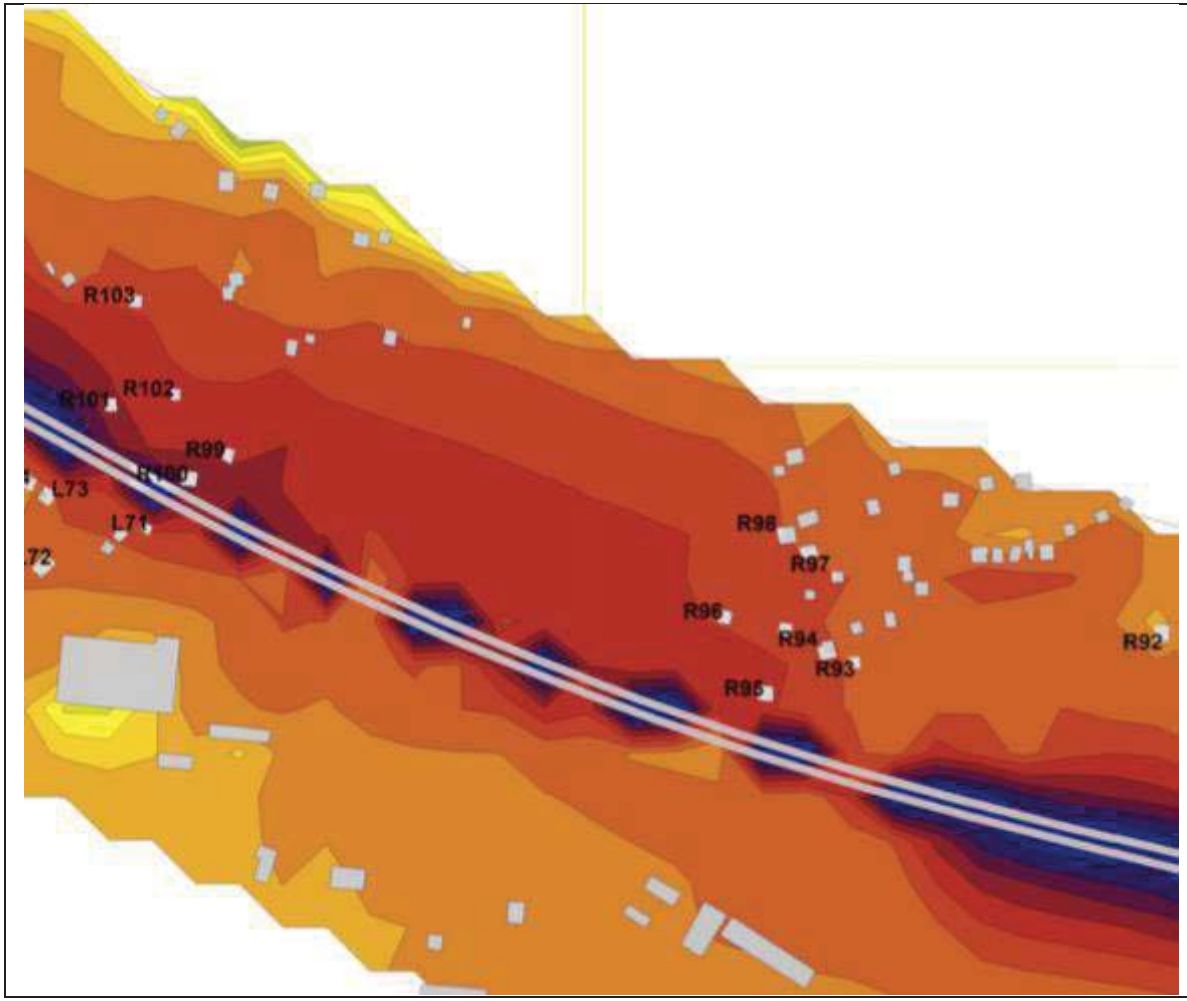


Figure F-51: Portion 9

Without Barrier / Day time

L71	62.3
L72	58.9
L73	62.1
R92	58.9
R93	62.9
R94	63.6
R95	66.0
R96	64.6
R97	62.9
R98	62.0
R99	67.8
R100	63.8
R101	67.8
R102	66.2
R103	63.9

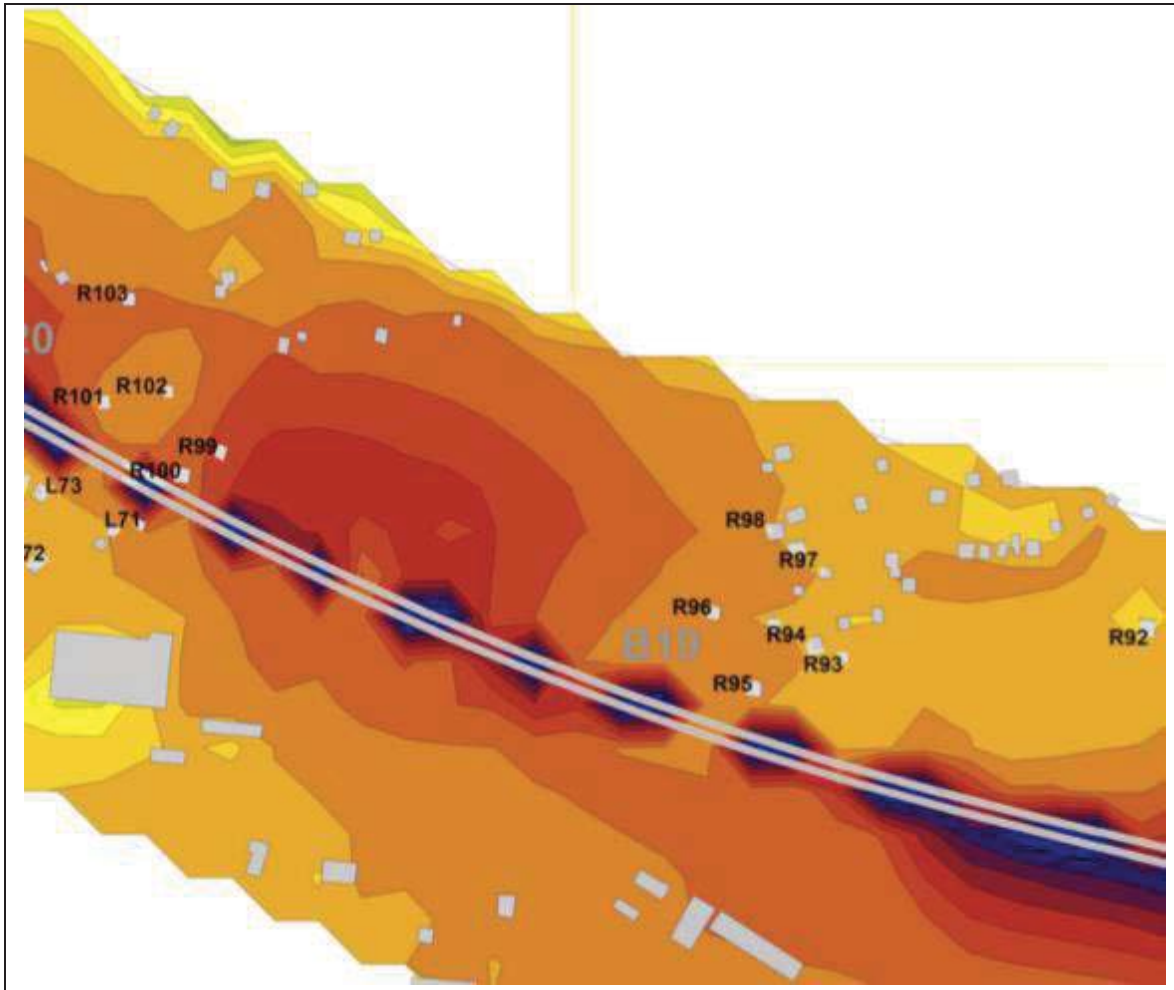


Figure F-52: Portion 9

With Barrier / Day time

L71	55.9
L72	53.4
L73	54.4
R92	54.3
R93	55.3
R94	55.2
R95	56.0
R96	56.3
R97	54.3
R98	54.6
R99	62.8
R100	57.5
R101	57.7
R102	57.9
R103	58.6

Barrier B19 – L380m / H4m

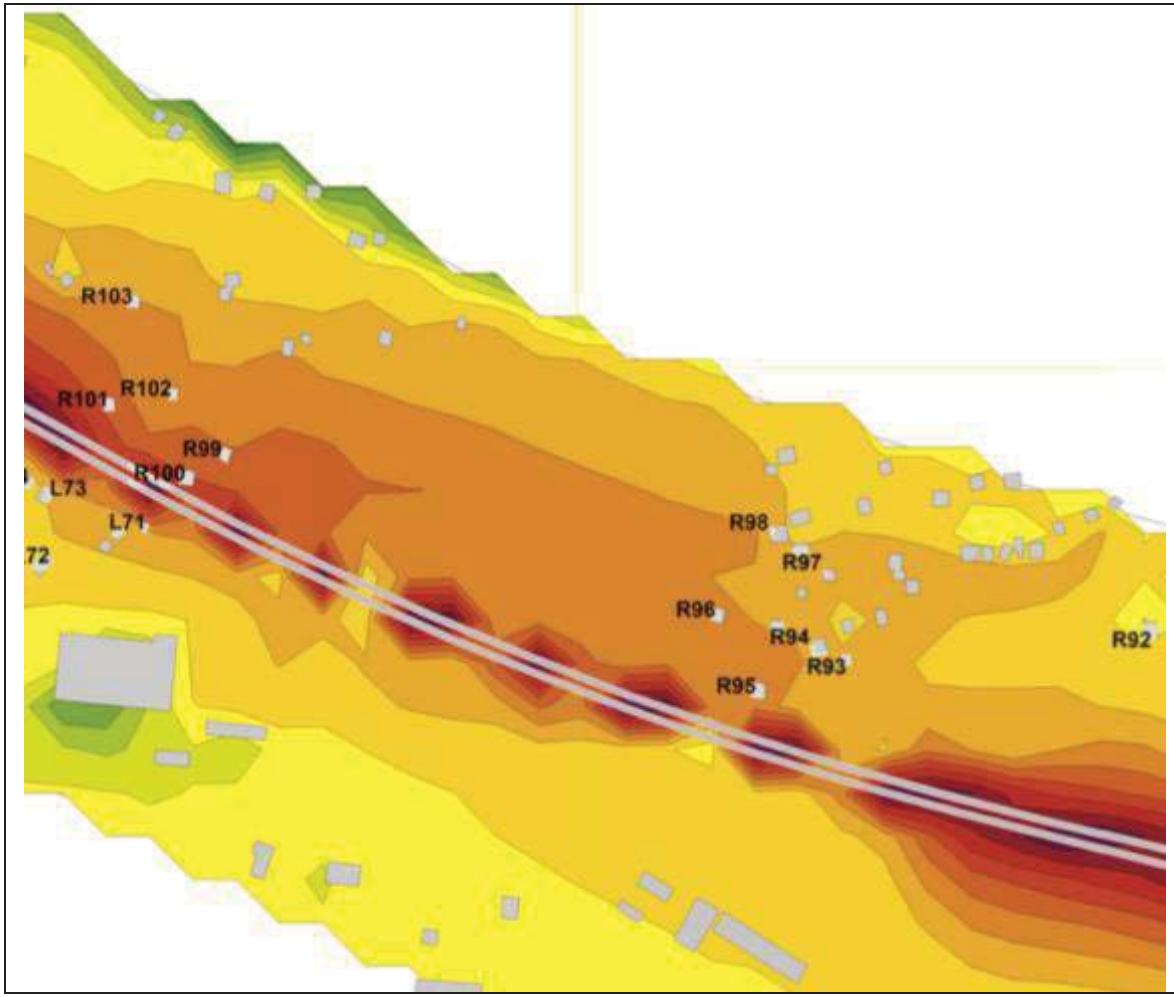
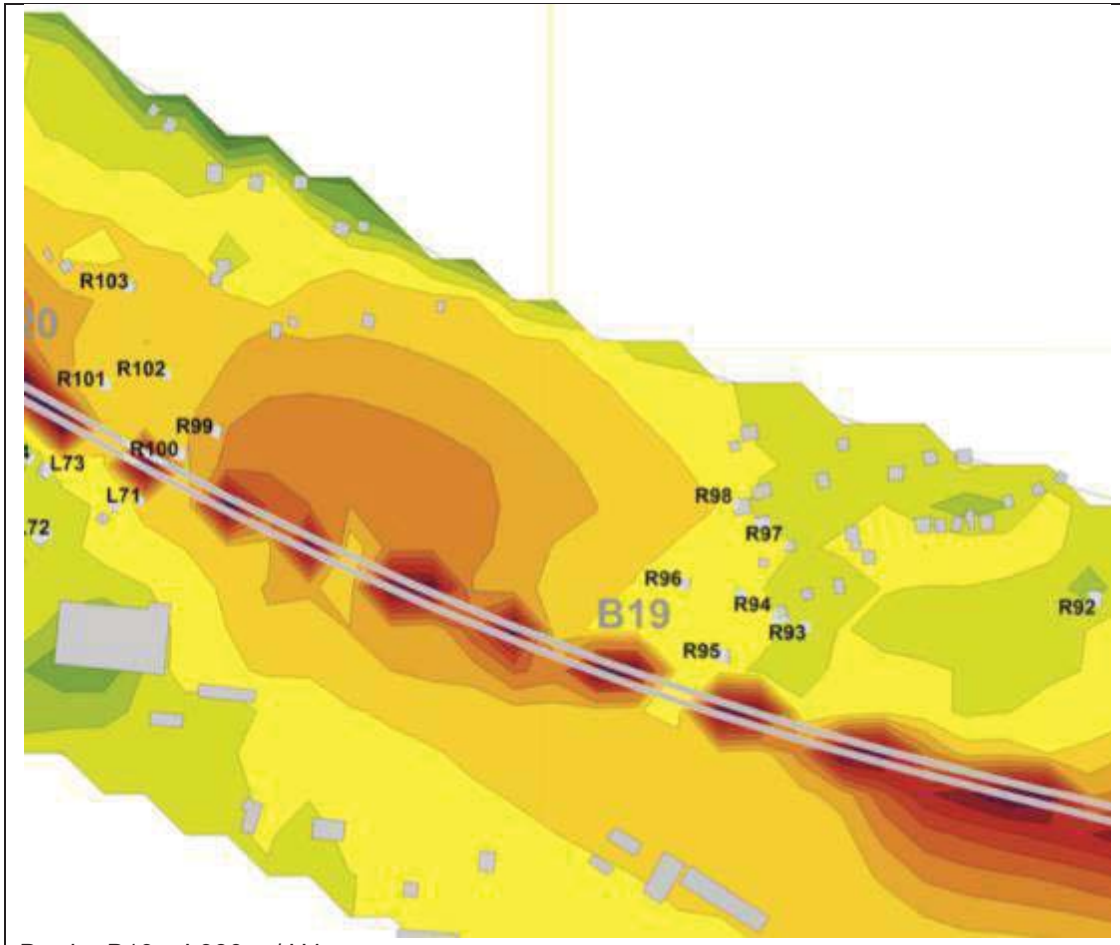


Figure F-53: Portion 9

Without Barrier / Nighttime

L71	54.3
L72	50.9
L73	54.0
R92	50.9
R93	54.8
R94	55.5
R95	58.0
R96	56.5
R97	54.8
R98	54.0
R99	59.8
R100	55.7
R101	59.8
R102	58.2
R103	55.9



Barrier B19 – L380m / H4m

Figure F-54: Portion 9

With Barrier / Nighttime

L71	47.9
L72	45.4
L73	46.3
R92	46.2
R93	47.3
R94	47.2
R95	47.9
R96	48.3
R97	46.3
R98	46.6
R99	54.7
R100	49.4
R101	49.6
R102	49.8
R103	50.5

Portion 9 Conclusion: All receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.

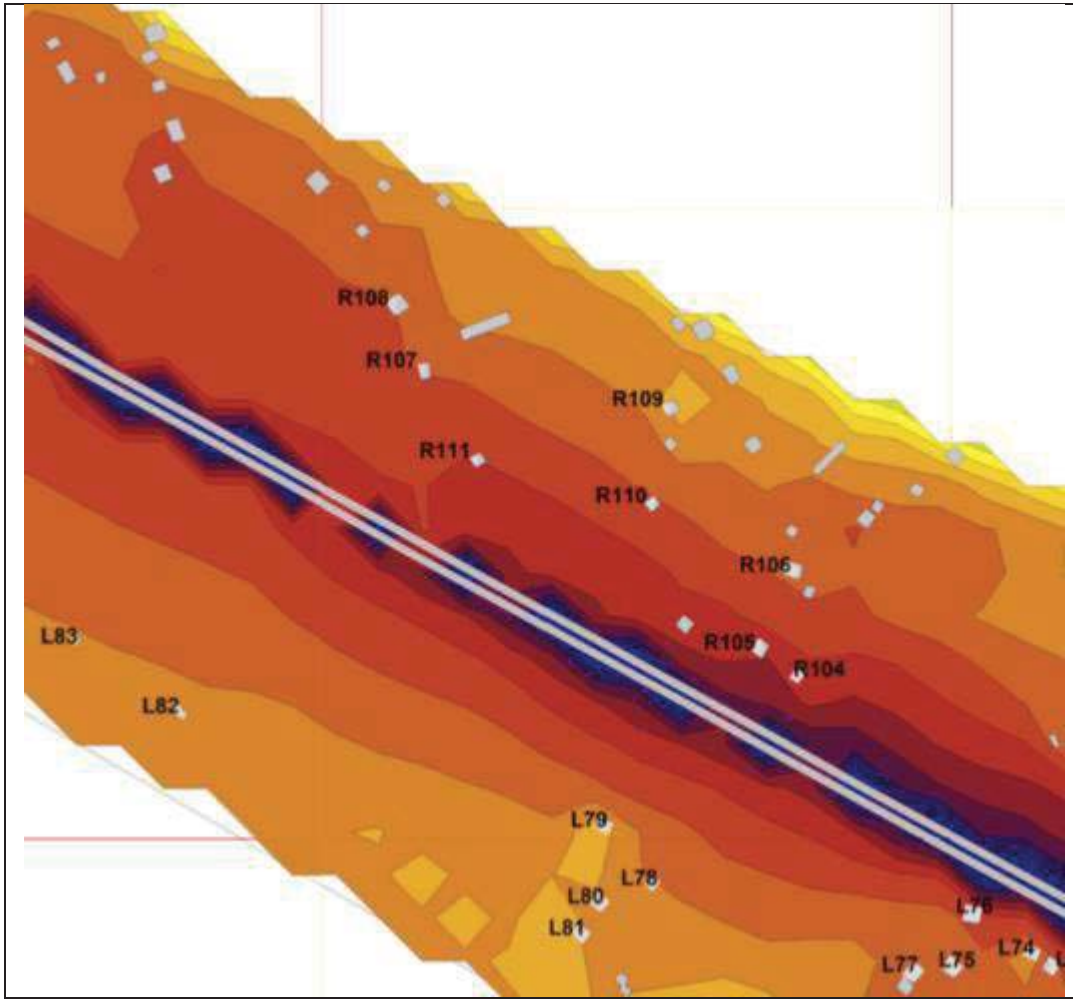


Figure F-55: Portion 10

Without Barrier / Day time

L74	62.2
L75	59.7
L76	62.6
L77	58.7
L78	56.9
L79	57.1
L80	54.6
L81	53.9
L82	58.0
L83	58.6
R104	67.7
R105	67.7
R106	60.9
R107	62.8
R108	61.1
R109	57.3
R110	62.4
R111	65.3

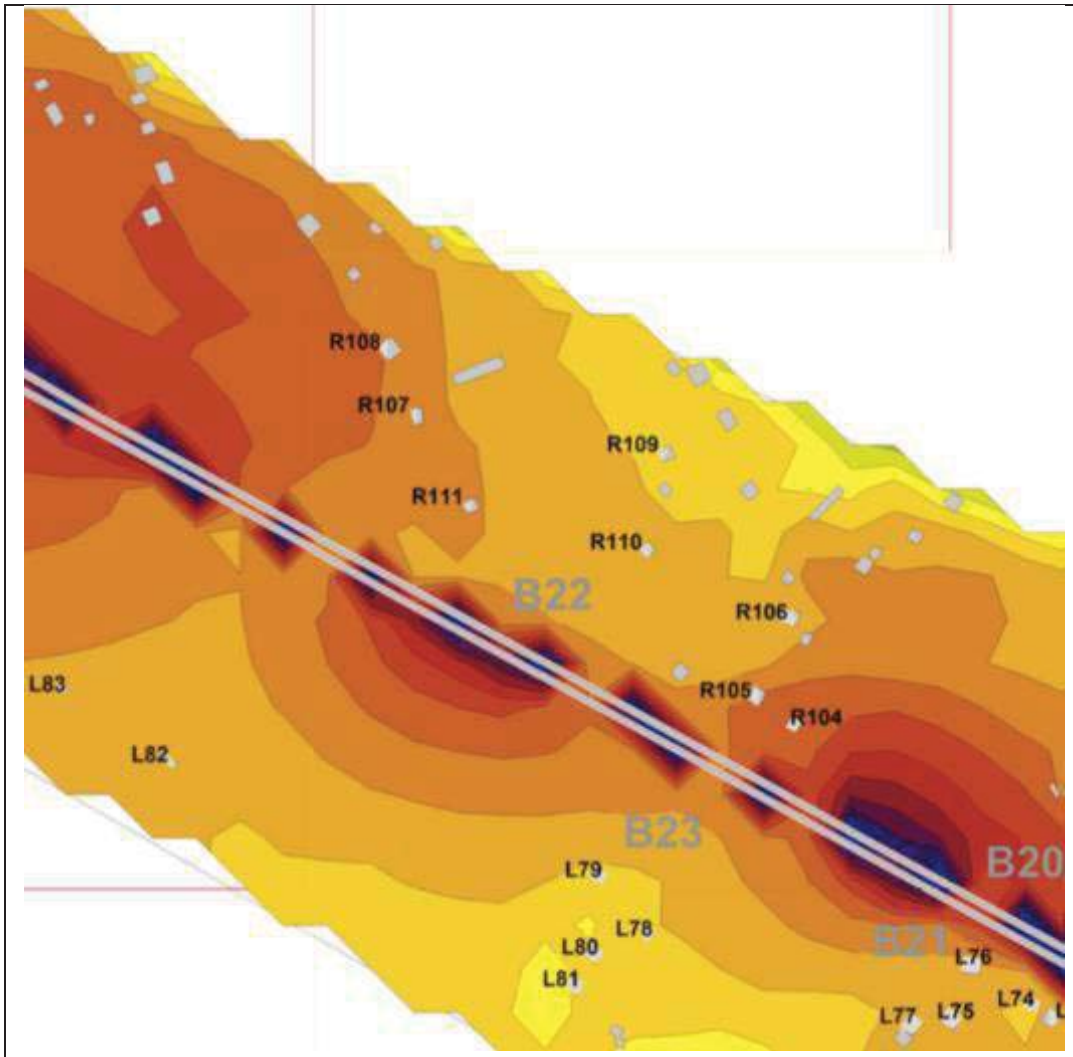


Figure F-56: Portion 10

With Barrier / Day time

L74	54.0
L75	53.0
L76	55.0
L77	52.6
L78	50.0
L79	50.6
L80	48.7
L81	49.6
L82	53.1
L83	54.6
R104	59.3
R105	56.9
R106	55.3
R107	57.9
R108	58.4
R109	52.9
R110	51.9
R111	56.3

Barrier B20 – L320m / H4m
Barrier B21 – L350m / H4m
Barrier B22 – L630m / H4m
Barrier B23 – L370m / H4m

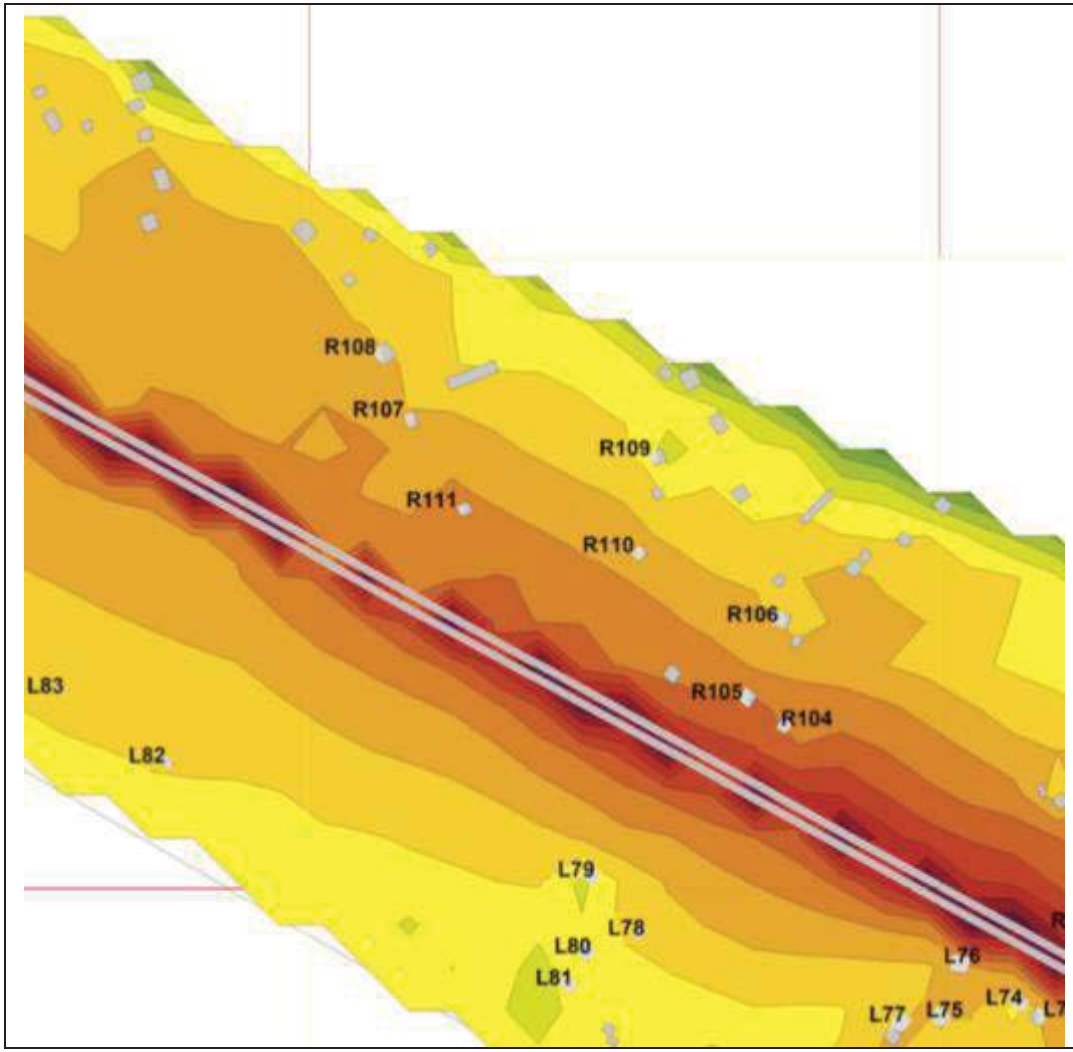
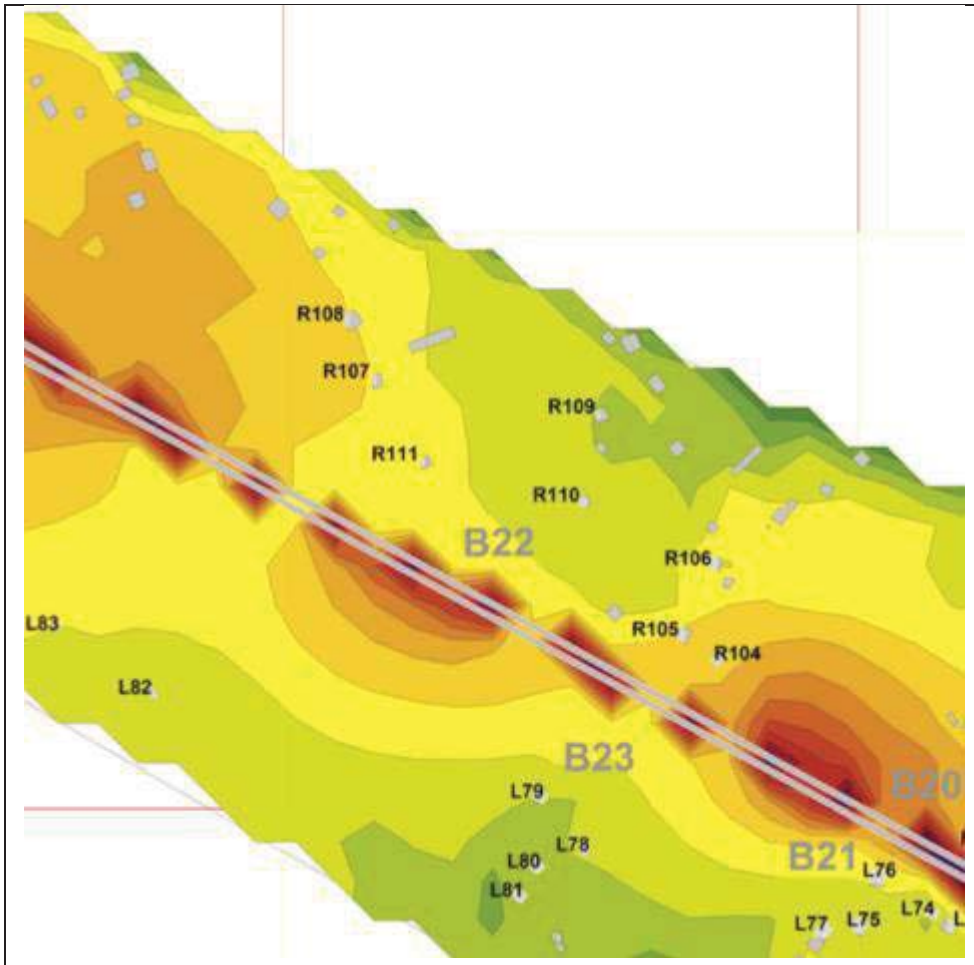


Figure F-57: Portion 10

Without Barrier / Nighttime

L74	54.1
L75	51.7
L76	54.5
L77	50.6
L78	48.8
L79	49.1
L80	46.5
L81	45.8
L82	49.9
L83	50.6
R104	59.6
R105	59.7
R106	52.9
R107	54.8
R108	53.1
R109	49.2
R110	54.4
R111	57.2



Portion 10 Conclusion: As with Portion 9, all receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.

Figure F-58: Portion 10

With Barrier / Nighttime

L74	45.9
L75	44.9
L76	47.0
L77	44.6
L78	42.0
L79	42.6
L80	40.6
L81	41.6
L82	45.1
L83	46.5
R104	51.2
R105	48.8
R106	47.2
R107	49.8
R108	50.3
R109	44.9
R110	43.8
R111	48.2

Barrier B20 – L320m / H4m
Barrier B21 – L350m / H4m
Barrier B22 – L630m / H4m
Barrier B23 – L370m / H4m

- Portion 4: Barrier B8 does not provide significant noise reduction for the receptors on the right side of the road, however, moving the noise barrier up the slope rather than adjacent to the side of the road may lead to significant noise reduction and as such this option should be considered. The five identified receptors on this side of the road exposed to elevated noise levels should be subject to alternative noise abatement, including expropriation due to their proximity to the road. Barrier B7 only provides suitable mitigation to meet IFC limits for its first half. All other receptors beyond this point are still subject to elevated noise levels, although the elevation is not significant (approximately 50 dBA for nighttime and around 55 dBA for daytime).
- Portion 5: Due to expropriation no barriers would be needed on the right hand side of the road. Barrier B9 does not provide any significant reduction in noise levels. Receptors L29 to L45 will all be subject to elevated noise levels during both daytime and nighttime. Alternative noise abatement measures need to be explored in this area.
- Portion 6: Noise barriers in this portion have no significant effect. Half of the receptors are below the IFC limits with or without barriers and half are above with or without barriers. Alternative noise abatement measures need to be explored in the areas above the IFC limits.
- Portion 7: Noise barriers B16 and B17 should be considered along this portion as it provides very good noise abatement reducing noise levels by 10 dBA.
- Portion 8: The noise barrier has a very positive impact on receptors R81 to R87. However, it is less effective closer to the interchange and the four receptors in this area should consider alternative noise abatement.
- Portion 9: Although noise barriers in this portion cannot, in all instances, meet IFC guideline limits, they get very close and as such noise barriers should be considered here as suitable abatement.
- Portion 10. Although noise barriers in this portion cannot, in all instances, meet IFC guideline limits, they get very close and as such noise barriers should be considered here as suitable abatement.

666. Given the above, approximately 5,950 meters of noise barrier is recommended for consideration as part of the Project. **Table F-22** below indicates the recommended barriers and their lengths for clarification.

Table F-22: Recommended Noise Barrier Locations and Lengths

Portion	Barrier No.	Suggested Length (m)	On Viaduct	Cut / Embankment
1	B1 - Not recommended	N/A		
2	B2 – Not recommended	N/A		
	B3 - Not recommended	N/A		
	B4 - Not recommended	N/A		
3	B5 - Recommended	620	620	
	B6-1 - Not recommended	600	203	397
	B6-2 - Not recommended	300	231	67
4	B7 - Recommended	700		700
	B8 – Recommended (in alternative location)	330		
5	B9 - Not recommended	N/A		
	B10 - Not recommended	N/A		
	B11 - Not recommended	N/A		
	B12 - Not recommended	N/A		
6	B13 - Not recommended	N/A		
	B14 - Not recommended	N/A		

Portion	Barrier No.	Suggested Length (m)	On Viaduct	Cut / Embankment
	B15 - Not recommended	N/A		
7	B-16 - Recommended	290		
	B-17 - Recommended	680		680
8	B-18 - Recommended	1000		928
9	B-19 - Recommended	380		380
10	B-20 - Recommended	320		320
	B-21 - Recommended	350		350
	B-22 - Recommended	630		630
	B-23 - Recommended	370		370
Total		**5,950**	**1,054**	**4,822**

667. As noted above, in some locations, even with the installation of a barrier, noise generated by traffic will still be elevated above IFC nighttime standards. Alternative noise abatement measures need to be considered for these locations, including for example:

- Fencing around individual properties (e.g. in Portion 1);
- Planting of vegetation around the border of properties;
- Construction of earth embankments around groups of properties;
- Installation of sound proof windows in properties; and
- Expropriation.

668. However, it is also possible that residents may not be willing to accept these measures as they may consider them an inconvenience and would rather accept the elevated noise levels, especially in the case of expropriation. This point can be put into context when considering that many countries in the EU only use 45 dBA as nighttime standard *indoors*, not at the *border* of the property, which is used as the IFC standard.

669. Given that the model has been prepared based on a 2037 operating scenario the following mitigation measures are recommended for operational phase noise levels:

- Noise barriers – As part of the Detailed Design, ensure that the road is designed to accommodate all of the noise barriers recommended in **Table F-22**. **Figure F-57** and **Figure F-58** illustrate the two types of foundation that would be required for the noise barriers, the first type being integrated with existing safety barriers and the second type being installed behind safety barriers. Within the first six months of operation (during the Defects Liability Period) daytime and nighttime noise monitoring will be undertaken by the Engineer at all of the identified receptors within the vicinity of these noise barriers. If noise levels are measured above IFC daytime or nighttime standards at these receptors the Engineer and RD will consult with the affected persons to determine if they want the noise barrier to be constructed. If any of the affected persons confirm they wish the barriers to be constructed the Contractor will be responsible for constructing the barrier. A budget shall be set aside from the Project to pay for the detailed design (which would specify the precise locations, dimensions and barrier material) and construction of these noise barriers. Noise monitoring at these receptors shall be undertaken and the same procedure will be undertaken every six months or less in line with traffic counts as well as existing traffic counts at fixed counting points by the Engineer and/or RD for the remaining eighteen months of the defects liability period to catch seasonal factor as well.
- Alternative noise abatement – some properties are located in areas where, according to the model, noise barriers will not be able to reduce noise levels

below 45 dBA by 2037. In these areas the Engineer (during the two year defects liability period) shall undertake annual noise monitoring at all of the potentially affected receptors in the Project area to determine actual noise levels at the receptors. If the noise levels in these areas are elevated above IFC guideline limits during this two year period the Engineer and RD shall consult with the affected receptors to determine what mitigation measures would be suitable for them, including the option of expropriation. In total around 120 receptors, or properties, could be affected, although in theory this figure will be lower (over 59 of the affected receptors are only between 1 and 5 dBA above the IFC nighttime guideline limit by 2037). A budget shall be set aside to pay for any potential expropriation of properties and will be included in the Project RAP.

- Other areas – Some of the barriers proposed in the model will only benefit one or two properties. The Engineer (during the two year defects liability period) shall monitor noise levels at each of these receptors annually, and if noise levels are above IFC guideline limits they shall consult with the affected receptor to determine what type of alternative mitigation is preferable, including noise proof windows, fencing, etc. Again, a budget shall be set aside for these minor items.

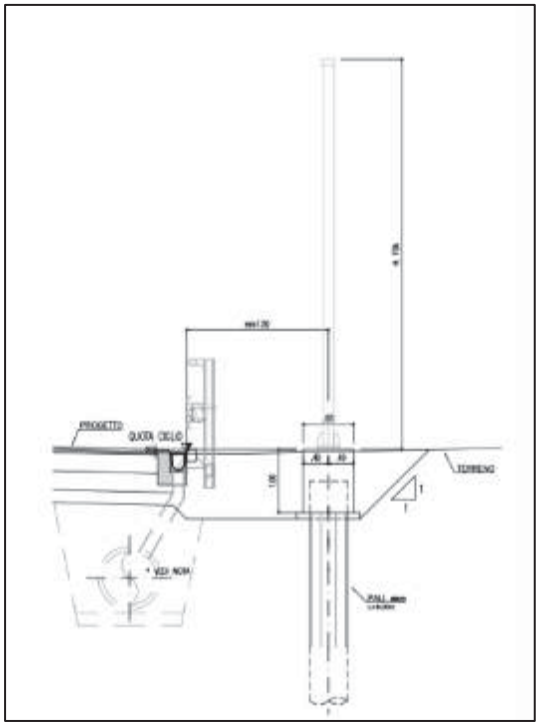


Figure F-59: Noise Barrier behind safety barrier

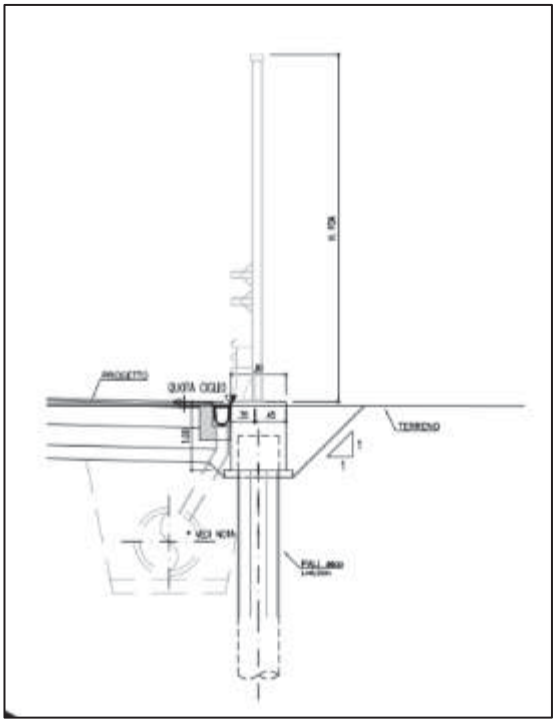


Figure F-60: Noise barrier integrated in safety barrier

F.8.8 Compliance Impacts

670. In addition to the impacts associated with the construction and operation phases of the project several compliance impacts have also been identified as follows:

1. Lack of Environmental Clauses in Contracts – The EIA is an environmental statement prepared by the RD. While it is prepared by the EIA consultant the EIA defines the commitment by the GoG through the proponent and its contractors

and consultants, to implement the mitigation and monitoring actions listed in the EIA. For the measures proposed in the EIA's EMP to be taken seriously, they must become legally binding through inclusion as environmental clauses in the loan agreement between the GoG and JICA as well as the specifications in the contract-bid documents. This will be achieved by integrating the EMP into the contract specifications as a clause and using the EMP to prepare the SSEMP defining specific steps to be taken by the contractors and the government during the project construction phase. References to the EMP will be made in the loan agreement between the GoG and JICA. It will be the Engineers responsibility to review the environmental mitigation and monitoring activities undertaken by the Contractor, with payments made only after verification that each work component has been completed as prescribed.

2. Lack of Construction Compliance Inspection Services and Environmental Training – While the EMP and the environmental covenants can be very clear and specific, if there is no one knowledgeable to undertake compliance monitoring, inspection and regular reporting, little of the EMP will be implemented or completed. The Engineer, through his National Environmental Specialist (NES) and International Environmental Specialist (IES), will ensure that compliance inspections are undertaken on a regular basis. In addition, the Engineers IES will also provide training to the Contractor and his Environmental Officer in the correct implementation of the SSEMPs prior to the commencement of works.

G. Environmental Management Plans and Institutional Requirements

G.1 Introduction

671. The EMP herewith provides the overall Project environmental management framework. It provides summary information of the types of impacts, which are described in detail in **Section F**. It also provides detailed information about the required mitigation and monitoring measures, their implementation arrangements reporting requirements. In addition, the approximate costs of the EMP are outlined.

G.2 Environmental Management Plan

672. **Table G-1**, **Table G-2** and **Table G-3** provides the environmental mitigation and observational monitoring for the Project during the pre-construction, construction and operational phases of the Project respectively.

G.3 Instrumental Monitoring Plan

673. Regular monitoring of air quality, water quality and noise levels against Georgian and IFC standards shall be carried out throughout the construction and commissioning periods. The party responsible for monitoring will be the Engineer who will report the results monthly to the RD. The reports shall clearly indicate the monitoring dates, times, locations, weather conditions, types of equipment used and calibration information. **Table G-4** provides the monitoring actions required during the construction phase of the Project. **Table G-5** provides the monitoring actions for the operational phase of the Project.

Table G-1: Environmental Management Plan - Detailed Design / Pre-construction Phase

Subject	Potential Impact / Issue	Mitigation Measure	Responsibilities	Monitoring	Monitoring Responsibility & Schedule
Air Quality	Construction impacts	Preparation of an Air Quality Plan (AQP) which shall include the locations of haul routes and the items specified under **Section F.5.1** of this EIA.	• Contractor to prepare AQP • Engineer to review and approve AQP.	N/A	N/A
	Air quality impacts from stationary sources	• Locations for borrow pits and concrete batching plants require approval from the Engineer and MoENRP and all necessary permits. • All of the above facilities will also have the appropriate GoG permits and licenses. • No borrow pit or batching plant shall be located within 500 meters of any urban area or sensitive receptor.	• Contractor to select sites. • Engineer and MoENRP to approve sites.	N/A	N/A
Land Use	Loss of land and Property	Before the commencement of the construction works of the Project at any road, the RD must prepare the Land Acquisition and Resettlement Plan (the LARP), obtain the approval of JICA and then implement the plan and acquire the land.	• RD to prepare the RAP. • JICA to approve the RAP. • RD to implement the Plan.	N/A	N/A
	Tree cutting	The LARP shall also contain the compensation methods and payments for loss of trees on private land.	• RD to prepare the RAP. • JICA to approve the RAP. • RD to implement the Plan.	N/A	N/A
Climate Change	Damage to roads and drainage systems due to increased flooding and more intense rainfall.	As part of the detailed design, the following measures will be considered: • Increase ditch and culvert capacity; • Maintain positive cross slope to facilitate flow of water from surface; • Increase pavement resistance to rutting; • Reduce splashing/spray through porous surface mixtures; • More frequent use of elevated pavement section;	• Engineer to review design documents prior to the start of construction and make any additions as necessary.	• N/A	• N/A

		• Improve visibility and pavement marking demarcation; and • Ensure that all embankments are seeded to help increase stability.			
Soils	Loss of Agricultural Soils	Before the commencement of the construction works of the Project at any road, the RD must prepare the Land Acquisition and Resettlement Plan (the LARP), obtain the approval of JICA and then implement the plan and acquire the land.	• RD to prepare the RAP. • JICA to approve the RAP. • RD to implement the Plan.	N/A	N/A
	Soil contamination	• Analysis of four additional soil samples taken close to the GAA. • Addendum to this EIA including the results of the additional soil samples.	• DD Consultant to hire a licensed laboratory for the analysis. • DD Consultant to provide the results in an addendum to this EIA	JICA	Before the start of construction.
Borrow Pits and Quarry's	New Quarry Sites	Any new quarries must obtain the required permits prior to commencement of works at these sites, this shall include approval from MoENRP and the Engineer.	• Contractor to select quarry sites and apply for approval from MoENRP and any other regulatory agencies as necessary. • Engineer to review quarry locations, licenses and approvals from MoENRP.	• N/A	• N/A
	Existing Borrow Pits	• For existing borrow pits a due diligence review will be carried out by the Engineer to determine their suitability. • The due diligence review shall be undertaken before the Contractor signs any contract with the existing borrow pit owner.	• Engineer to undertake due diligence review. • Results of the due diligence review shall be presented to RD and Contractor clearly stating the reasons for any rejection of the site.	N/A	N/A

	New Borrow Pits	• Obtain all necessary permits from the regulatory authorities. • Prepare a Borrow Pit Action Plan (BAP) according to the requirements of **Section F.7.5 of the** EIA.	• Contractor to select borrow sites and apply for approval from MoENRP and any other regulatory agencies as necessary. • Engineer to review borrow locations, licenses and approvals from MoENRP.	N/A	N/A
Hydrology	Bridge Construction	• All new bridges shall be designed for the life expectancy of 100 years. • A design discharge of 100 years return period is considered for bridges. • Bridge designs should ensure that drainage from bridge decks over 50 meters does not discharge directly to the watercourses beneath the bridges. • The bridge run-off waters should lead to an interceptor tank, or filter pond adjacent to the bridge in order to trap oil and grease run-off and prevent pollution of surface water courses. • The bridge design and layout must be aesthetically pleasing and in harmony with the existing environment.	• DD Consultants • Engineer to review design documents prior to the start of construction.	N/A	N/A
		• Establish the fish spawning period in relation to the bridge construction works to ensure that all works are undertaken in periods least likely to affect the fish spawning period.	• Contractor to consult with MoENRP regarding fish spawning periods. • Contractor to inform Engineer of any periods of construction restriction based on the consultations with MoENRP.	N/A	N/A
	Culverts	A design discharge of 50 years return period is considered for culverts.	• DD Consultants • Engineer to review design documents prior to the start of construction.	N/A	N/A

	Tunneling	Contractor shall develop a ground water management plan for each tunnel under which shall be submitted for approval by the Engineer at least four weeks prior to the start of tunnelling works.	• Contractor to prepare plan. • Engineer to review and approve plan.	N/A	N/A
	Siting of facilities	No construction camp, permanent or temporary, shall be located within 500 meters of any river, or irrigation channel (not including drainage channels) including the Dzirula, Kvirila and Borimela rivers.	• Contractor to select sites. • Engineer and MoENRP to approve sites.	N/A	N/A
Flora & Fauna	Land clearance	• The Contractor shall prepare a Clearance, Re-vegetation and Restoration Management Plan for prior approval by the Engineer. The Clearance Plan shall be followed strictly by the contractor. Areas to be cleared should be minimized as much as possible. • Prior to the commencement of works the Contractor shall stake the boundary of the entire site, including intersections and areas under bridges. The Contractor will then undertake a survey of all trees within 5 meters of the boundary of the staked site and identify if any Georgian red-list species are located within this zone. This survey will form part of the Contractors Clearance, Re-vegetation and Restoration Management Plan. • All temporary construction facilities should be located on already heavily disturbed ground where secondary forest growth has not yet become well-established.	• Contractor to prepare and implement Plan. • Engineer to review and approve plan. • Contractor to survey trees for vulnerable species.	N/A	N/A
	State Forest Fund	Prior to cutting trees in the identified State Forest Fund areas, it is required to obtain permit (Decree of the Government of Georgia on the "exclusion of certain areas from the State Forest Fund"), also known as 'delisting' the trees from the State Forest Fund and for compensation payments to be made.	• RD to obtain permit and submit to Engineer for review. • Engineer to review permit. • RD to make compensation payments.	N/A	N/A

	Impacts to Protected Areas	• No haul route will pass through a protected area. • No borrow pits or quarries will be allowed in a protected area.	• Contractor to implement mitigation. • Engineer to approve Borrow Pit Plans and Traffic Management Plans.	N/A	N/A
	Impacts to birds from street lighting	• Ensure that lower wattage lamps are used in street lights which direct light downwards to reduce glare.	• DD Consultants to incorporate the measures.	N/A	N/A
Construction Camps	Selection of Construction Camp Site	• Preparation of a Construction Camp Site Plan. • Preparation of a Spills Response Plan. • Construction camps shall not be located within one kilometer of an urban area and at least 50 meters from any surface water course and not within 2 kilometers of a protected area. • Coordinate all construction camp activities with neighboring land uses.	• Engineer to review & approve Plans. • Engineer and RD to approve camp locations.	N/A	N/A
Transportation and Utilities	Damage to roads	Prior to the commencement of works a road condition survey will be undertaken to record the condition of access roads to borrow pits, asphalt plants, camps, etc.	• Engineer to complete road condition survey. • Contractor to review and agree to the findings of the road condition survey.	N/A	N/A
	Traffic management	Preparation of a traffic management plan as part of the SSEMP.	• Contractor to prepare plan. • Engineer to review and approve plan.	N/A	N/A
Occupational Health and Safety	Worker Health and Safety	• Prepare an Occupational Health and Safety Plan (OHS Plan), including the items specified by **Section F.8.3** of this EIA. • Ensure that sub-contractors are provided with copies of the SSEMP and that they adhere to the content of the SSEMP.	• Contractor to prepare OHS Plan. • Contractor to provide copies of the SSEMP to sub-contractors prior to their access to the site. • Engineer to review and approve OHS Plan.	N/A	N/A

	Traffic Safety	Submit a Traffic Management Plan (TMP) to local traffic authorities prior to mobilization.	• Contractor to prepare TMP. • Engineer to approve TMP.	N/A	N/A
Emergency Response	Fires, explosions, earthquake, etc.	Preparation of an Emergency Response Plan (ERP).	• Contractor to prepare ERP • Engineer to review and approve ERP.	N/A	N/A
Waste Management	Management of waste materials	• Preparation of a waste management plan, including measures to re-use and recycle wastes and measures to dispose of hazardous waste. • Preparation of a construction camp management plan to manage liquid wastes.	• Contractor to prepare Plans • Engineer to review and approve Plans.	N/A	N/A
	Tunnel and Embankment Spoil	• Consultations between Kutaisi Bypass Contractor and RD to determine if the static balance from F4 can be re-used as embankment material for Kutaisi Bypass. • Preparation of a Spoil Re-use and Disposal Plan according to **Section F.8.3**.	• Contractor to consult with RD and Kutaisi Bypass Contractor. • Contractor to prepare plan. • RD and Engineer to review and approve the plan.		
PCR	Chance Finds	The Contractor shall prepare a chance find procedure in line with the requirements of the GoG. **Appendix E** provides a sample procedure.	• Contractor to prepare Plans • Engineer to review and approve Plans.	N/A	N/A
Noise	Noise barriers	Include areas for the installation of the identified noise barriers in **Table F-22** in the detailed design.	• Detailed Design Consultant.	N/A	N/A
Vibration	Construction vibration	The Contractor will develop a detailed Tunnel Blasting Plan (TBP) as part of the overall construction schedule.	• Contractor to prepare Plans • Engineer to review and approve Plans.	N/A	N/A
SSEMP Requirement	Preparation of SSEMP	Prepare SSEMP.	• Contractor to prepare SSEMP. • Engineer to review and approve SSEMP.	N/A	N/A
	Incorporation of Items into Bid Documents	A specific environmental and social section shall be included within the main Bid Documents indicating that the Contractor shall be responsible for conforming with the requirements of this EMP.	RD to ensure EMP is included within Bid Documents.	N/A	N/A

Table G-2: Environmental Management Plan - Construction Phase

Subject	Potential Impact / Issue	Mitigation Measure	Responsibilities	Monitoring	Monitoring Responsibility & Schedule
Air Quality	Open burning of waste materials	No burning of debris or other materials will occur at any camp or construction site.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Rock-crushing plant	• Rock crushing plant equipment shall be fitted with water sprinklers that will run continuously while the plant is operational. • If the sprinklers stop working, the plant shall also cease operation until the sprinklers are functioning. • Water run-off from the sprinkler system shall not discharge directly to surface water courses without first passing through a silt trap or any other suitable device to prevent siltation of surface waters.	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities.	Engineers NES	Daily site inspections, throughout construction period.
	Exhaust emissions from the operation of construction machinery	• No furnaces, boilers or other similar plant or equipment using any fuel that may produce air pollutants will be installed without prior written consent of the Engineer. • Construction equipment will be maintained to a good standard and fitted with pollution control devices regularly monitored by the Contractor and Engineer.	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities.	Engineers NES	Daily site inspections, throughout construction period.
	Emissions from Construction vehicles.	• Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following should be considered: • Regardless of the size or type of vehicle, owners / operators should implement the manufacturer recommended engine maintenance programs. • Drivers should be instructed on a routine basis by the Contractors EM on the benefits	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities including vehicle maintenance records.	Engineers NES	• Daily site inspections, throughout construction period. • Annual inspection of vehicle maintenance records.

		of driving practices that reduced both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits. • Implement a regular vehicle maintenance and repair program.			
	Fugitive emissions.	• Conveyor belts (e.g. at batching plants and rock crushing plants) shall be fitted with wind-boards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. • All trucks used for transporting materials to and from the site will be covered with canvas tarpaulins. • Carry out watering for dust control at least 3 times a day: in the morning, at noon, and in the afternoon during dry weather with temperatures of over 25C, or in windy weather. Avoid overwatering as this may make the surrounding muddy. • Earthwork operation to be suspended when the wind speed exceeds 20 km/h in areas within 500 m of any community.	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities.	Engineers NES	Daily site inspections, throughout construction period.
Soils Erosion and Soil Contamination	Contamination of Soils	• All fuel and chemical storage will be sited on an impervious base within a bund and secured by fencing. • The storage area will be located away from any watercourse or wetlands. • The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund). • The construction camp maintenance yard will be constructed on impervious hardstanding with adequate drainage to collect spills (including oil interceptor tanks), there will be no vehicle maintenance activities on open ground. • Filling and refueling will be strictly controlled and subject to formal procedures. • Drip pans will be placed under all filling and fueling areas. Waste oils will be stored and disposed of by a licensed contractor. • All valves and trigger guns will be resistant to	• Contractor to implement mitigation. • Engineer to review and approve bunding prior to the start of construction. • Engineer to review and approve vehicle fueling area prior to the start of construction.	Engineers NES	Daily site inspections, throughout construction period.

		unauthorized interference and vandalism and be turned off and securely locked when not in use. • The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any soils. • No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hardstanding. • Areas using bitumen will be constructed on impervious hardstanding to prevent seepage of oils into the soils. • No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hard standing. • Areas using bitumen will be constructed on impervious hard standing to prevent seepage of oils into the soils.			
	Loss of topsoil	• Locate topsoil stockpiles outside drainage lines and protect stockpiles from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Rip ground surface prior to the spreading of topsoil. • Remove unwanted materials from topsoil such as roots of trees, rubble and waste etc. • Specifically regarding soil compaction, the Contractor will confine operation of heavy equipment within the RoW, as much as possible, to avoid soil compaction and damage to privately owned land. • If in case private lands are disturbed, the contractor should promptly inform the owner and agree on the ways to remedy the situation.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

	Soil Erosion	• Material that is less susceptible to erosion will be selected for placement around bridges and culverts. • Re-vegetation of exposed areas including; (i) selection of fast growing and grazing resistant species of local flora; (ii) immediate re-vegetation of all slopes and embankments if not covered with gabion baskets; (iii) placement of fiber mats to encourage vegetation growth. • The Engineer and the Contractor will both be responsible for ensuring that embankments are monitored continuously during construction for signs of erosion.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Contaminated Land	Should the results of the additional soil sampling in the pre-construction phase indicate any elevated levels of contamination further testing of the excavated soils in this area will be required. The procedure for any construction phase testing is as follows: • identify a temporary storage area for material excavated from the area identified in **Figure F-13**. The area should be fenced and signposted. The area shall comprise an impermeable surface to prevent leachate from the stockpiles potentially contaminating soils and groundwater in the area of the storage area. • strip the topsoil in the area of **Figure F-13** in batches of 2,500 m^2 and store the mixed material in the temporary storage area (the stockpile). The height of the stockpile shall be no more than 2 meters. It is possible to have more than one stockpile, depending upon the rates of excavation in this area. • divide the stockpile into quadrants of 250m^3. • hire a certified laboratory to take a soil sample from each of the quadrants for further chemical analysis (a stockpile of 2,500m^3 would require 10 samples). Sampling should be uniformly distributed throughout the stockpile, including sampling at depth. • If the results show the all of the samples are within the proposed national limits of outlined	• Contractor to implement mitigation. • Engineer to hire certified laboratory and review results. • Engineer to undertake periodic inspections of the stockpiles to ensure the correct procedures are being followed.	Engineers NES	Weekly inspections of stockpiles.

		in **Table E-13**, **Table E14** and **Table E-15** and the Dutch target values the material can be removed from the stockpile area and disposed of as non-hazardous material. • If any of the ten samples show elevated levels of contamination the material from the respective contaminated quadrants will be disposed of as hazardous waste. Any other non-contaminated quadrants may be disposed of as non-hazardous waste. • Final disposal of any contaminated soil must be undertaken at a waste management facility licensed to handle such wastes. As with normal waste materials, the Contractor will be obliged to keep records of any hazardous materials removed from the site, including: ▪ Volume of soil removed; ▪ Details of any identified contamination; ▪ Soil stockpile (and/or storage container) unique identifier; ▪ Date excess soil was excavated from each location and subsequently transported to a disposal facility; ▪ Details of the vehicle transporting the soil to a disposal facility; ▪ Details of the disposal facility; and ▪ Date the excess soil arrived at the disposal facility. • provide a copy of the licensed waste management contractors contract to the Engineer before any contaminated soil is removed from the site. The Engineer will also be responsible for undertaking an additional due diligence review of the waste management contractors disposal site.		

		Alternative treatment of contaminated land prior to disposal	• Contractor responsible for the preparation of a Contaminated Spoil Treatment Plan. • Plan approved by the Engineer. • Contractor to implement treatment measures and disposal. • Engineer to undertake periodic review and assessment of the activity and results.	Engineers NES	Weekly inspections of any proposed treatment activity.
Hydrology	Ground and surface water pollution.	• Implementation of the specific mitigation measures outlined under **Construction Camps**, below and **Soil Contamination** above. • Provide portable toilet facilities for workers at road work sites.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Groundwater depletion	• Routine monitoring of groundwater levels in groundwater wells in the Project area will be undertaken on a weekly basis by the Contractor within the vicinity of each tunnel he is excavating, in line with his groundwater management plan. The monitoring shall continue for a two month period after the tunnel is sealed. If drawdown levels in wells are significant the Contractor will provide a temporary source of potable water to the affected persons until the groundwater levels are recharged. • Monitoring shall continue for a two month period after the completion of the tunnels. If the wells fail to re-charge, new boreholes will be constructed for affected persons.	Contractor to implement mitigation	Engineers NES	Weekly review of groundwater monitoring reports.
	Bridges	The Contractor will: • Divert the water flow near the bridge piers. • Provide coffer dams, silt fences, sediment barriers or other devices to prevent migration of silt during construction within streams. • Perform dewatering and cleaning of cofferdams to prevent siltation by pumping from cofferdams to a settling basin or a	Contractor to consult with MoENRP and provide copies of letters confirming construction periods to the Engineer.	Engineers NES	Routine monitoring of bridge works to ensure they are in compliance with MoENRP guidelines.

		containment unit. • Carry out bridge construction works without interrupting the traffic on the existing road with the provision of suitable diversions. • Ensure no waste materials are dumped in the river, including re-enforced concrete debris. • Place generators more than 20 meters from the river. • Ensure that no concrete waste from concrete mixers is dumped in the river. • Provide areas where concrete mixers can wash out leftover concrete without polluting the environment. This may be in the form of a lined settling pond at each bridge site. Drivers will be informed of these locations and the requirements to use these settling ponds on a routine basis by the Engineer. Dried waste from the settling ponds can be used as backfill for culverts, etc. • Carefully collect all polystyrene (from expansion joints) so that it does not litter the local environment. • Ensure that no hazardous liquids are placed within 10 meters of the river. • Provide portable toilets at bridge construction sites to prevent defecation by workers into the river. • Ensure that workers are provided with correct PPE including harnesses. • During piling works ensure that pumped water is filtered through a silt trap before being discharged to the river. • In addition, the Contractor, through his Environmental Manager, will be responsible for consulting with MoENRP to establish the fish spawning period in relation to the bridge construction works to ensure that all works are undertaken in periods least likely to affect the fish spawning period.			
	Drainage and Flooding	• During the construction phase the Contractor will be required to construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage to	Contractor to implement mitigation.	Engineers NES	Monitor drainage channels on a weekly basis.

		properties and land by flooding and silt washed down from the works. • Arrange with the village representatives those works which might interfere with the flow of irrigation waters to be carried out at such times as will cause the least disturbance to irrigation operations. • Should any operation being performed by the Contractor interrupt existing irrigation facilities, the Contractors will restore the irrigation appurtenances to their original working conditions within 24 hours of being notified of the interruption. • The Contractor will also be responsible for ensuring that no construction materials or construction waste block existing drainage channels within the Project corridor.			
	Dewatering of tunnels	The Contractor will pass all drainage water from the tunnel through a settlement tank. Weekly monitoring of the water quality from the tank will be undertaken by the Contractor to assess for any pollution. If the drainage water meets drinking water standards it can be considered for re-use in any potentially depleted wells during the construction phase.	• Contractor to implement mitigation. • Engineer to review and approve settlement tank locations and designs.	Engineers NES	• Review of weekly water monitoring results. • Weekly inspection of settlement tanks.
	Water Supply	Only legally permitted water resources shall be used for technical water supply, including rivers.	Contractor to implement mitigation. Engineer to review all water extraction permits.	Engineers NES	• Weekly inspections, throughout construction period. • Annual review of permits.
Flora & Fauna	Tree cutting	• Trees cleared from private land plots will be compensated in accordance with the Land Acquisition and Resettlement Plan (LARP). • Tree cutting shall not occur during bird nesting seasons.	GoG to implement the LARP.	According to the LARP	According to the LARP

	State Forest Fund	• The Contractor will be provided with plans indicating the areas of State Forest Fund. • Tree-cutting works in the State Forest Fund areas shall be implemented under the supervision of specialists of the National Forestry Agency. • Contractor to remove the trees to a location specified by the National Forest Agency.	• RD to provide plans to Contractor. • Contractor to undertake tree cutting. • Contractor to remove trees.	National Forestry Agency	None
	Tree Re-planting	• Coordinate with the National Forest Agency to identify a site, or sites, within the Project area where 615 red-list species can be re-planted. • Plant maintenance will be carried out for at least two years. • Monthly monitoring of the re-planted areas and report on the success rate of the re-planted trees, which should be above 80%. • If the success rate falls below 80% re-plant on a 1:1 basis to compensate for losses.	• Contractor to coordinate with NFA. • Contractor to purchase, plant and maintain the seedlings. • Contractor to plant additional seedlings if success rate not met.	• Engineer to monitor success rate (NFA to determine success rate criteria).	Monthly monitoring of success rate.
	Protection of Vulnerable Species	The Contractor will place protective wood fencing around the any Georgian red-list species identified within 5 meters of the site boundary in the pre-construction survey in order to protect the tree during construction works, including its root zones.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Vegetation clearance	No chemicals shall be used to clear vegetation.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Fish Spawning	The Contractor shall consult with the MoENRP to determine when works in rivers should be ceased in order to limit impacts to fish spawning periods.	Contractor to implement mitigation.	Engineers NES	Review of documentation provided by MoENRP.
	Impacts to habitat	Prior to the start of construction in river beds, or close to river embankments (within 10 meters), the Contractor shall undertake a site survey (using a local ecologist) to ensure that there are no otter burrows in these areas. If burrows are found in these areas the Contractor will prepare a method statement for the management of these areas which will be sent to the Engineer for review and approval.	• Contractor to hire local ecologist. • Contractor to prepare method statement. • Engineer to review and approve method statement.	Engineers NES	Review method statement and periodically monitor works in this area.

	Poaching	Poaching of wildlife shall be strictly prohibited.	Contractor to implement mitigation.	N/A	N/A
Waste Management and Spoil	Recycling and re-use	• Where possible, surplus materials will be reused or recycled. • Used oil and grease shall be removed from site and sold to an approved used oil recycling company.	Contractor to implement mitigation.	Engineers NES	Monthly review of waste manifests to determine if wastes are being recycled.
	Spoil	• Under no circumstances shall the Contractor dump excess materials on private lands. • Excess spoil shall not be dumped or pushed into any river at any location. • Spoil re-use and disposal haul routes shall be included within the traffic management plan. • The Contractor will be responsible for upgrading and maintenance of any locals roads used for the transport of spoil materials. • Transport of spoil material from tunnels on local roads shall be prohibited between 10pm and 6am. • Routine spraying of haul routes during dry periods.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Inert Solid & Liquid waste	• Provide refuse containers at each worksite. • Maintain all construction sites in a cleaner, tidy and safe condition. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • Train and instruct all personnel in waste management practices and procedures. • Collect and transport non-hazardous wastes to all approved disposal sites. • Keep copies of waste manifests on site. • Keep a record of waste on-site and waste removed.	• Contractor to implement mitigation and conduct training. • Engineer to approve any waste disposal site.	Engineers NES	Daily site inspections, throughout construction period. Regular review of Contractors training sessions.
	Asphalt and Concrete	• Waste asphalt will be recycled where possible for base material and shoulder material. • Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. • Waste concrete shall be crushed and re-used as fill material, or base material where possible. • Under no circumstances should concrete	• Contractor to implement any recommendations for re-use of asphalt. • Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		mixers be washed out onto open ground at construction sites, such as bridges.			
	Hazardous Waste	• Storage of hazardous waste shall be in specific secure locations as identified by the waste management plan. • Hazardous liquids must be stored within impermeable bunds (the bund should be able to contain at least 110% of the volume of the largest storage tank within the bund). • Collect and temporarily store used hazardous waste separately in specialized containers and place in safe and fire-free areas with impermeable floors roofs, at a safe distance from fire sources and according to the requirements of their MSDS. • Training and suitable PPE will be provided to all personnel handling hazardous waste. • Disposal of waste materials shall be undertaken by a licensed waste management company. Keep copies of the companies licenses on record as well as the agreements with the company. • Keep records of the types and volumes of waste removed from the site on a weekly basis. • Keep copies of waste manifests.	• Contractor to implement mitigation. • Engineer to approve any waste disposal site. • Engineer to review waste manifests.	Engineers NES	Daily site inspections, throughout construction period. Monthly review of waste manifests.
Transport and Utilities	Transportation	The Contractor will: • Provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions at least 24 hours before the disruptions; • Allow for adequate traffic flow around construction areas via diversions or temporary access roads; • If temporary access roads are to be constructed with a gravel surface they shall be routinely watered by the Contractor during dry weather to reduce dust impacts; and • Provide adequate traffic signs, appropriate lighting, well-designed traffic safety signs, barriers and flag persons for traffic control.	Contractor to implement mitigation.	Engineers NES	Weekly inspections, throughout construction period.

		• Access roads for borrow pits, batching plants, etc, will be maintained during the construction phase and rehabilitated at the end of construction.			
	Working Close to Railways Lines	• The Contractor will be responsible for the preparation of an Environmental, Health and Safety Method Statement for working in the area above the railway line at KM 6.3 and at Bridge BR 4.0.1.AT/TA.	• Contractor to prepare method statements. • Engineer to review and approve method statements	Engineers NES	Weekly monitoring of works in these areas.
	Utilities	• All utilities in the Project area shall be kept operational, particularly during the winter months. • The Contractor will be responsible for liaising with the relevant utilities operators to ensure all utilities remain operational. • Should utilities need relocating in a different location the Contractor will consult with the relevant utilities and local community to ensure that there is no change in supply as a result of these changes.	Contractor to implement mitigation.	Engineers NES	Weekly inspections, throughout construction period.
Borrow Pits and Quarry's	New Borrow Pits	• The Contractor will: o Before the materials extraction the layer of top-soil (about 20 cm) will be removed to the side of excavation area and kept until the area works will be finalized. o Top-soil stockpiles will be located at least 50 meters distance from any watercourses to avoid water siltation and obstruction. The height of stockpiles will not exceed three meters to avoid wind erosion and dust emissions. o Provide an access road to the borrow site. All drivers will be instructed to use only this officially designated road. • If the Engineer deems the site to be hazardous to the local community he will request the Contractor to fence the site to prevent access and provide warning signs on the fencing. • Due to the sensitivity of the borrow pit locations, borrow haul routes will follow	• Contractor to select borrow sites and apply for approval from MoENRP and any other regulatory agencies. • Engineer to review borrow locations, licenses and approvals from MoENRP. • Engineer to determine if the site requires fencing.	Engineers NES Engineers NES and IES to ensure reinstatement of borrow pits are completed satisfactorily.	Monthly inspections of borrow pits. Final inspection of reinstatement activities.

		established transport corridors/rights-of-way, to the extent that is practicable. • Full site reinstatement will be undertaken by the Contractor to avoid landscape damage and habitat loss. Rehabilitation measures will include: o Removing of all types of equipment from the site; o Removing of all types of waste or/and polluted soil and materials if any exist; o Slope stabilization measure such as re-covering with top soil, and further seeding, grassing and planting of appropriate bushes or/and trees if reasonable. • The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the Engineer will be required before final acceptance and payment under the terms of contracts. • Additional borrow pits will not be opened without the restoration of those areas no longer in use.			
	Existing Borrow Pits	• Due diligence review of borrow pit. • A copy of the agreement between the operator and the Contractor will be provided to the Engineer.	• Engineer to undertake due diligence review • Contractor to provide agreement to Engineer	N/A	N/A
	New Quarry Sites	• Any new quarries must obtain the required permits prior to commencement of works at these sites, this shall include approval from MoENRP and the Engineer. • No quarry shall be located within one kilometer of any urban area or sensitive receptor and not within one kilometer of a protected area./	• Contractor to select quarry sites and apply for approval from MoENRP and any other regulatory agencies. • Engineer to review quarry locations, licenses and approvals from MoENRP.	N/A	N/A
Asphalt Plants	Emissions & Noise	• Asphalt plants will be located downwind of urban areas and not within one kilometer of any urban area. • Adequate PPE will be provided to staff working in areas of high noise and emissions.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		• Storage and Use of Hazardous Materials (including bitumen): • Ensure all hazardous materials are stored (including within suitable sized bunds for liquids), handled and disposed of according to their Material Safety Data Sheet (MSDS). • Copies of MSDS will be kept on site with all hazardous materials. • The Contractor will keep a log of the type and volume of all hazardous wastes on site. • The Contractor will keep a plan of site indicating where all hazardous materials are stored.			Monthly review of hazardous waste log.
	Vehicle Movement	• The Contractor will include the asphalt plant in his Traffic Management Plan, including haul routes from the plant.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Health and Safety	• To prevent bitumen burns it will be compulsory for the workers handling hot bitumen to wear full-body protection. • All transportation, handling and storage of bitumen will be handled safely by experienced personnel. • The dust from the manufacturing process may pose respiratory hazards, hence protective air mask will be provided to the operators for the loading and unloading of aggregates. • Ear-muffs will be provided those working on the plant. • First Aid kit will be available on site for the workers in case of emergency. • The Material and Data Sheet (MSDS) for each chemical product will be made accessible onsite and displayed.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
Construction Camps	Pollution and Emissions	• The Contractor will ensure that all of the following conditions are met: • Rain-water run-off arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage system will be fitted with oil and grease interceptors.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		• There will be no direct discharge of sanitary or wash water to surface water. • In the absence of functioning sewerage and sewage treatment facilities it is recommended that the Contractor provides his own on-site wastewater treatment facilities. For sites servicing a small number of employees (less than 150), septic tanks may be used. For larger sites, liquid wastes will as a minimum receive primary treatment in anaerobic tank or pond preceded by a bar screen to remove large solid objects (e.g. sticks, rags). • There will be no direct discharge of untreated sanitary or oily wastewater to surface water bodies. • Licensed contractors will be required to collect and disposal of liquid waste from the septic tanks on regular basis. • Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies will be prohibited. • Liquid material storage containment areas will not drain directly to surface water. • Waste water from vehicle washing bays will be free of pollutants if the wash bay has been constructed correctly. • Lubricating and fuel oil spills will be cleaned up immediately and spill cleanup materials will be maintained at the storage area. • Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters and are connected to septic tanks, or waste water treatment facilities. • Discharge of sediment-laden construction water directly into surface watercourses will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge. • Washing out concrete trucks at construction sites will be prohibited unless specific concrete washout areas are provided for this purpose at the construction site (e.g. a bridge site). The washouts will be impermeable and emptied when 75% full.			

		• Spill cleanup equipment will be maintained on site (including at the site maintenance yard and vehicle fueling areas). The following conditions to avoid adverse impacts due to improper fuel and chemical storage: • Fueling operations will occur only within containment areas. • All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tanks. • Filling and refueling will be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids. • All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use. • The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any drain or watercourses. • Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited. • Should any accidental spills occur immediate cleanup will be undertaken and all cleanup materials stored in a secure area for disposal to a site authorized to dispose of hazardous waste. • If determined warranted by the Engineer, the Contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the sites. • If so requested, the Contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. • The Contractor will provide necessary			

		cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site. • The Contractor will be responsible to maintain and cleanup campsites and respect the rights of local landowners.			
Concrete Batching Plants	Pollution and Emissions from Concrete Batching Plants	• To limit impacts from dust, the following conditions will apply: - Batching plants will be located downwind of urban areas and not within one kilometer of any urban area. - The entire batching area traversed by vehicles – including driveways leading into and out of the area – will be paved with a hard, impervious material. - Sand and aggregates will be delivered in a dampened state, using covered trucks. If the materials have dried out during transit they will be re-wetted before being dumped into the storage bunker. - Sand and aggregates will be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls should extend one metre above the height of the maximum quantity of raw material kept on site, and extend two metres beyond the front of the stockpile. - The hopper or bunker will be fitted with water sprays which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition. - Overhead storage bins will be totally enclosed. The swivel chute area and transfer point from the conveyor will also be enclosed. - Rubber curtain seals may be needed	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		to protect the opening of the overhead bin from winds. - Conveyor belts which are exposed to the wind and used for raw material transfer will be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas will be fully enclosed. - Conveyor belts will be fitted with belt cleaners on the return side of the belt. - Weigh hoppers at front end loader plants will be roofed and have weigh hoppers shrouded on three sides, to protect the contents from the wind. The raw materials transferred by the front end loader should be damp, as they are taken from a dampened stockpile. - Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work will be dust-tight. - Silos will be equipped with a high-level sensor alarm and an automatic delivery shut-down switch to prevent overfilling. - Cement dust emissions from the silo during filling operations must be minimised. The minimum acceptable performance is obtained using a fabric filter dust collector. - Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere. - An inspection of all dust control components will be performed routinely – for example, at least weekly. • All contaminated storm water and process wastewater will be collected and retained on site. • All sources of wastewater will be paved and			

		bunded. The specific areas that will be paved and bunded include; the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues. • Contaminated storm water and process wastewater will be captured and recycled by a system with the following specifications: - The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain. - Water captured by the bunds will be diverted to a collection pit and then pumped to a storage tank for recycling. - An outlet (overflow drain) in the bund, one metre upstream of the collection pit, will divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours). - Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments. - Wastewater will be pumped from the collection pit to a recycling tank. The pit will have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails. - Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity.			
Community Health and Safety	Blasting	Blasting will be conducted using standard mining industry practices and procedures to ensure safety of personnel and equipment. This includes establishing a safety zone around the blast area, say to a distance of 500 m (actual distance will be established by the Contractor and approved by the	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		Engineer based on the safety standards) and evacuating it.			
	HIV / AIDS	• Subcontract with an Approved Service Provider to provide an HIV Awareness Program to the Contractor's Personnel and the Local Community. • Repeat the HIV Awareness Program at intervals not exceeding four months	• Contractor to implement mitigation. • Service Provider to implement training. • Engineer to review program.	Engineers NES	Annual review of awareness program activities.
	Code of Conduct	The Contractor shall develop an induction program, including a Code of Conduct, for all workers directly related to the Project. A copy of the Code of Conduct is to be presented to all workers and signed by each worker.	Contractor to implement mitigation.	Engineers NES	Routine assessment of workers staff to determine if the code of conduct has been presented.
	Monthly Meetings	The Contractor will be responsible for holding monthly community meetings within the Project area throughout the construction period.	Contractor to implement mitigation.	Engineers NES	Engineers NES to attend all community meetings.
Occupational Health and Safety	Worker Health & safety	• Initial Safety Induction Course: All workmen will be required to attend a safety induction course before they are allowed access to the Site. • Develop a Safety Training Program including training to recognize and respond to workplace chemical hazards. • Safety Meetings conducted on a monthly basis. • Regularly inspect, test and maintain all safety equipment. • Equipment, which is damaged, dirty, incorrectly positioned or not in working order, shall be repaired or replaced immediately. • All construction plant and equipment used on or around the Site shall be fitted with appropriate safety devices. • A fully equipped first aid base shall be provided at the Construction Camp and Asphalt Plant. • Coordinate with local public health officials and shall reach a documented understanding with regard to the use of hospitals and other community facilities. • Workers will be provided (before they	• Contractor to implement mitigation. • Engineer to review and approve training program.	Engineers NES	Daily site inspections, throughout construction period. Periodic attendance of training sessions to determine quality and numbers in attendance.

		commence works) with of appropriate PPE suitable for electrical work such as safety boots, helmets, gloves, protective clothes, goggles, and ear protection at no cost to the workers.			
	Sub-contractor H&S	• All sub-contractors will be supplied with copies of the SSEMP. • Provisions to be incorporated into all sub-contracts to ensure the compliance with the SSEMP. All sub-contractors will be required to appoint a safety representative who shall be available on the Site.	• Contractor to provide SSEMP. • Sub-contractors to ensure compliance with SSEMP	Engineers NES	Routinely monitor sub-contractors activities.
	Noise	Zones with noise level above 80 dBA must be marked with safety signs and appropriate PPE must be worn by workers.	Contractor to implement mitigation.	Engineers NES	Daily site inspections and monitoring (with smartphone technology) throughout construction period.
PCR	Impacts to Cemetery	During the construction phase the northern boundary of the cemetery (50 meters south of tunnel TUN 4.0.06-AT/TA) shall be fenced off to ensure that there is no encroachment into this area by construction workers or equipment.	Contractor to implement mitigation.	Engineers NES	Weekly site inspections of the fencing.
	Natural Spring	During the construction works the spring shall be fenced on the northern side to prevent construction works impacting upon the spring.	Contractor to implement mitigation.	Engineers NES	Weekly site inspections of the fencing.
	Impacts to Historical and archeological areas	In the event of any chance finds during the construction works procedures shall apply that are governed by GoG legislation and guidelines and as outlined in the Contractors Chance Find Procedure.	Contractor to implement mitigation.	Engineers NES	Daily site inspections throughout construction period.
Noise	Construction noise	• During the construction phase the Contractor will be responsible for the following: - Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the Engineer having due regard for possible noise disturbance to the	Contractor to implement mitigation.	Engineers NES	Daily site inspections throughout construction period.

		local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas (within 250 meters) such as residential, nursery, or medical facilities, the Contractor's hours of working shall be limited to 8 AM to 6 PM; - Give notice as early as possible to sensitive receptors for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress. - Within normal working hours, where it is reasonable to do so: - schedule noisy activities for less sensitive times. - provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise). - The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times. - All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair. - Maintenance tools, machines and equipment so that they are in good conditions. When some wrong is found, they must be fixed			

		immediately in order to reduce noise from the equipment. - Fit all pneumatic tools with an effective silencer on their air exhaust port. - Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed. - Turn off plant when not being used. - All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the Engineer. - Keep good conditions of trucks that use to transport construction materials so they cause no loud noise and control the truck speed, to be not exceeded 40 km/hr when driving through communities, and not exceeded 80 km/hr when driving on highways. - Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area. - Provision of noise protection kits such as ear plug, earmuff, for workers who are working in the area with noise level is higher than 85 dB(A). It is designated as a regulation that workers must wear protection kits in case of working in a noisy area.		
Vibration	Tunneling Vibration	The Contractor shall follow the procedures outlined in **Section F.8.6** of the EIA.	Contractor and Engineer to implement mitigation.	N/A	N/A
	Piling Vibrations	Condition surveys of all properties within 50 meters of bridge piles.	Engineer	N/A	N/A

	Blasting	• No blasting will be carried out within 100 m of the portal of the tunnel. • Blasting will be scheduled during the day only. • Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.	Contractor and Engineer to implement mitigation.	Engineers NES	Routine inspections of blasting activities.

Table G-3: Environmental Management Plan – Operational Phase

Subject	Potential Impact / Issue	Mitigation Measure	Responsibilities	Monitoring	Monitoring Responsibility & Schedule
Tree re-planting	Tree maintenance	If tree maintenance extends beyond the construction period the Contractor shall continue maintenance of the trees to complete the two-year maintenance period.	Contractor (during defects liability period) .	N/A	N/A
Noise	Traffic and road noise	Based on the results of the annual noise monitoring (see **Table G-5**) construct the noise barriers specified in **Table F-22**, or develop other noise mitigation measures, such as sound proof windows, in consultation with affected receptors.	Engineer (during defects liability period	N/A	N/A

Table G-4: Construction Phase Instrumental Monitoring

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
Air Quality	Establish routine ambient air quality monitoring throughout the construction period. The following parameters shall be monitored: Particulate Matter (PM_{10} & $PM_{2.5}$).	• KM 4.4 • KM 5.8 • KM 6.4 • KM 9.2 • KM 12.6 • KM 13.3	Monitoring to be undertaken monthly during construction period (30 months)	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within three days of the monitoring activity.
Noise	Ensure that routine noise monitoring is undertaken throughout the construction	• KM 4.4 • KM 5.8	Monitoring to be undertaken	The Engineer shall hire certified laboratory	The certified laboratory shall provide the

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
	period. Parameters to be monitored include: Laeq 1h (dBA)	• KM 6.4 • KM 9.2 • KM 12.6 • KM 13.3	monthly both daytime and night-time measurements during construction period (30 months)	to perform the monitoring activities.	results to the Engineer within three days of the monitoring activity.
Vibration	Vibration sensors for PPV monitoring.	At each tunnel location	Throughout tunnel blasting period.	Contractor to purchase, install and monitor vibration.	Weekly reporting of vibration results to the Engineer.
Surface Water Quality	Establish routine water quality monitoring throughout the construction period. The following parameters shall be monitored: pH; Suspended Solids; BOD5; COD; Coliforms; Nitrate (NO3); Phosphate (PO4); Oil and Grease	50 meters upstream from all bridge sites crossing rivers (3 locations) during construction; 50 meters downstream of the bridge site.	Monitoring to be undertaken monthly during bridge construction works	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within seven days of the monitoring activity.
Tunnel water	Monitoring of water from tunnel dewatering settlement tanks. Parameters will include all required to meet Georgian drinking water standards.	At all settlement tanks.	Weekly	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within 5 days of the monitoring activity.
Ground water	Monitoring of groundwater levels.	Selection of ten sites	Weekly	The Engineer shall perform the monitoring activities.	Weekly reporting by the Engineer to affected parties.
Soils	If required, undertake a soil sampling program on the stockpiles of excavated material to the north of the GAA.	Contractor to divide the stockpiles into ten	Monitoring to be completed before materials can be removed from the	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within 20 days of the

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
	Parameters to be monitored: All parameters tested in **Table E-13**, **Table E-14** and **Table E-15** of this EIA.	quadrants of mixed soil.	stockpile site.		monitoring activity. The Engineer will immediately provide the results to the Contractor for disposal as hazardous or non-hazardous materials.

Table G-5: Operational Phase Instrumental Monitoring

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
Air Quality	Air quality monitoring of PM_{10}, $PM_{2.5}$, NO_X, SO_X and CO.	Same as during the construction phase.	Bi-annually during DLP	Engineer (during defects liability period)	Bi-annual submission of results to JICA.
Noise	Noise monitoring - Laeq 1h (dBA) both daytime and nighttime periods.	At all receptors within Project corridor	Twice per year during DLP	Engineer (during defects liability period)	Annual submission of results to JICA for two years after the completion of the project.
Final noise barrier monitoring	Undertake noise monitoring at sensitive receptors behind finished noise barriers to ensure the barriers are functioning according to their design.	At all identified receptors.	Once, daytime and nighttime	Contractor	Provide final results to RD within one month of the completion of construction of any noise barrier.

G.4 EMP Costs

674. Most costs associated with the environmental recommendations of the EMP are a normal part of preparing the bid and contract documents and ensuring that proper environmental provisions are incorporated therein. The installation of septic systems at construction camps, for example, is an environmental necessity, but not generally considered an "environmental cost". **Table G-6** lists the proposed mitigation measures and indicates where they would be "included in the project budget" as part of a bid document and where additional costs are a likely "environmental cost" beyond what would normally be included in a project budget.

Table G-6: EMP Costs

Activity	Item	Number of Units / Unit cost /US$	Cost estimate / US$	Responsibility	Source: JICA	Source: RD
Pre-construction						
SSEMP	SSEMP and associated plans	Included in Project Construction costs	-	Contractor	X	
Approval of Camp locations	Approval	Included in Project Construction costs	-	Engineer	X	
Incorporation of Environmental Items into Bid Documents	Item in Bid Document	Included in Detailed Design Budget.	-	RD		X
Obtain permits	Permits	Included in Project Construction costs	-	Contractor	X	
SFF	Compensation	Approx. 4,200	Approx. 4,200	Contractor		X
Total Pre-construction costs						$4,200
Construction						
Standard site management	Septic Tanks	Included in Project Construction costs	-	Contractor	X	
Additional environmental measures	Spill Kits	20 / US$200	4,000	Contractor	X	
	Bunds for fuel and oil storage	Included in Project Construction costs	-	Contractor	X	
	Waste containers	Included in Project Construction costs	-	Contractor	X	
	Waste Storage areas	Included in Project Construction costs	-	Contractor	X	
	Waste collection and disposal	Included in Project Construction costs	-	Contractor	X	
	Storage areas for hazardous materials	Included in Project Construction costs	-	Contractor	X	
	Sprinklers for rock crushing plant	Included in Project Construction costs	-	Contractor	X	
	Drainage (including oil and grease interceptors)	Included in Project Construction costs	-	Contractor	X	

Activity	Item	Number of Units / Unit cost /US$	Cost estimate / US$	Responsibility	Source: JICA	Source: RD
	Vehicle washing bay	Included in Project Construction costs	-	Contractor	X	
	Fire safety	Included in Project Construction costs	-	Contractor	X	
	PPE	Included in Project Construction costs	-	Contractor	X	
	Impervious hardstanding (for maintenance yards, bitumen storage, etc)	Included in Project Construction costs	-	Contractor	X	
	First aid facilities	Included in Project Construction costs	-	Contractor	X	
	Animal Crossings	Included in Project Construction costs	-	Contractor	X	
	Fencing around borrow pits	8 / $,2000	$16,000	Contractor	X	
	Fencing around PCR	2 / $1,000	$2,000	Contractor	X	
	Water bowsers	Included in Project Construction costs	-	Contractor	X	
	Water sprinklers (rock crushing plant)	Included in Project Construction costs	-	Contractor	X	
	Dust control measures (rock crushing and batching plants)	Included in Project Construction costs	-	Contractor	X	
	Tarpaulins	Included in Project Construction costs	-	Contractor	X	
SFF Tree Cutting and tree removal	Labour	Included in Project Construction costs	-	Contractor	X	
Fencing around red-list species (over 8cm in diameter)	Fencing	Approximately 200 / $50	10,000	Contractor	X	
Re-planting of red-list species	Seedlings	615 / $10	6,150	Contractor	X	
Tunnel Excavation	Pre-condition surveys	Approximately 200 / $100	20,000	Contractor	X	
Tree / Vegetation maintenance	Labour and water	Included in Project Construction costs	-	Contractor	X	
Embankment vegetation and soil erosion measures	Vegetation, Labor and maintenance	Included in Project Budget	-	Contractor	X	
Potentially Contaminated Soil	Disposal of soil.	TBD	TBD	Contractor	X	

Activity	Item	Number of Units / Unit cost /US$	Cost estimate / US$	Responsibility	Source: JICA	Source: RD
Training & Awareness Programs	Safety Training	Included in Project Budget	-	Contractor	X	
	HIV/AIDS Training	4 / US$1,000	4,000	Contractor	X	
	Toolbox Training	Included in Project Budget	-	Contractor	X	
	Construction orientation meetings	Included in Project Budget	-	Contractor	X	
	Periodic meetings with stakeholders	Included in Project Budget	-	Contractor	X	
Clean-up of construction sites.	Labor, waste disposal	Included in Project Budget	-	Contractor	X	
Environmental Staff	EO	30 / US$ 2,000	60,000	Contractor	X	
	IES	5 / US$ 20,000	100,000	Engineer	X	
	NES	30 / US$ 1,500	45,000	Engineer	X	
Total Construction Costs						US$267,150
Operation						
Noise	Noise Barriers[22]	5,950 m / $1,352 m	8,044,440	Contractor	X	
	Noise Barrier foundations	4,822 m / $200 m	964,400	Contractor	X	
	Resettlement	Maximum 120	See RAP for costs	RD		X
	Other noise mitigation (noise proof windows, etc)	Maximum 120 receptors / US$2,000	240,000	Contractor	X	
Operation Costs						**US$9,248,840**
Total Cost						**US$9,520,190**

Table G-7: Construction Phase Instrumental Monitoring Costs

Activity / Item	Frequency / Responsibility	Unit Cost	Cost /USD
Air Quality Monitoring	Monthly (six sites) / Engineer to hire certified laboratory.	200 per site	36,000
Soil Sampling	Ten samples from each of the eight stockpiles (2,500m^3) / Engineer to hire certified laboratory.	400 per sample	32,000
Noise Monitoring	Monthly (six sites) / Engineer to hire certified laboratory.	200 per site	36,000
Surface Water Quality Monitoring	Weekly during construction period at the bridge sites crossing rivers (three sites) / Engineer to hire certified laboratory.	200 per site	28,800
Groundwater levels	Weekly during construction period of each tunnel / Engineer to hire	20 per site	2,880

[22] Cost estimate is provided by **Appendix H**.

	certified laboratory.		
Tunnel dewatering	Weekly during construction period of each tunnel / Engineer to hire certified laboratory.	200 per site	41,600
Vibration Monitoring	Continuous during blasting in the vicinity of tunnels. One sensor for each cluster of house within the risk zones. At least 5 sensors within 100 m and 5 beyond. 10 sensors in total / Contractor	800	8,000
Total			**185,280**

Table G-8: Operational Phase Instrumental Monitoring Costs

Activity / Item	Frequency / Responsibility	Unit Cost	Annual Cost /USD
1. Air Quality Monitoring to JICA	Bi-annually (six locations) for two years / Engineer (during DLP)	200 per site	2,400
2. Noise Monitoring for Noise Mitigation.	Twice per year (all affected receptors) / Engineer	200 per site	Maximum 80,000
Total			**82,400**

*Final noise barrier monitoring costs to be included in the general construction costs for the noise barriers

G.5 Site Specific EMP (SSEMP)

675. The SSEMP is the documents that the Contractor shall prepare outlining how he intends to implement the EMP and ensure that all of the mitigation and monitoring is completed according to the implementation arrangements specified in this EMP and the EIA as a whole.

676. The SSEMP will describe the precise location of the required mitigation / monitoring, the persons responsible for the mitigation / monitoring, the schedule and reporting methodology. The SSEMP will also include:

- Waste Management Plan.
- Traffic Management Plan.
- Occupational Health and Safety Plan.
- Emergency Response Plan.
- Borrow Pit Management Plan.
- Air Quality Plan.
- Spill Response Plan.
- Vibration Monitoring Plan.
- Clearance, Re-vegetation and Restoration Management Plan.
- Groundwater Management Plan.
- Tunnel Blasting Plan.

677. The SSEMP will be submitted to the Engineer and RD for approval at least 10 days before taking possession of any work site. No access to the site will be allowed until the SSEMPs are approved by the Engineer and RD.

G.6 Bid Documents

678. The Bid Documents for the potential Contractor will contain two sections relating to environmental issues, firstly a basic clause indicating that the Contractor

will be responsible for following the requirements of the EMP and that he should prepare his own SSEMP for the Project. Secondly, the EMP shall be repeated in its entirety as an Annex to the Bid Documents so as the bidder is aware of his environmental requirements under the Project and help him put environmental costs to his proposal.

G.7 Contract Documents

679. The Contract Documents will follow a broadly similar pattern to the Bid Documents. It is not considered necessary to repeat the mitigation measures verbatim in a list of environmental contract provisions, rather the Contract will specify that the Contractor is responsible for implementation of the EMP via his SSEMP. Again, the EMP will be included as an Annex to the Contract so the Contractor will be liable for any non-conformance with the EMP, and thereby this EIA.

G.8 Contractor Requirements

680. As stated above, the Contractor will be responsible for the preparation of the SSEMP. The SSEMP will need to be fully compliant with the EMP and this EIA as a whole and will need to be prepared within 30 days of Contract award and approved 10 days prior to access to the site.

681. During construction the Contractor must retain the expertise of an Environmental Officer (EO) to implement and continually update the SSEMP and to oversee and report on the operation throughout the contract period. The EO should be full-time member of staff on the Contractors roster and should be on site at least five days per week.

682. The required qualifications of the EO are as follows:
- Degree in environmental sciences and related expertise.
- Fluent in Georgian and English.
- Experience of at least one construction project of a similar size and scale.

678. The EO will be responsible for the preparation of weekly environmental checklists and an environmental section of the Contractor's monthly progress reports that shall be submitted to the Engineer for review.

683. The monthly reports, which will include the weekly environmental checklists, shall contain sections relating to:
(1) General Progress of the Project.
(2) Environmental Incidents; e.g. spills of liquids, accidents, etc.
(3) Progress of any environmental initiatives, e.g. energy savings, recycling, etc.
(4) Records of any environmental monitoring, both observational and instrumental.
(5) Conclusions and Recommendations.

684. The EO shall provide daily toolbox training at the construction camp and also at construction sites. The EO shall keep a record of all monthly training and toolbox training undertaken.

G.9 Engineer Requirements

685. As noted in the mitigation plans below, the Engineer is tasked with specific responsibility to review designs and ensure safeguard compliance of civil works – with particular emphasis on the monitoring of implementation of EMP through the

Contractors SSEMP and related aspects of the project. The Engineer will also be responsible for reviewing and approving the monthly reports prepared by the Contractor, especially the first monthly report, to ensure that it contains all of the required reporting elements, such as instrumental monitoring results. The Engineer will also be responsible for regular review and attendance of the Contractors environmental, health and safety training.

686. The Engineer is also responsible for engaging external services from a certified laboratory for instrumental monitoring of air quality, noise and water during the construction phase.

687. The Engineer should retain the use of Environmental Specialist, both national (NES) and international (IES), to ensure that the Contractor is compliant with his environmental obligations. Terms of reference for both specialists is provided below.

Engineers National Environmental Specialist

688. Scope of Services: He/she will (i) review all documents and reports regarding the integration of environmental including contractor's environmental action plan, (ii) supervise the contractors' compliance to EMP, and (iii) prepare monthly compliance reports.

689. Qualification: Degree in environmental sciences or equivalent. Preferably five years' experience in conducting environmental impact assessments and implementation of environment mitigation plans and/or monitoring implementation of environmental mitigation measures during implementation of projects including highway projects funded by developing partners.

690. Time Period – The NES shall be employed permanently over the duration of the construction period.

Engineers International Environmental Specialist

691. Scope of Services: The IES will prepare a detailed action plan including environmental monitoring checklists to be completed by the NES. He/she will conduct environmental training and briefings to provide environmental awareness on JICA and the government environmental safeguards policies, requirements and standard operating procedures in conformity with the government's regulations and international practice for project and RD Safeguards staff; ensure baseline monitoring and reporting of Contractor's compliance with contractual environmental mitigation measures during the construction phase.

692. Qualification: Degree or diploma in environmental sciences or equivalent. Preferably fifteen years' experience in conducting environmental impact assessments and implementation of environment mitigation plans and/or monitoring implementation of environmental mitigation measures and health and safety plans during implementation of projects including road projects funded by developing partners, including twelve years' international experience. Working knowledge of Georgia is preferred.

693. Time Period: The IES shall be engaged on a part-time basis for a period of five months spread over the duration of the construction period (two months per year). The specific on-site inputs will be determined by the Engineers Team Leader and the RD.

G.10 PMU Requirements

694. A review of the capacity of the RD was undertake as part of this EIA. The review indicates that the existing RD has sufficient expertise to adequately manage the Contractors environmental performance. The RDs safeguard department has extensive experience of implementing road projects for a range of donors, including ADB and JICA. As such no further capacity building is recommended within the RD.

G.11 EMP Implementation Summary

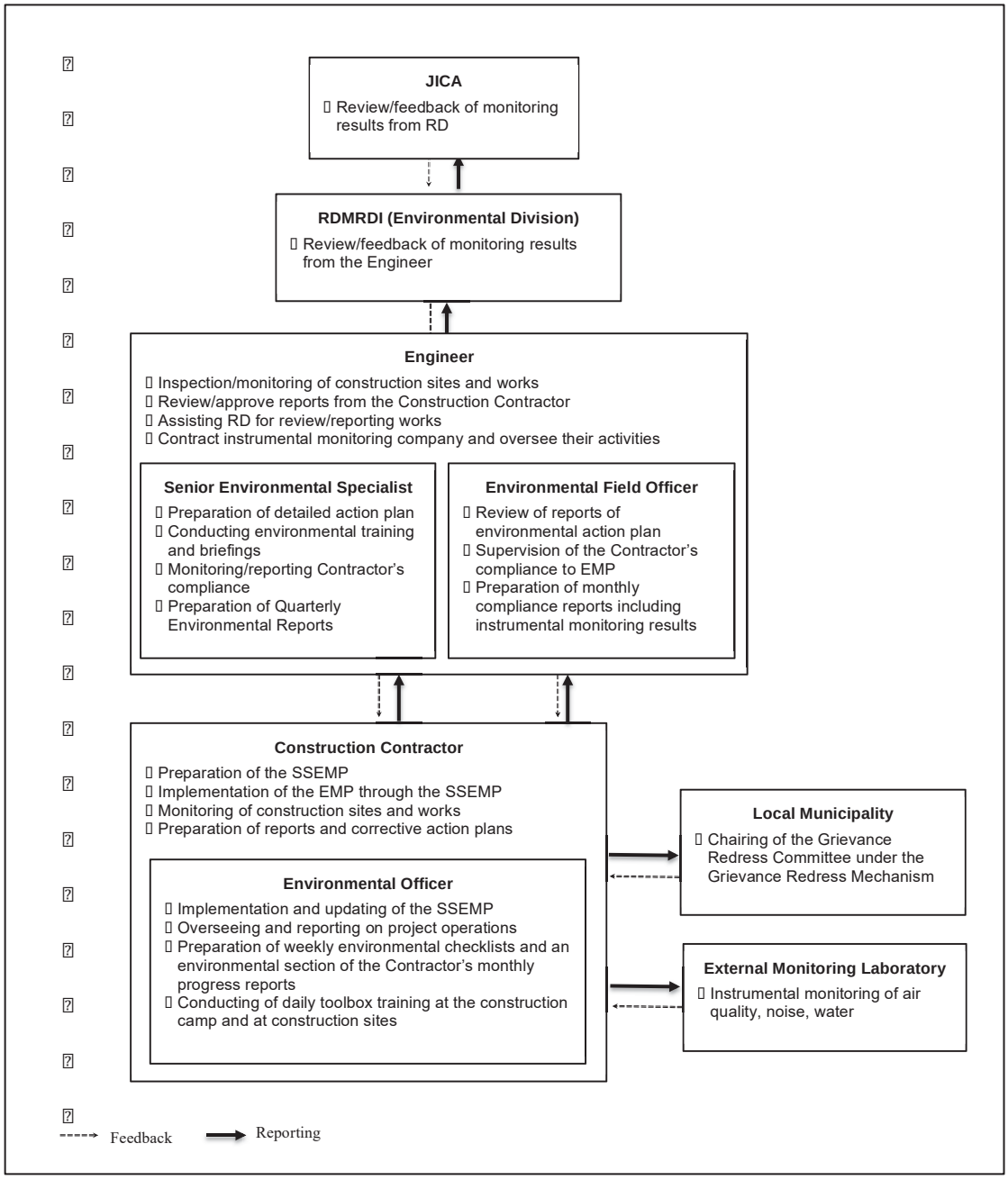
695. The following Table (**Table G-7**) summarizes the various institutional responsibilities for the implementation of the environmental management plan at various stages of the Project Road rehabilitation.

Table G-7: EMP Implementation

Project Stage	Responsible Institution	Responsibilities
Detailed Design	RD with the Detailed Design Consultant and EIA Team.	• Incorporate EMP mitigation measures into engineering design.
	RD	• Ensure EMP is incorporated into the works Contracts.
	RD	• Review Contractors proposals to ensure that they are aware of the EMP requirements and that line items for environmental management as per the EMP are included in the BOQ.
Pre-construction	Contractor	• Prepare SSEMP
	Engineer, JICA and PMU	• Review and approve SSEMP
	Contractor and Engineer	• Site Induction
Construction	Contractor (through its EM)	• Daily monitoring of environmental issues • Preparation of weekly environmental checklists • Preparation of Monthly environmental reports • Preparing Corrective action plans
	PMU	• Routine site visits to monitor Contractors performance.
	Engineer	• Weekly monitoring of the Contractors compliance with EMP / SSEMP by the NES. • Issuing the Contractor with Non-compliance Notices • Monthly reporting to RD of Contractors performance based on the review of Contractors weekly checklists and weekly site visits. • Quarterly Environmental Reports prepared by the IES and submitted to PMU and JICA.

696. **Figure G-1** illustrates the EMP implementation activities during the construction phase.

Figure G-1: Construction Phase EMP Implementation



H. Public Consultation, Information Disclosure & Grievance Mechanism

H.1 Public Consultations

697. According to the ADB Safeguard Policy Statement (2009):

"*The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:*

1. *Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;*
2. *Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;*
3. *Is undertaken in an atmosphere free of intimidation or coercion;*
4. *Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and*
5. *Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.*

Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report."

698. Category A EIA require two rounds of consultations which were undertaken in June 2017 and November 2017.

H.1.1 Scoping Consultations

699. Scoping consultations were held in June, 2017 in Zestafoni. The consultations were arranged by the RD. Information about the date, time and venue of the meeting was published in a newspaper. Communication with local municipal authorities was also undertaken to inform them of the meeting. Participants in the consultations were given an overview of the proposed project and then asked what they thought may be the significant issues that would require detailed study as part of an EIA. A copy of the presentation made can be found as **Appendix A**. The following provides an overview of the consultations (names of all attendees can be found in **Appendix B**).

Table H-1: Zestafoni Scoping Consultation

Date: 7th June, 2017 **Location:** Zestafoni Town Hall **Panel Members:** Mr. Nick Skinner – International Environmental Specialist Mr. Giansante Bonin – Team Leader Ms. Maka Stamateli – National Environmental Specialist Ms Lika Bubashvili – Environmental Specialist, Road Department of Georgia Mr. Gia Sopadze – Head of Environmental Division, Road Department of Georgia **List of Participants:** 40 Participants (see **Appendix B** for list)			
#	**Question / Comment**	**Answer**	**EIA Status**

1	In previous road projects in the region we have had bad experiences with disposal of spoil material, especially from tunnels. Locations were selected, but there was too much spoil material and as such locals were paid to allow spoil material to be dumped on their land.	We will ensure that adequate space is made available for spoil disposal. If additional areas are required for spoil material their locations will require approval by the Engineer and the RD.	Calculations of spoil material have been made and discussions have been held with the RD regarding the re-use of the material (See **Section F.7.3**). If other sites are to be chosen the Contractor will be responsible for following the procedures for spoil disposal also outlined in **Section F.7.3**.
2	Where will the borrow pits be located?	The locations have not been finalized at this stage.	The final locations of the borrow pits will be determined by the Contractor and will be based on a number of decisions including the quality and availability of materials as well as the costs to transport the materials. Notwithstanding the above, **Section F.7.5** contains specific provisions for the operating of new, or use of existing borrow pits, including specific provisions required by the GoG.
3	Landslides are a problem in this region, the project must carefully manage this issue.	We are aware of this issue and will make sure that the detailed design takes landslide issues into account.	As noted in **Section E.1.4**, several landslide areas have been identified. They are not anticipated to significantly impact on the Project, but further survey will be conducted. The Project is not anticipated to increase the chances of landslides occurring.
4	For every tree cut, at least three must be replanted as part of the project.	The exact tree-replanting requirements will be confirmed during the EIA preparation.	As noted in **Section F.6.1**, all trees within State Forest Fund locations that will be cut shall be replaced.
5	How will issues be resolved during the construction phase?	There will be a grievance mechanism for complaints to be aired and regular consultations throughout the construction phase with affected villages.	**Section H.3** provides the Grievance Redress Mechanism (GRM) for the Project. In addition, **Section F.8.2** provides requirements for the Contractor to undertake monthly community meetings in villages along the alignment in order to discuss specific issues before reaching the GRM level.
6	We are concerned about access to our property, both during the construction phase and the operational phase of the project.	This issue is noted and we will try to ensure that access is maintained as far as is practical throughout the construction phase.	Careful consideration has been given to the issue of access in this section. Only a small section of the new road will affect the existing road, and in this location two interchanges will be constructed that will provide access to this area during the operational phase of the Project. In addition, **Section F.7.1** states that the Contractor will ensure access to land and properties remains at all times during construction, through diversions, or temporary roads.

7	Will the Contractors repair access roads after construction works are completed?	We will include specific mitigation measures to ensure that access roads are left in the same condition as before the project.	**Section F.7.1** makes recommendations for a condition survey of the roads and for any roads to be repaired by the Contractor if the Engineer deems it necessary.
8	Will we be able to review your documents?	Yes, and we will hold a second round of consultations based on your review of the findings of this report.	As per **Section H.3.2**, this report and a Georgian EIA will be published on the JICA and RD websites. In addition a second round of consultations was held to discuss the draft EIA,
9	There are lots of cultural heritage sites along the corridor. How will they be protected?	We will identify all cultural heritage sites within the corridor and prepare mitigation measures to protect these resources.	Surveys of cultural heritage within the Project corridor have been undertaken (**Section E.4.4)** and none have been identified directly within the RoW with the exception of a small natural spring north of the GAA plant. Provisions have been outlined to protect this area, as well as a cemetery close to the Project alignment (see **Section F.9.5**). The Contractor will be responsible for following GoG procedures for chance finds as per Section.

Figure H-1: Scoping Consultation in Zestafoni, 7th June, 2017

H.1.2 Public Consultations

700. A second round of consultations were held in Zestafoni in January 2018. Participants in the consultations were presented with the initial findings of the EIA (see **Appendix C** for the presentation). The following provides an overview of the consultations (names of all attendees can be found in **Appendix D**).

Table H-3: Zestafoni Public Consultation

Date: 17th January, 2018 **Location:** Zestafoni

Panel Members: Mr. Nick Skinner – International Environmental Specialist Zura Mgaloblishvili - Director of Gamma Consulting Ltd (LCF) Elene Mgaloblishvili, Social Specialist of Gamma Consulting Ltd (LCF) **List of Participants:** 30 Participants (see **Appendix D** for list)			
#	**Question / Comment**	**Answer**	**EIA Status**
1	Is there a risk that construction of the highway results in loss of water in the wells around?	Impact on ground water is may be possible in the sections of the road where tunnels are planned. Prior to construction water wells in the boundaries of potential impact zone of tunneling works will be identified. Measures have been provided in the EIA to monitor groundwater and provide temporary/alternative source of potable water if impacts occur.	Impacts of groundwater from tunneling activities are addressed in **Section F.7.6** - Tunnels.
2	Construction of the highway is planned in the mineral water spring behind the GAA. Will it be affected?	During the construction works the spring will be fenced from the northern side to prevent impact of construction works. Close to the area of interest, excavation works capable to affect the flow are not planned. Impact on the spring is not expected.	Protection of the spring behind GAA is addressed in **Section F.8.5** - Physical and Cultural Resources
3	The lighting along the road will affect migratory birds. Has this risk been considered?	Illumination does have impact on wildlife, including birds (migratory and nocturnal). The impact cannot be fully avoided. However, modern Lower wattage flat lens lamps widely used on highways, direct light down and reduce glare. This enables to reduce light pollution effect to some extend.	Street lighting impacts and mitigation are addressed in **Section F.6.2** – Flora.
4	It is advisable to arrange additional access near Shorapani to make access to the highway for local population easier. Is this possible?	The design team has considered the aspect of access in considerable detail. However, in some instance not all of the access roads will be as convenient as they were with the existing road.	Access impacts are considered as part of the Detailed Design.

701. The meeting was also attended by Representative of MoENRP Irakli Pirckhaleishvili, Environmental Impact Permits Department, Senior Specialist in the Second category of the Permits Division. Other questions and comments raised by the participants, which are not related to environmental issues, are not included in the table above.

Figure H-2: Consultation in Zestafoni, January 17th, 2018

H.2 Planned Information Disclosure

702. It is anticipated that in compliance with JICA's requirements for EIAs (Category A environmental analyses), the document will be provided for disclosure on the JICA website and the RD Website (in local language).

703. The RD PMU will be responsible to notify and inform the public of construction operations prior to construction works, publish an emergency response plan disclosing his intentions to deal with accidents and emergencies, including environmental/public health emergencies associated with hazardous material spills and similar events, etc.

H.3 Grievance Mechanism

H.3.1 Introduction

704. Grievance redress mechanisms (GRMs) are institutions, instruments, methods, and processes by which a resolution to a grievance is sought and provided. GRM is seen by ADB as a pre-litigation mechanism for conciliation of disagreements and addressing concerns of project affected persons (PAPs) at early stages of dispute. GRM is aimed on smooth and creative resolution of disputes, minimizing time and resources waste and reputational risk to the project. The experience gained in ADB and other donor funded projects demonstrates that the efficient GRM enables to avoid time-consuming and complex legal procedures in majority cases of claims.

705. The GRM is an integral part of the ADB Accountability Mechanism (AM) that complements the problem solving (OSPF) and compliance review (CRP) functions of the ADB AM Policy 2012.

706. The GRM should be established and operated in compliance with the Georgian Regulations and ADB Policy requirements.

707. According to the ADB requirements, the GRM should be arranged to address

the resettlement related issues (SPS 2009 – Safeguard Requirements 2: Involuntary Resettlement, Requirement 7. Grievance Redress Mechanism) and the environmental concerns of the affected communities and other stakeholders (SPS 2009 - Safeguard Requirements 1: Environment, Requirement 5. Grievance Redress Mechanism).

H.3.2 Georgian Regulations

708. The Administrative Code of Georgia is the legal document defining the rules and procedures for the grievance review and resolution.

709. According to the law, the Administrative body receiving officially lodged claims is obliged to review the claims and engage the claimant in the grievance review and resolution process, and issue final decision in that regard.

710. Clause 181. defines the content and the grievance submission forms. In particular, the grievance package should include: a) Name of the administrative body to whom the complaints are addressed; b) Name, address and contact details of the claimant; c) Name of the administrative body, who's decisions or administrative acts are the subject of complain; d) Name of the administrative act or decision, which is subject of complain; e) Content of the claim; f) The context and facts, based on which the complaint is substantiated; g) list of attachments;

711. Clauses 194 and 198 define the rules and procedures ensuring participation of the claimants in the grievance review process.

712. According to the clause 202, the decision issued by the Administrative Body in relation with the reviewed claim has a status of individual administrative legal act.

713. The standard period given for the issuance of the decision in relation with the grievance is 1 month.

H.3.3 ADB Policy (SPS, 2009) Requirements

714. The borrower/client will establish a mechanism to receive and facilitate the resolution of affected persons' concerns and grievances about physical and economic displacement and other project impacts, paying particular attention to the impacts on vulnerable groups.

715. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project.

716. It should address affected persons' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the affected persons at no costs and without retribution.

717. The mechanism should not impede access to the country's judicial or administrative remedies. The borrower/client will inform affected persons about the mechanism.

H.3.4 Grievance Redress Process

718. At the LARP/EIA preparation stage, during the consultation meetings and

negotiations the PAPs shall be fully informed of the grievance redress mechanism, its functions, procedures, contact persons and rules of making complaints.

719. Grievance resolution is viewed as a two-stage process, first involving local resources for the grievance resolution and only in case of failure engaging top management and entire capacity of the central offices of RD/PIUs.

720. Grievance redress procedures of Stage 1 represent an informal tool of dispute resolution allowing the PAPs and the project implementation team to resolve the disagreement without any formal procedures, procrastination and impediments. Such informal grievance redress mechanism helps to solve most of the complaints without formal procedures (i.e. without using the procedures specified in the Administrative Code or litigation). This mechanism enables unimpeded implementation of the Project and timely satisfaction of complaints.

721. Care will always be taken to prevent grievances rather than going through official procedures of Stage 2. The achievement of this goal can be ensured through careful planning and preparation of EIA and LARP, active participation of PAPs, effective consultations, proper communication and coordination among local communities, IAs and local authorities.

722. In case of failure of the grievance resolution attempts at the stage 1, the process of grievance review and resolution enters Stage 2. Stage 2 is a process formalized in accordance with the Administrative Code of Georgia. The claimant submits official claim in a written form to the RD and the RD as an administrative body is conducting the grievance review and response process following requirements of the law, regarding time frames, involvement of claimant, etc. The stage 2 process may require involvement of different departments and specialists of the RD, its consultants, local authorities and other stakeholders.

723. If the grievance is not resolved at the stage 2, the claimant has right and possibility to apply to court and the GRM helps the claimant to prepare application package.

H.3.5 Grievance Redress Mechanism

724. The GRM consists of temporary, project-specific units established at the municipal level in project affected municipality and regular system established at the RD level:

- ***Grievance Redress Committee (GRCE)*** established at municipal level as a project-specific instrument, which is functional only for the period of the project implementation.
- ***Grievance Redress Commission (GRCN)*** is formed as permanently functional informal structure within the RD to ensure grievance review, resolution and record.

H.3.6 Grievance Redress Commission for Stage 1

725. A Grievance Redress Committee (GRCE) is an informal, project-specific grievance redress mechanism, established to administer the grievances at Stage 1. This informal body will be established at community level in both the affected Municipality. The representative of Zestafoni Municipality will be a Chairman of the GRCE. The RD representative(s) of Environmental and Resettlement Unit in GRCE shall coordinate the GRCE formation. The Contact Person will then be responsible for the coordination of GRC activities and organizing meetings. In addition, GRCE

shall comprise representative of Shorapani (Secretary), representatives of PAPs, women PAPs (if any), and appropriate local NGOs to allow voices of the affected communities to be heard and ensure a participatory decision-making process.

726. GRCEs will be established at the community level (office of the official Representative of Zestafoni Municipality). The establishment of GRCE will be formalized by the protocol of the first meeting, as a part of binding agreement of the Government and JICA. For the GRCE following composition is proposed (**Table H-4**). There shall be at least one female member of the GRCE.

Table H-4: GRCE Composition

1	Representative(s) of Environmental and Resettlement Safeguards Unit of RD	Member
2	Representatives of Zestafoni Municipality	Chairman
3	Representative of Shorapani	Member
4	Representative of PAPs	Member
5	Representative of NGO	Member
6	Representative of Contractor	Member
7	Environmental and Resettlement Specialists of Engineer	Member

727. The representative(s) of the Environmental and Resettlement Unit of RD shall coordinate the work of the Committee and at the same time they will be the contact person for collecting the grievances and handling grievance log. The local authorities at the municipal level (Zestafoni), Contractor, Engineer, as well as PAPs (through informal meetings) will be informed about the contact person.

728. The PAPs should be informed about the available GRM. This shall be achieved through the public consultation process and routine community meetings throughout the construction phase.

H.3.7 Grievance Redress Commission for Stage 2

729. Grievance Redress Commission (GRCN) is formed by the order of the Head of the RD as a permanently functional informal structure, engaging personnel of RD from all departments having regard to the environmental and LARP issues and complaint resolution. This includes top management, Environmental and Social Safeguards Units, Legal Departments, PR department and other relevant departments (depending on specific structure of the RD). The GRCN is involved at the Stage 2 of grievance resolution process. The Order shall also state that if necessary representative of local authorities, NGOs, auditors, representatives of PAPs and any other persons or entities can be engaged in a work of GRCN. For the GRCN the following composition is proposed in **Table H-5**. There shall be at least one female member of the GRCE.

Table H-5: GRCN Composition

1	RD Management	Member
2	Head of Environmental and Social Safeguards Unit at RD	Member
3	Legal Department of RD	Member
4	PR Department of RD	Member

H.3.8 Grievance Redress Procedures

Stage 1 – informal review of the AP's complaint (whether written or oral)

730. **Grievance Collection and registration.** The representative(s) of the Environmental and Resettlement Unit of the RD is the person responsible for collecting the grievances received from different entry points and for recording them. Through the consultations conducted at the early stages of the project development and throughout construction, the PAPs will be informed that grievances should be addressed directly to the Contact Person. However, it is expected that some portion of grievances will be addressed to the local authorities at the Municipal level, to the Contractor and Engineer. All these stakeholders will arrange entry points and recording systems for grievances and will readdress the grievances to the Contact Person. Further, the Contact Person will register the grievances and will coordinate the grievance resolution process, engaging the required members of GRCE.

Step 1: Informal negotiations

731. The Representative of the RD will review the grievance, and based on that will:

- Define the list;
- Agree with the claimant the date and site for the informal meeting;
- Conduct meetings, site visits and negotiations with the PAP with participation of relevant members of the GRCE; and
- Will document all site-visits, meetings and discussions with the involved parties (minutes of meetings, photos, etc.)

732. In case of amicable resolution of the dispute, a Protocol of Agreement (Protocol 1: Action Plan) will be prepared by the RD describing agreed actions, dates, other conditions. The protocol will be signed by the claimant and Contact Person. The Action Plan should define:

- Clear timeline for each action; and
- Parties responsible for undertaking and completing each action, budget.

733. After implementation of the agreed action another protocol is prepared by the RD (Protocol of Grievance Closure), which confirms the fact that the parties have finally resolved the dispute. The protocol will be signed by RD as a representative of GRCE and by the claimant.

Step 2.: Formal Review of the Grievance by GRCE:

730. If informal negotiations conducted as step 1 of the stage 1 process fails to resolve the issue, the official procedure of the grievance review by the GRCE is triggered.

734. The Contact Person of Environmental and Resettlement Safeguards Unit of RD assists the claimant to prepare the official written claim addressed to the GRCE

and supplements this by his information notes.

735. The written claim will contain the following information:
- Name and contact details of the claimant;
- Date of submitting claim;
- The brief description of the essence of claim; and
- Documents prepared (photos, maps, other documents) confirming the information presented in a claim.

736. The RD and all members of the GRCE regarding the need of execution of the formal GRCE procedure. The RD will agree the date of formal meeting with the chairman and Secretary of the GRCE and inform the claimant and all members of the GRCE regarding the meeting site and date. The meeting should be held not later than two weeks after the notification issued by the RD. The RD will distribute the claim supplementary documents among the GRCE members.

737. The GRCE will engage all required specialists in reviewing the claim and, in case of need, will invite them on a planned meeting. During 1 week after the meeting the GRCE will issue its Conclusion and the Contact Person will inform the claimant about the decision.

738. In case of amicable resolution of the dispute, a Protocol of Agreement is prepared by the RD describing agreed actions, dates, other conditions. The protocol is signed by the claimant and Chairman of the GRCE.

739. After implementation of the agreed action the Protocol of Grievance Closure is prepared by the RD. The protocol will be signed by the Chairman of GRCE and by the claimant.

737. If informal negotiations conducted as stage 1 process fails to resolve the issue, the grievance resolution by GRCE at the local level is considered as not sufficient and the claim resolution process by GRCN at the central level is triggered.

738. The RD assists the claimant to prepare the official written claim addressed to the GRCE and supplements this by his information notes.

740. The written claim will contain following information:
- Name and contact details of the claimant;
- Date of submitting claim;
- The brief description of the essence of claim; and
- Documents prepared (photos, maps, other documents) confirming the information presented in a claim.

Stage 2 – Official Review of the Grievances by GRCN

741. The Stage 2 process is triggered by notice from the RD sent to the GRCN with the attached claim and the supplementary package of documents prepared with the assistance of the RD. The notice sent by the RD contains brief description of the grievance review and resolution attempts made at the Stage 1, including explanation of the reasons of disagreement and attachments (minutes of meetings, protocols, photos etc.).

742. Upon receiving the grievance and supplementary documents, the secretary of the GRCN will register the claim in a grievance log and initiate the formal grievance

review and resolution process in accordance with the requirements of the Administrative Code. The GRCN members will discuss the issue and engage relevant departments and specialists of the RD, in order to find solutions for the grievance resolution. In case of need the specialists from other governmental institutions or expert groups could be also engaged.

743. Not later than two weeks from receiving the claim, the GRCN will conduct a formal hearing participation of the claimant at a date fixed by the GRCN member secretary. On the date of hearing, the aggrieved PAP will appear before the GRCN at the RD office for consideration of grievance. The member secretary will note down the statements of the complainant and document all details of the claim, proposed solutions and final agreement.

744. In case of amicable resolution of the dispute, a Protocol of Agreement (protocol 1) is prepared by the Secretary of GRCN, describing agreed actions, deadlines and other conditions. The protocol is signed by the claimant and Chairman of the GRCN.

745. After implementation of the agreed action the Protocol of Grievance Closure is prepared by the Secretary of GRCN. The protocol will be signed by the Chairman of GRCE and by the claimant.

746. If the RD decision fails to satisfy the aggrieved PAPs, they can pursue further action by submitting their case to the appropriate court of law (Rayon Court). GRCN (secretary) will help the claimant to prepare the documents for submission to the Rayon (municipal) court.

747. A brief description of all stages of Grievance Resolution Process are given in the **Table H-6** below.

Table H-6: Grievance Resolution Process

Steps	Action Level	Process
Stage 1 (GRCE Level)	Step 1: Informal negotiations with PAPs	The complaint is informally reviewed by the GRCE Contact Person – Representative of Environmental and Resettlement Unit of RD, which takes all necessary measures to resolve the dispute amicably. At this stage, RD Contact Person engages in discussions with PAP only those members of the GRCE, who have direct relation to the issue.
	Step 2: Formal negotiations with PAPs GRCE level resolution of grievance	If the oral grievance is not solved during the negotiations, the GRCE will assist the aggrieved PAPs to formally lodge the grievances to the GRCE. The aggrieved PAPs shall submit their complaints to the GRCE within 1 week after completion of the negotiations at the village level or later, as he wishes. The aggrieved PAP shall produce documents supporting his/her claim. The GRCE RD Contact Person will review the complaint and prepare a Case File for GRCE hearing and resolution. A formal hearing will be held with the GRCE at a date fixed by the GRCE RD Contact Person. On the date of hearing, the aggrieved PAP will

		appear before the GRCE at the Municipality office for consideration of grievance. The member secretary will note down the statements of the complainant and document all details of the claim. The decisions from majority of the members will be considered final from the GRCE at Stage 1 and will be issued by the RD Contact Person and signed by other members of the GRCE. The case record will be updated and the decision will be communicated to the complainant PAP. After implementation of the agreed action the Protocol of Grievance Closure is prepared by the RD Contact Person. The protocol will be signed by the Chairman of GRCE and by the claimant.
Stage 2	Step 3 Decision from central RD GRCN	If any aggrieved PAP is unsatisfied with the GRCE decision, the next option will be to lodge grievances to the RD at the national level. GRCE should assist the plaintiff in lodging an official complaint to GRCN (the plaintiff should be informed of his/her rights and obligations, rules and procedures of making a complaint, format of complaint, terms of complaint submission, etc.). The aggrieved PAP shall produce documents supporting his/her claim, in accordance with the legal requirements (Administrative Code of Georgia). The GRCN of the RD shall review the complaint in compliance with the procedures specified in the Administrative Code of Georgia. If needed, a formal hearing will be held with the GRCN at a date fixed by the GRCN member secretary. On the date of hearing, the aggrieved PAP will appear before the GRCN at the RD office for consideration of grievance. The Contact person will note down the statements of the complainant and document all details of the claim. The plaintiff shall be informed of the decision.
Stage 3	Step 4 Court decision	If the RD decision fails to satisfy the aggrieved PAPs, they can pursue further action by submitting their case to the appropriate court of law (Rayon Court). The aggrieved PAP can take a legal action not only about the amount of compensation but also any other issues, e.g. occupation of their land by the contractor without their consent, damage or loss of their property, restrictions on the use of land/assets, etc.

H.3.9 Grievance Log

748. The Grievance Logs will be developed at GRCE level.

Grievance Log in GRCE

749. The GRCE Grievance Logs will be developed and maintained at the Municipal level.

750. The Grievance Logs will be developed and managed by the RD representative at site. The logs will be kept on Excel files and shared copies will be available at the RD and at site in the Engineers office. The records in Grievance logs include the following information:

- Name and contact details of the claimant;
- Date of receiving claim;
- Form of claim – (oral or written);
- To whom the claim has been addressed initially (entry point);
- The brief description of the essence of claim;
- The stages, dates and participants of negotiations with the PAP with GRCE (stage 1);
- Minutes of meetings;
- Final decision of the GRCE (in case of the dispute is resolved, the decision is about closure of the issue. In case if the dispute remains unresolved, the decision is about passing to the stage 2 of the grievance redress process);
- Date of decision of GRCE; and
- Documents prepared by PAP with the help of GRCE for passing to GRCN.

751. The copies of the records/documents may be also kept in the municipal office.

ADB Accountability Mechanism Policy, 2012

752. In addition to the GRM, the ADB has also developed its Accountability Mechanism (AM) Policy. The AM provides a forum where people adversely affected by ADB-assisted projects can voice and seek solutions to their problems and report alleged noncompliance with ADB's operational policies and procedures. It consists of two separate but complementary functions: problem solving function and compliance review function. The objective of the Accountability Mechanism Policy 2012 is to be accountable to people for ADB-assisted projects as a last resort mechanism.

H.3.10 Disclosure of the Grievance Process

753. The complaints resolution process was presented formally during the public consultations. The grievance redress mechanism will also be presented during routine community meetings in the Project area during the construction phase of the Project.

I. Conclusions and Recommendations

I.1 Conclusions

754. This EIA has established that there are no significant environmental issues that cannot be either totally prevented or adequately mitigated to levels acceptable GoG and international standards for all Project activities. However, further detailed assessment is required to determine the exact nature and extent of noise impacts within the Project corridor so that suitable and cost effective mitigation measures can be provided.

755. The total estimate costs of the environmental mitigation and management to be funded by JICA has been calculated at approximately US$9,787,870, or approximately 3% of the total project cost of $328m. This figure does not include costs of resettlement of people affected by noise (which will be included in the Project LARP).

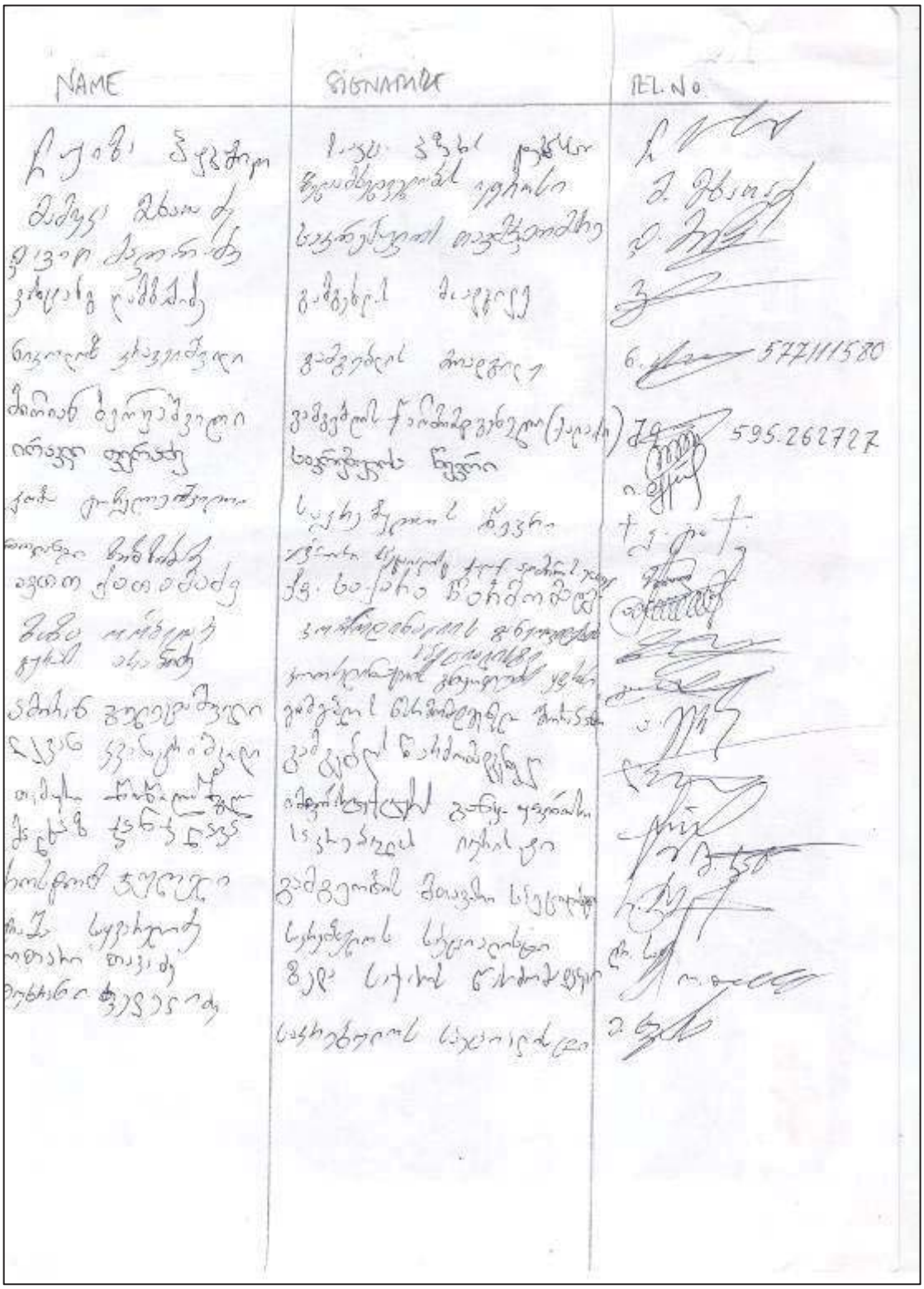
I.2 Recommendations

756. The EMP, its mitigation and monitoring programs, contained herewith will be included within the Bidding documents for project works for all Project components. The Bid documents state that the Contractor will be responsible for the implementation of the requirements of the EMP through his own SSEMP which will adopt all of the conditions of the EMP and add site specific elements that are not currently known, such as the Contractors borrow pit locations. This ensures that all potential bidders are aware of the environmental requirements of the Project and its associated environmental costs.

757. The EMP and all its requirements will then be added to the Contractors Contract, thereby making implementation of the EMP a legal requirement according to the Contract. He will then prepare his SSEMP which will be approved and monitored by the Engineer. Should the Engineer note any non-conformance with the SSEMP (and the EMP) the Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SSEMP the Contractor should employ an Environmental Manager to monitor and report Project activities throughout the Project Construction phase.

APPENDIX A

List of Consultation Attendees, June 2017


NAME
SIGNATURE
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APPENDIX B

Consultation Presentation, June, 2017

Project Overview

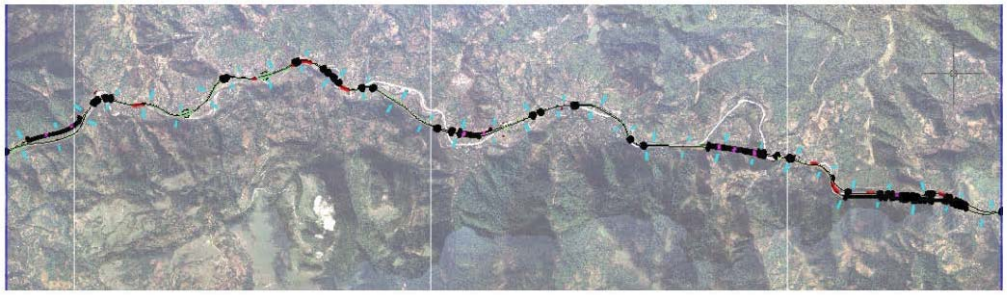
The Project is construction of a new road requiring new tunnels, bridges and other structures in order to allow traffic capacity expansion. Construction will be undertaken in difficult topographic and geological conditions without interrupting the traffic flow.

Item	Description
Road Length	41.665 km
Road Width / Number of Lanes	27m/4 lanes
Design Speed	100/80 km/h
Number of Bridges	77
Number of Tunnels	40
Construction Period	3 years

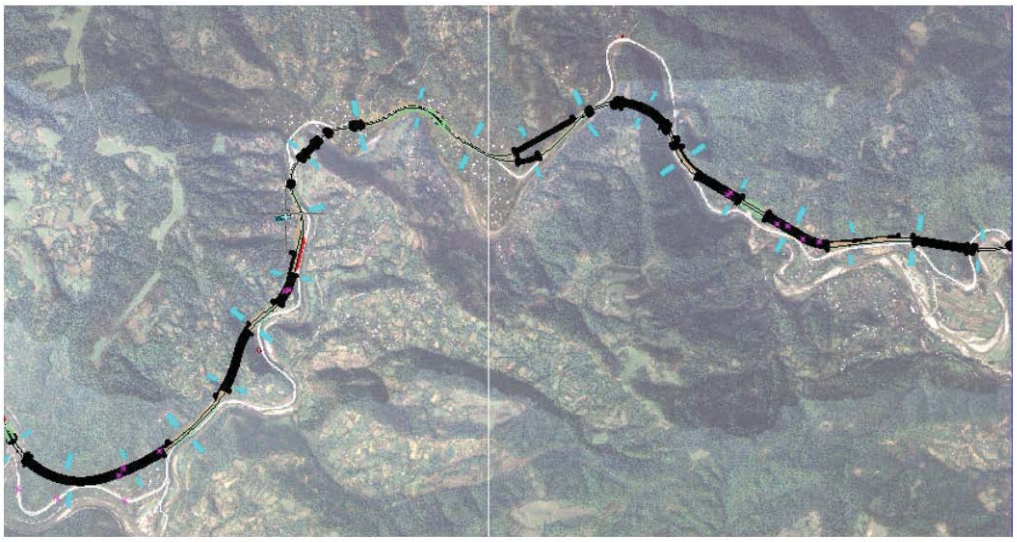
Project Location

Khevi-Argveta section of E60 Highway starts at the 9th km west from the existing Rikoti tunnel and ends near village Argveta. The entire section is divided in 3 Lots: F2-F3-F4

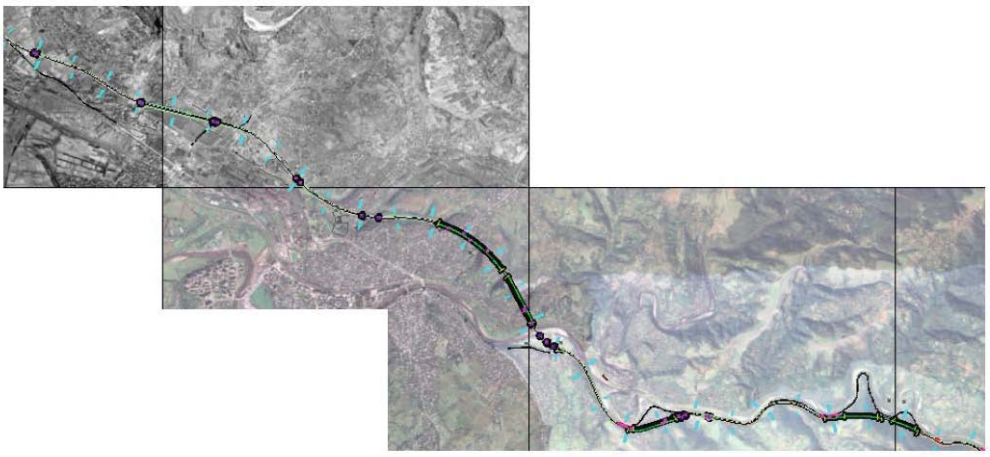
1st Lot: F2 (from km 8+880 to km 24+266 – Tot Length = 15.4 km



3rd Lot: F4 (from km 34+695 to km 50+545 – Tot Length = 10.4 km



2nd Lot: F3 (from km 24+266 to km 34+695 – Tot Length = 10.4 km



Need for the Project

Transport sector development in Georgia is essential for the achievement of sustainable economic growth, alleviation of poverty and promotion of tourism.

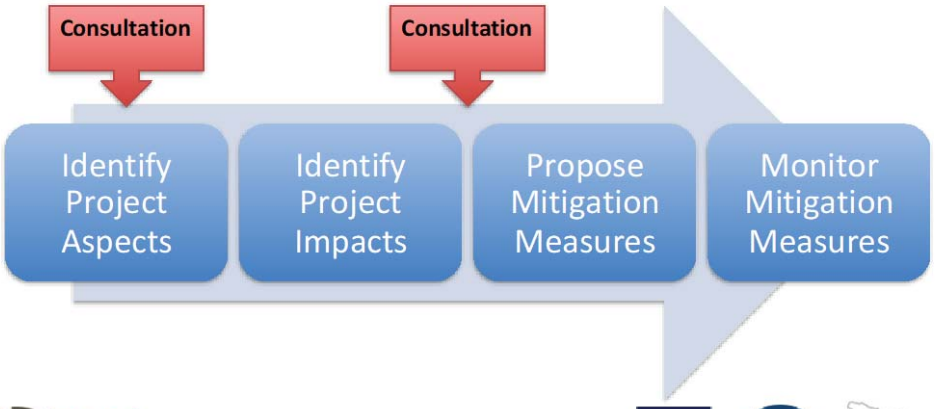
Deterioration of transport infrastructure increases the cost of doing business, deters foreign investment, hampers transit traffic growth, and leaves segments of the population out of mainstream economic activities.

Georgia's geographical location is at the center of East-West (Black Sea and Caspian Sea) and North-South (between Russia and Turkey) transit routes.

Trade with neighboring countries is therefore an important driver of Georgia's economy.

What is EIA?

"A process for predicting and assessing the potential environmental and social impacts of a proposed project, evaluating alternatives and designing appropriate mitigation, management and monitoring measures."



Need for Consultations

EIA of the Project is required by both Government of Georgia and the Asian Development Bank (ADB)

ADB specifically state:

"The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation."

For environment category A projects, such consultations will include consultations at the early stage of EIA field work and when the draft EIA report is available during project preparation, and before project appraisal by ADB.

Type of Consultations

Second round – review draft EIA and comment on the findings of the report

First Round – Initial discussions regarding the scope of the EIA and potential impacts

Other EIA Activities

1. Collection of Baseline Data, including surveys of flora, fauna & rivers.
2. Instrumental monitoring of existing air quality, noise and water quality.
3. Review regulatory requirements.
4. Examine potential alternatives.
5. Assess impacts using tools such as impact matrices and models (air and noise)
6. Prepare of Environmental Mitigation and Monitoring Plans

Potential Physical Impacts

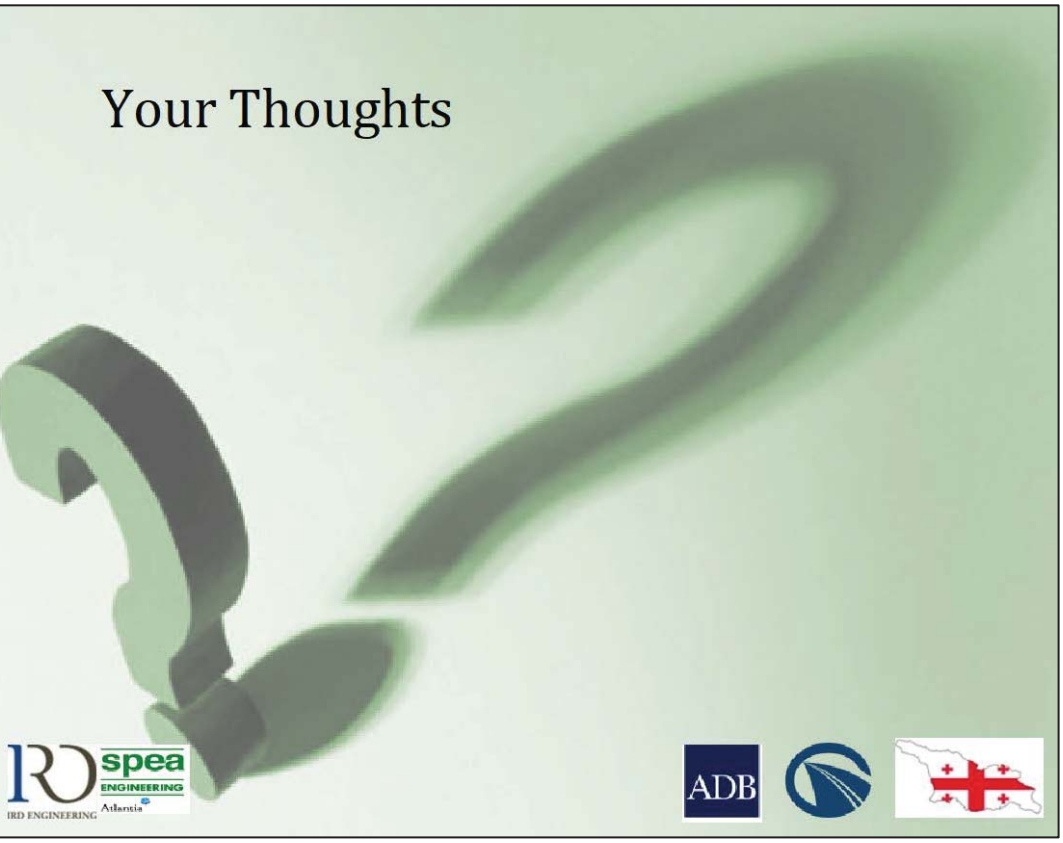
Aspect	Potential Impact
Air quality	• Dust during construction – from vehicle movement, batching plants, blasting, tunneling, etc. • Vehicle and machinery emissions both during construction and operational phases of the project.
Soils	• Spills and leaks of hazardous liquids. • Poor management of borrow pits. • Soil Erosion during the operational phase.
Water Quality	• Spills and leaks of hazardous liquids into rivers. • Sedimentation of water ways. • Poor disposal of waste water from camp sites.
Climate Change	• Increased levels of GHGs from vehicle emissions. • Impacts of climate change to the Project, e.g. flooding.

Potential Biological Impacts

Aspect	Potential Impact
Flora	• Clearance of vegetation for road widening, borrow pits, construction camps and access roads. • Illegal cutting of trees. • Damage to trees and vegetation during construction.
Fauna	• Destruction of habitat for road widening, borrow pits, construction camps and access roads. • Blocking migration routes. • Degradation of river habitat and associated impacts to fish and other aquatic fauna.
Protected Areas / Forests	• Degradation of forests for road widening, borrow pits, construction camps and access roads.

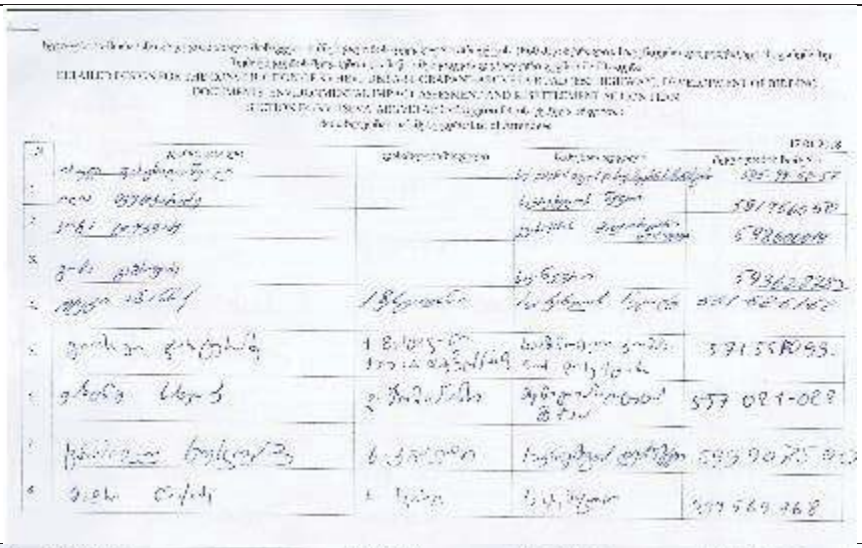
Potential Socio-economic Impacts

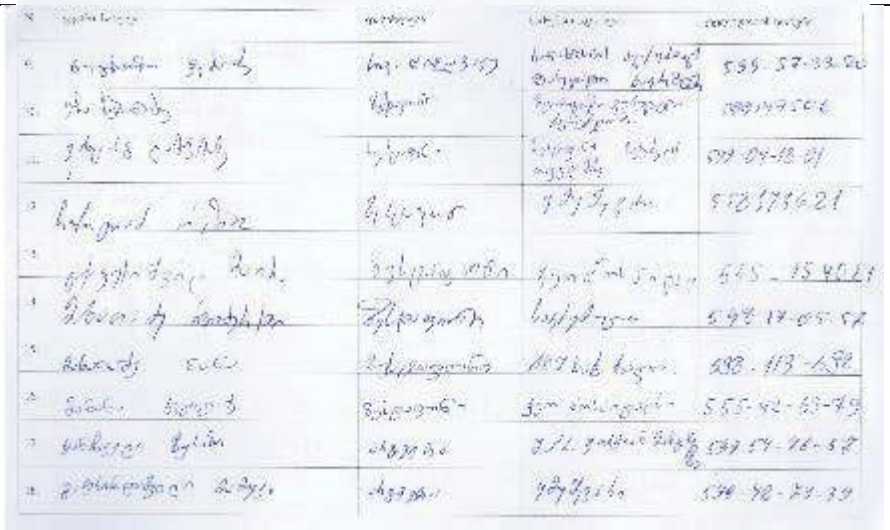
Aspect	Potential Impact
Access	• Construction works impeding access to properties and shops / businesses.
Noise	• Elevated noise levels during both construction and operational phases of the project.
Traffic and Safety	• Construction traffic accidents. • Blasting during tunnel excavation and embankment works. • Accidents to workers. • Accidents involving the public at work sites.
Waste	• Illegal dumping of solid and liquid waste • Poor management of hazardous waste leading to pollution of soil, groundwater and health impacts
Cultural Heritage	• Road encroaching on cemeteries and sites of cultural value

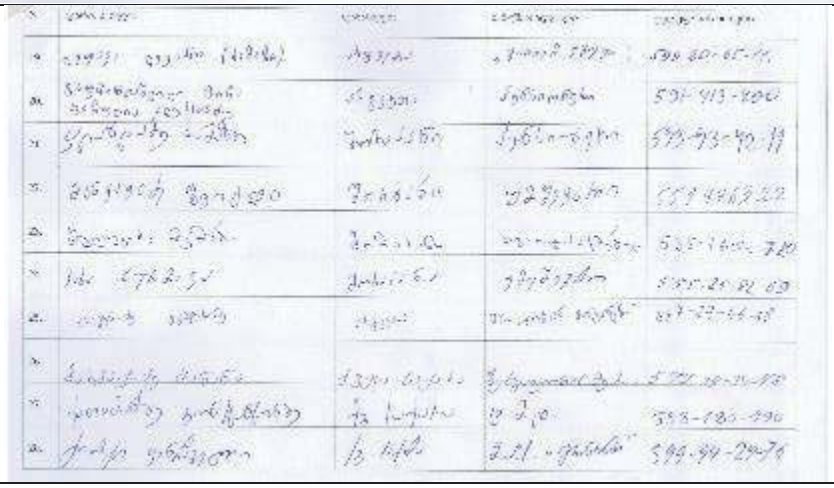


APPENDIX C

List of Consultation Attendees, January 2018







APPENDIX D

Consultation Presentation, January, 2018


Tbilisi
Argveta
jICA
spea
ENGINEERING
Atlantia
IRD ENGINEERING


2

პროექტის მიზანი

- საქართველოს მთავრობა ახორციელებს ქვეყნის ძირითადი საგზაო მაგისტრალების მოდერნიზაციას.
- პროგრამის ფარგლებში, ევროპის იაპონიის საერთაშორისო განვითარების სააგენტოს (JICA) დაფინასებით, იგეგმება ქვ.წევა-არგვეთას გზის მონაკვეთის მშენებლობა.

3

პროექტის გზშ-ს საფუძველი - საქართველოს კანონმდებლობა და საერთაშორისო მოთხოვნები

- საქართველოს კანონმდებლობით - საერთაშორისო და შიდასახელმწიფოებრივი მნიშვნელობის საავტომობილო გზის, რკინიგზის და მათზე განთავსებული ხიდის, გზაგამტარის, გვირაბის საჭიროებს გარემოზე ზემოქმედების შეფასებას.
- საერთაშორისო საფინანსო ინსტიტუტების მოთხოვნების შესაბამისად - პროექტი მიეკუთვნება ე.წ. A კატეგორიას და საჭიროებს გარემოზე ზემოქმედების შეფასებას

4

მონაწილე მხარეები

- ✓პროექტი ხორციელდება რეგიონალური განვითარების და ინფრასტრუქტურის სამინისტროს საავტომობილო გზების დეპარტამენტის ხელმძღვანელობით;
- ✓პროექტი მუშავდება იტალიური კომპანიების „აი არ დი“-ს და „სპეა“-ს (IRD- SPEA) კონსორციუმის მიერ;
- ✓გარემოზე ზემოქმედების შეფასება და განსახლების სამოქმედო მომზადებაზე პასუხისმგებელია “გამა კონსალტინგი” **IRD- SPEA-**ს ექსპერტებთან თანამშრომლობით.

5

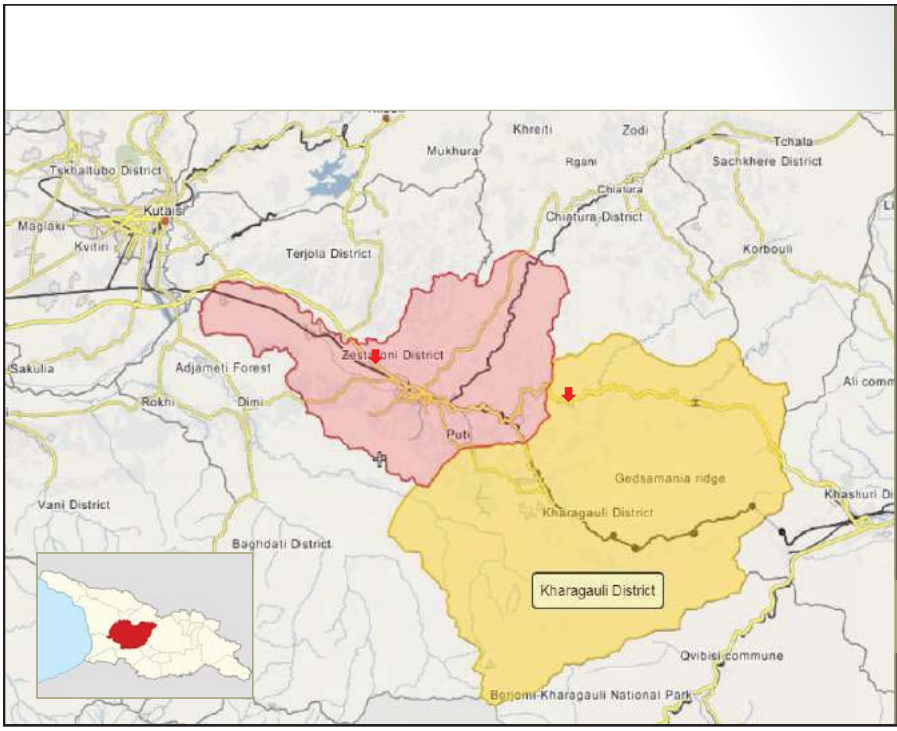
ალტერნატივები

უპირატესი ვარიანტის შესარჩევად განხილული ალტერნატივები:

- ნულოვანი (არაქმედების) ალტერნატივა
- ტექნიკურ-ეკონომიკური შეფასების ეტაპზე განხილული 3 ოპტიმიზებული ალტერნატივა
- ახალი მარშრუტი (ტექნიკურ-ეკონომიკური შეფასებისას განხილული დერეფნის ფარგლებში)
- გზის საფარის ალტერნატივები (მყარი/ხისტი)

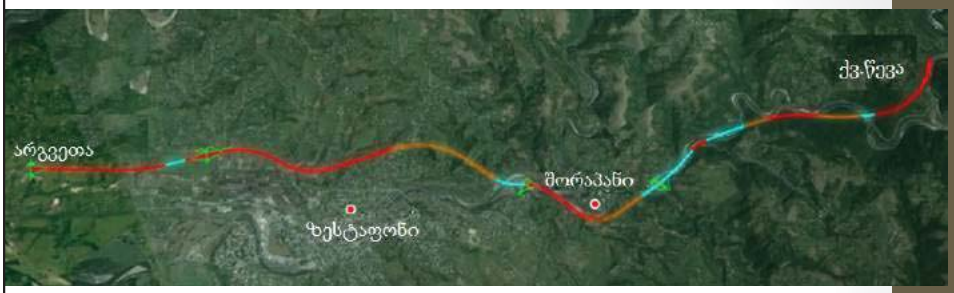
6

7


Khreiti
Zodi
Mukhura
Tchala
Rgani
Sachkhere District
Tskhaltubo District
Chiatura
Kutaisi
Chiatura District
Maglaki
Kvitiri
Korbouli
Terjola District
Zestaponi District
Sakulia
Adjameti Forest
Rokhi
Dimi
Puti
Gedsamania ridge
Vani District
Kharagauli District
Baghdati District
Kharagauli District
Qvibisi commune
Borjomi-Kharagauli National Park

8

პროექტის აღწერა



წითელი - გზა;
ცისფერი - ხიდი;
ყავისფერი - გვირაბი

გზის სიგრძე:

- თბილისი არგვეთას მიმართულება - 14.778 კმ;
- არგვეთა - თბილისის მიმართულება - 14.726 კმ.

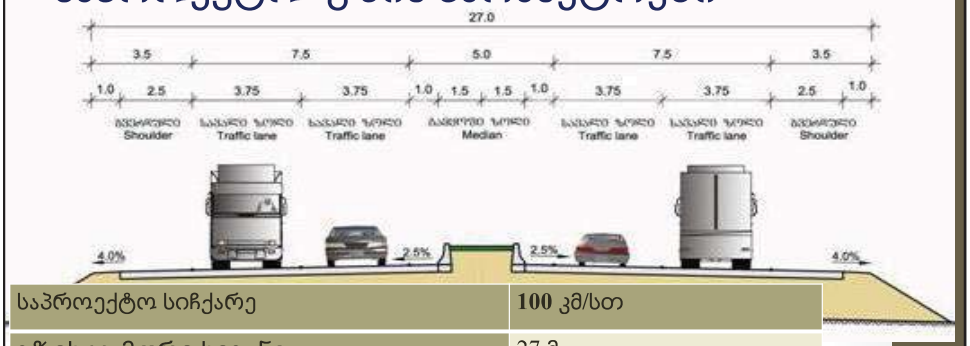
9

პროექტის აღწერა

- საპროექტო მონაკვეთის სიგრძე 14.7 კმ
- საპროექტო მონაკვეთი იწყება თბილისი-სენაკი-ლესელიძეს საავტომობილო გზის 185-ე კმ-ზე და სრულდება ამავე გზის 200 კმ-ზე სოფ. არგვეთასთან.
- პროექტით გათვალისწინებულია ხიდების (ჯამური რაოდენობა **10**) და გვირაბების (გვირაბები **6** ორმაგი გვირაბი, სიგრძით 399-დან 1166 მ-მდე) მშენებლობა.
- პროექტის ფარგლებში ასევე მოეწყობა:
  - გადასასვლელები სოფლის გზებისთვის;
  - გასასვლელები პირუტყვისთვის;
  - კულვერტები

10

საპროექტო გზის პარამეტრები



საპროექტო სიჩქარე	**100** კმ/სთ
გზის ჯამური სიგანე	27 მ
სავალი ნაწილის ჯამური სიგანე:	2x7.5 მ
ზოლების რაოდენობა:	4
ზოლის სიგანე:	3.75 მ
ცენტრალური არეზერვო სიგანე:	5.0 მ
გვერდულის სიგანე:	2.5 მ
გზისპირის სიგანე:	1 მ

11

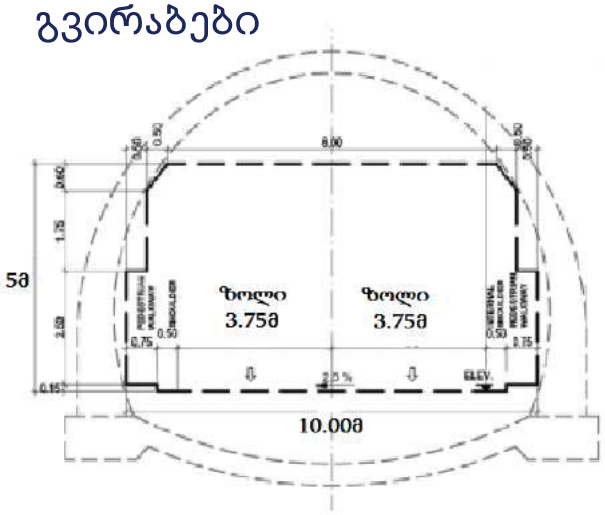
ხიდები

ხიდი #	დასაწყ. პკ (მ)	ბოლო პკ (მ)	მდინარე	ხიდის სიგრძე (მ)	მალის სიგრძე, მ
1-AT	1,256	1,846	ძირულა	589	42, 48, 54
1-TA	1,250	1,890	ძირულა	640	და 60
2-AT	2,039	2,980	ძირულა	941	
2-TA	2,050	2,930	ძირულა	880	
3-AT	3,230	3,485	ბორიმელა	255	34
3-TA	3,210	3,470	ბორიმელა	260	
4-AT	5,862	6,317	ყვირილა	455	48, 54, 60
4-TA	5,853	6,273	ყვირილა	420	და 72
5-AT	9,044	9,240	-	196	34
5-TA	9,018	9,214	-	196	
6-AT	7,061	7,101	-	40	
6-TA	7,031	7,071	-	40	
ჯამი				4,812	

#3,5 - სხმული ბეტონის; # 1,2,4 - ფოლად-ბეტონის

12

გვირაბები



გვირაბების ვერტიკალურ ცენტრალურ ღერძებს შორის მანძილი =30მ

გვირაბი აღჭურვილი იქნება ვენტილაციით, ხანძრ-საწინააღმდეგო, ავარიული სატელეფონო სისტემებით, საავარიო გასასვლელებით.

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გვირაბები

გვირაბი #	სიგრძე (მ)	პიკეტაჟი		ლითოლოგია
		დასაწყ.(მ)	ბოლო (მ)	
01-AT	560	165	725	საშუალო ხარისხის ქანები
01-TA	399	226	625	
02-AT	510	725	1,235	
02-TA	445	725	1,220	
03-AT	1,165	3,472	4,637	
03-TA	804	3,490	4,294	
04-AT	715	6,330	7,045	ზომიერად სუსტიდან საშ. ხარისხის ქანებამდე
04-TA	723	6,300	7,023	
05-AT	1,193	7,137	8,330	
05-TA	1,152	7,107	8,259	
06-AT	450	9,277	9,727	
06-TA	444	9,265	9,709	

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გასასვლელები და გადასასვლელები

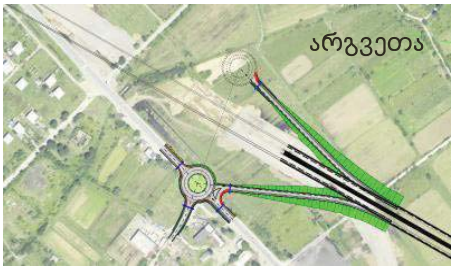
- **6** გასასვლელები ადგილობრივი გზებისთვის - 6.0x4.5 მ
- **4** ნახირსარეკი - 4.0x2.5 მ
- **17** კულვერტი - 2.0x2.5 მ
- **2** კულვერტი (წყალსატარი) - 4.0x2.5 მ

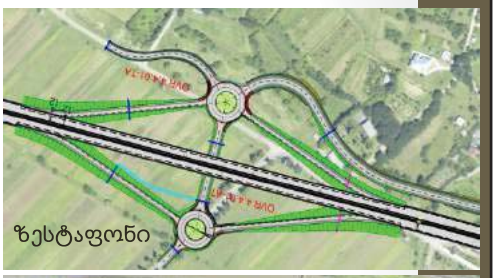
- 1 გადასასვლელი (km 11+854-ზე) - სიგრძე =40 მ.

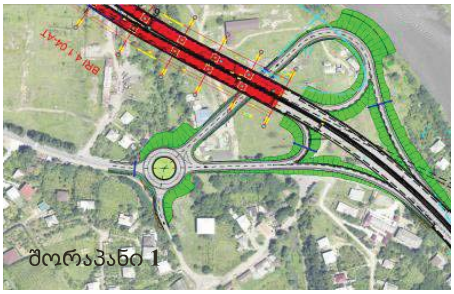
15

კვანძები

დაგეგმილია 4 კვანძის მოწყობა







17

18

ეტაპები

- ფონური მდგომარეობის შესწავლა - კამერალური და საველე სამუშაოები;
- რეცეპტორების განსაზღვრა, ზემოქმედების და მისი მნიშვნელოვნების შეფასება;
- ალტერნატივების შედარება პოტენციური ზემოქმედების; შერბილების შესაძლებლობის; საჭირო ხარჯების; ნარჩენი ზემოქმედების მნიშვნელოვნების თვალსაზრისით.
- უპირატესი ალტერნატივის შერჩევა;
- პროექტის ეტაპებისთვის ზემოქმედების მართვის და მონიტორინგის გეგმის მომზადება.

19

შეფასების "საზღვრები"

ხმელეთის ბიომრავალფეროვნება	200 მ საპროექტო გზის ორივე მხარეს. 5 მ მოსასვლელი გზიდან.
წყლის ბიომრავალფეროვნება	მდინარის გადაკვეთის უბანზე - 50 მ დინების ზედა და 250მ დინების ქვედა მიმართულებით.
ჰაერი	გზის ღერძულა ხაზიდან 200 მ.
ხმაური	გზის ღერძულა ხაზიდან 250 მ,

ზემოქმედება მოსამზადებელ (წინა-სამშენებლო) ეტაპზე

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ნებართვების აღება პროექტთან დაკავშირებით; • გეგმების (როგორიცაა: ნარჩენების მართვის. სატრანსპორტო მოძრაობის მართვის. ეროზიის მართვის) შემუშავება და დამტკიცება; • მასალების წყაროს/ მიმწოდებლების იდენტიფიცირება; • დროებითი ბანაკებისათვის. მასალის. ნიადაგის ნაყოფიერი ფენის. გრუნტისა და ნარჩენების (დროებითი. ხანმოკლე) განთავსების ადგილების შერჩევა გარემოსდაცვის და უსაფრთხოების მოთხოვნების გათვალისწინებით;	გარემოზე ზემოქმედება მოსალოდნელი არ არის

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ტერიტორიის მომზადება - მცენარეული საფერის მოხსნა, ნაყოფიერი ნიადაგის მოხსნა და დროებით დასაწყობებას. სამუშაო ტერიტორიის პროფილირება; • ტერიტორიაზე და მის გარეთ წარმოებული სამუშაოები.	• მტვრის და წვის პროდუქტების ემისია; • ხმაური და ვიბრაცია; • ნარჩენების წარმოქმნა; • საწვავის/ზეთების შემთხვევითი დაღვრა - ნიადაგისა და წყლის დაბინძურება; • ნიადაგის ეროზია/დატკეპნა; • ზემოქმედება ფლორასა და ფაუნაზე; • საგზაო მოძრაობის ზრდა - ზემოქმედება ინფრასტრუქტურაზე; • განსახლების/მიწის შეძენის (დროებით სარგებლობაში აღების) საჭიროება; • უსაფრთხოების რისკები - პერსონალის და მოსახლეობის უსაფრთხოება; • დროებითი დასაქმება (შენიშვნა: დადებითი ზემოქმედება).

ზემოქმედება მშენებლობის ეტაპზე

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ინერტული მასალების შემოტანა გზის ვაკისის მოსაწყობად; • მასალის დასაწყობება სპეციალურად გამოყოფილ ადგილას; • გვირაბის გაყვანა; • ვაკისის მოწყობა - ფორმირება. დატკეპნა; • დრენაჟის სისტემის მოწყობა; • შპუნტური კედლების მოწყობა მდინარის კალაპოტში ხიდის მშენებლობისას; • ხიდის მშენებლობა - მიწის. ბეტონის, სამონტაჟო	• ემისიები – მტვერი. გამონაბოლქვი, შედუღების აეროზოლები; • ხმაური და ვიბრაცია; • წყლის ხარისხის შესაძლო გაუარესება მდინარის კალაპოტში ან მის უშუალო სიახლოვეს მუშაობისას; • კალაპოტის ჩახერგვის რისკი; • ნავთობპროდუქტების ავარიული დაღვრის შემთხვევაში - ნიადაგის დაბინძურების შესაძლებლობა; • ნიადაგის ეროზია/დატკეპნა;

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ხიდის და სავალი ნაწილის საფარის მოწყობა. გვერდულების ჩათვლით; • გზის მონიშვნა და საგზაო ნიშნების დადგმა; • ტერიტორიაზე და მის გარეთ წარმოებული სამუშაოები.	• ნარჩენების წარმოქმნა; • ზემოქმედება ფაუნაზე; • ზემოქმედების რისკი მცენარეულობაზე; • სატრანსპორტო ნაკადის ზრდა; • ზემოქმედება საგზაო ინფრასტრუქტურაზე; • კერძო საკუთრების შემთხვევითი დაბინძურების რისკი; • დროებითი დასაქმება მშენებლობის დროს (დადებითი ზემოქმედება); • შესაძლო უსაფრთხოების რისკები - პერსონალის და მოსახლეობის უსაფრთხოება; • სატელიტური ბიზნესის ხელშეწყობა (დადებითი

ზემოქმედება ექსპლოატაციის ეტაპზე

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• სატრანსპორტო მოძრაობა ახალ მარშრუტზე; • ხიდებისა და გზების ტექმომსახურება/მოვლა	• ემისია - მტვერი. გამონაბოლქვი; • ხმაური და ვიბრაცია; • უსაფრთხოების რისკები; • ზემოქმედება ტექმომსახურების/შეკეთების დროს - ზემოქმედების სახეები და რისკები მსგავსია მშენებლობის დროს მოსალოდნელის. თუმცა ნაკლები სიდიდის და უფრო ლოკალური.

გარემოზე ზემოქმედების შეფასების ჯგუფის მიერ ჩატარებული საველე კვლევები

- პროექტის ზემოქმედების ზონაში მცენარეული საფარის/ ფლორის და ცხოველთა სამყაროს შესწავლა
- ზედაპირული, გრუნტის წყლის და ნიადაგის ფონური ხარისხის განსაზღვრა;
- ხმაურის და ჰაერის ხარისხის ფონური დონე;
- ვიბრაციის გაზომვა;
- სოციალურ-ეკონომიკური ინფორმაციის შეგროვება.

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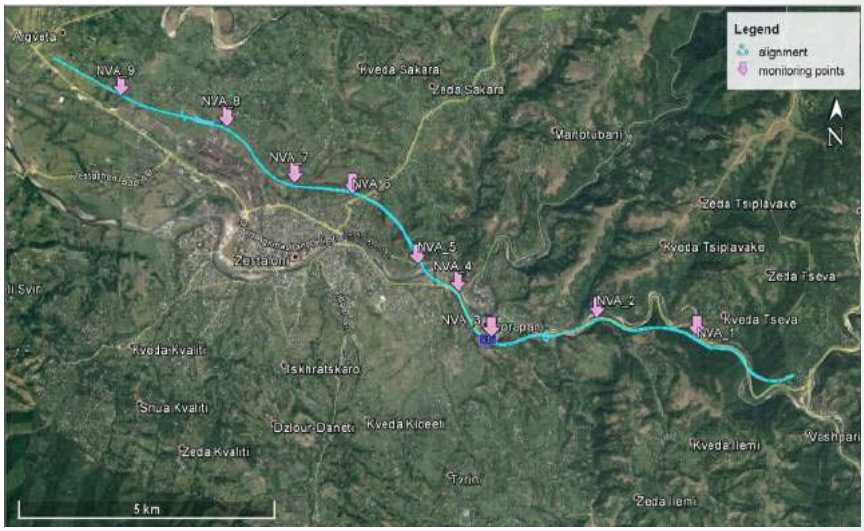
ხმაურის ფონური დონე



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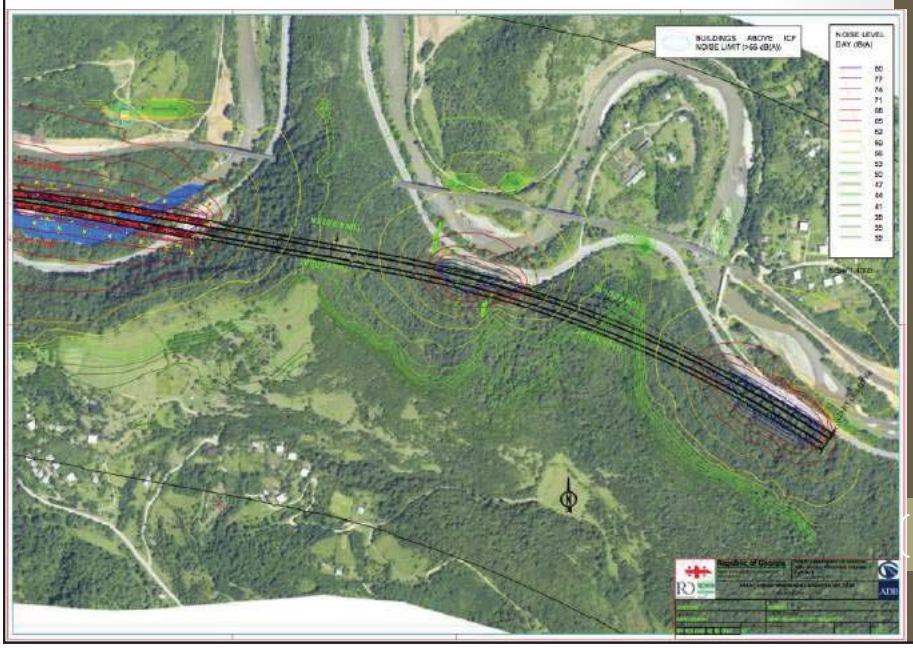
ხმაურის მოდელირება

- მშენებლობის დროს 25-50მ ხმაურის დონე დღის და ღამის საათებისთვის დაწესებულ ნორმას გადააჭარბებს. 100მ დაშორებით ხმაური დღის ნორმის ფარგლებში იქნება. 250მ-ზე - დღის და ღამის საათებში ხმაურის დონე დასაშვებს არ აღემატება.

- ხმაურის მოდელირება გზის ექსპლოატაციისას SOUND PLAN VER. 7.2 პროგრამის გამოყენებით - სატრანსპორტო ნაკადის პროგნოზული (30 წელი) ნაკადის გათვალისწინებით.

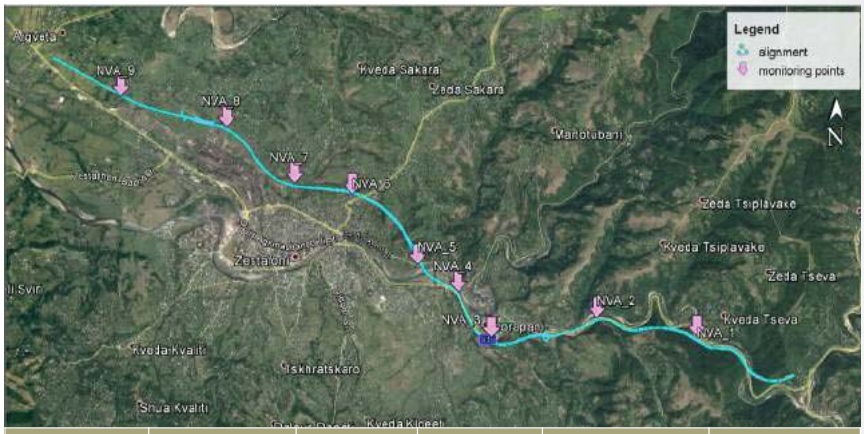
28



29

30

ჰაერის ფონური ხარისხი



CO. მკგ/მ3	NO_2. მკგ/მ3	SO_2. მკგ/მ3	PM10. მკგ/მ3	PM 2.5. მკგ/მ3	TSP. მკგ/მ3

საკონტროლო წერტილებში გაზომილი მახასიათებლები არ აღემატება დასაშვებს. NO2 და მტვრის მომატებული კონცენტრაცია დაფიქსირდა გზის მახლობლად .

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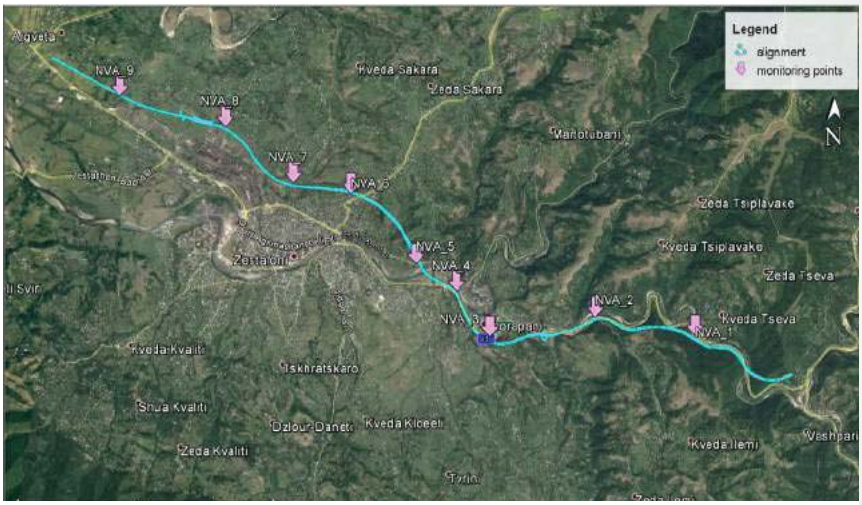
ფონური ვიბრაცია



მშენებლობის დროს ვიბრაციის წყაროების - სამშენებლო ტექნიკა, პნევმატური ჩაქუჩი, კომპაქტორი, გენერატორი (საჭიროების შემთხვევაში), აფეთქებითი სამუშაოები გვირაბში.

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ვიბრაცია

- ვიბრაცია მშენებლობისას წყაროდან 25მ დაშორებით არ გადააჭარბებს 10მმ/წმ.

ვიბრაციის შედეგად სტრუქტურული დაზიანების შესაძლებლობის კრიტერიუმები

ზიანი მოსალოდნელი არ არის	**PPV < 5 mm/s**
კოსმეტიკური დაზიანების რისკი	PPV 5 to 15 mm/s
კონსტრუქციული დაზიანების რისკი	PPV > 15 mm/s

- სამუშაოების დაწყებამდე (გვირაბის მოწყობის მონაკვეთი ზესტაფონთან) საჭირო იქნება ახლომდებარე შენობების ტექნიკური მდგომარეობის შემოწმება.

- ექსპლოატაციის დროს კონსტრუქციული დაზიანების შესაძლებლობის მქონე ვიბრაციის ონე მოსალოდნელი არ არის

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ნიადაგის ხარისხი

სპილენძი
თუთია
ნიკელი
ქრომი
ტყვია
დარიშხანი
კადმიუმი
ვერცხლისწყალი
პოლიქლორირებული ბიფენილები
ასბესტი

ზესტაფონის მიმდებარედ დაფიქსირდა ტყვიის და დარიშხანის ოდნავ მომატებული დონე.

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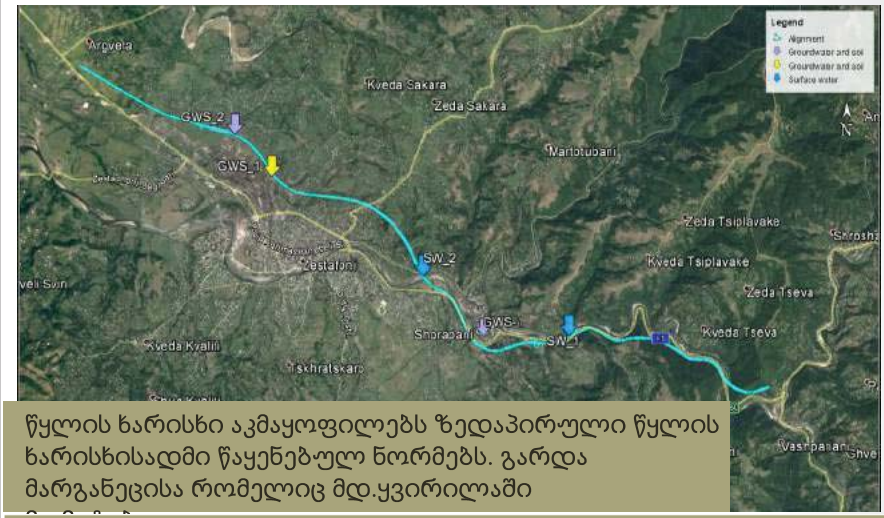
ზედაპირული წყლის ხარისხი



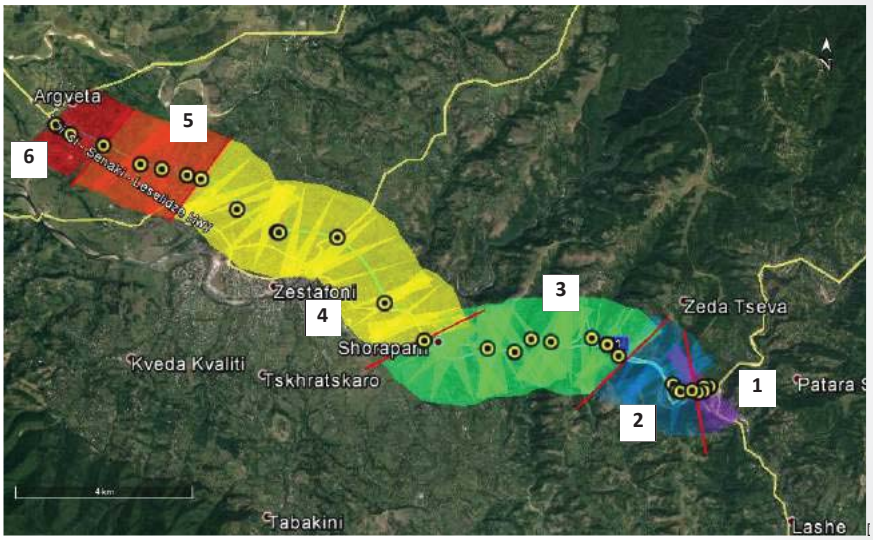
წყლის ხარისხი აკმაყოფილებს ზედაპირული წყლის ხარისხისადმი წაყენებულ ნორმებს. გარდა მარგანეცისა რომელიც მდ.ყვირილაში

ზედაპირული წყალი: **pH**, ელგამტარობა **(EC)**, სიმღვრივე, ჟბმ$_5$, ჟქმ, გახსნილი ჟანგბადი **(DO)**, **TSS**, ჯამური ფოსფორი, ჯამური აზოტი, ჯამური ამონიუმი, ჯამური თუთია, გახსნილი სპილენძი, მარგანეცი, სიმღვრივე, **TPH**, ტოტალური კოლიფორმები

გრუნტის წყლის ხარისხი

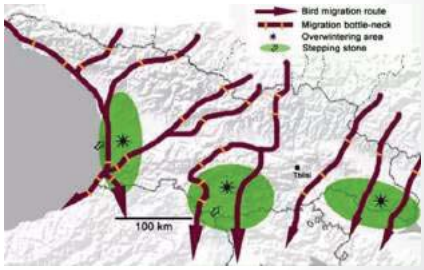
pH
გახსნილი ჟანგბადი
ელგამტარობა
ტუტიანობა
სიხისტე
ჯამური შეტივნარებული ნაწილაკები
დარიშხანი
ქლორიდები
რკინა
ნიტრატები
ნატრიუმი
კალიუმი
კალციუმი
მაგნიუმი
მარგანეცი
ტყვია
სულფატები

წყლის ხარისხი აკმაყოფილებს საქართველოში მოქმედ მოთხოვნებს.


Argveta
5
6
Zestaponi
4
3
Zeda Tseva
Shorapani
Kveda Kvaliti
Tskhratskaro
1
2
Patara
Tabakini
Lashe

ცხოველთა სამყარო - დაცული სახეობები

სახეობა	წით. წუაწა	IUCN	სწვა	Section N
კავკასიური ციყვი	VU	LC	EU ჰაბიტატების დირექტივა (92/43) IV 21/05/92; ბერნის კონვენცია 01/03/02,	1/2/3
წავი	VU	NT	CITES დანართი I, ბერნის კონვენცია დანართი II, ჰანიტატების დირექტივა დანართი II და IV	4
ხმელთაშუა აზღვის კუ	VU	VU	-	1/4/



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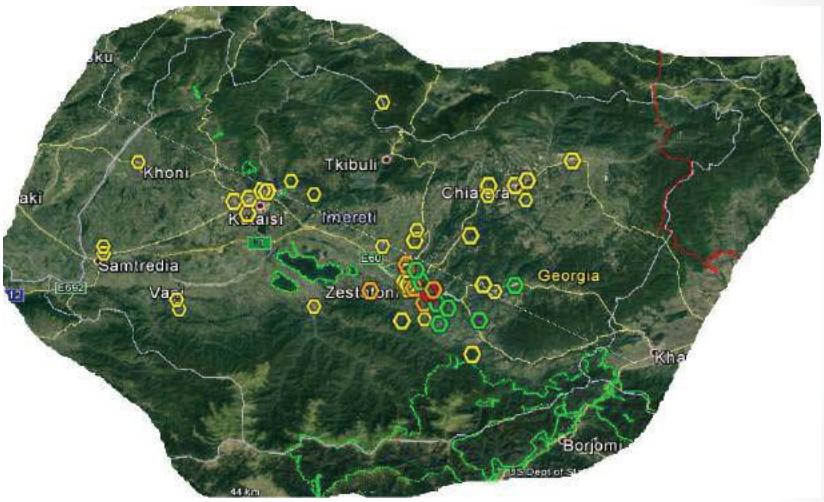
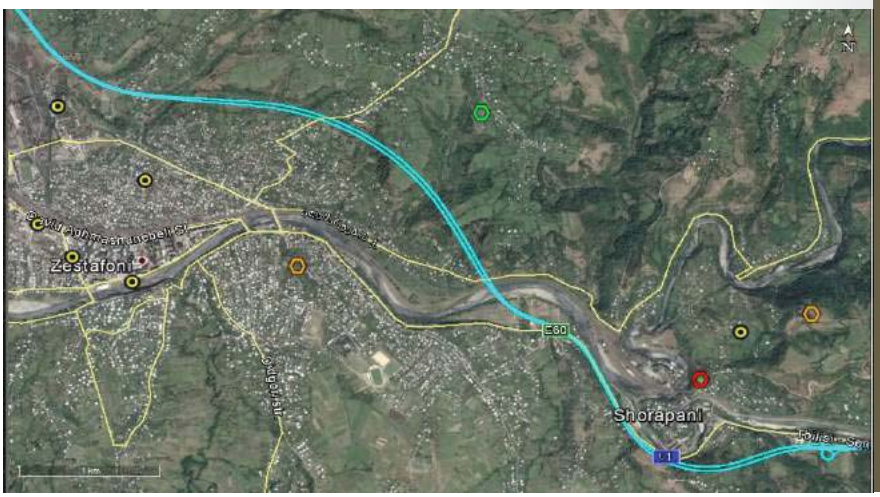
დაცული ტერიტორიები

კულტურული მემკვიდრეობა



კულტურული მემკვიდრეობა



ყვითელი ექსლკუთხედი - ეკლესია; მწვანე ექვსკუთხედი - ეკლესია და სასაფლაო; ნარინჯისფეი ექვსკუთხედი - სასაფლაო;

1წმ,ნინოს წკლესია,მიახლოებითი მანძილი 260m; 2 – წმ.ნიკოლოზის ეკლესია - მიახლ.მანძილი 650m. 3 – სასაფლაო - მიახლ მანძილი 630m; 4 – შორპმის ციხე - მიახლ. მანძილი 590მ

კულტურული მემკვიდრეობა - არქეოლოგია

ზემოქმედება	რანგირება
მშენებლობა	
ხარისხის გაუარესება	L-M, S, R, ადგილობრივი.
ხმაური და ვიბრაცია	L-M.S, R, ადგილობრივი
წყლის ხარისხი	L-M, S. R, ადგილობრივი
ნიადაგის ხარისხის გაუარესება	L-M, S, R, ადგილობრივი
ზემოქმედება ფლორაზე/ მცენარეულობა ზე	L-M, ადგილობრივი, ტერიტორიებზე, რომელიც გასხვისება არ ხდება მუდმივად - საშუალოდან ხანმოკლე (დროებითი), შექცევადი.
ზემოქმედება ფაუნაზე	L-M, დამოკიდებულია სამარშრუტო მონაკვეთზე, S, R, ადგილობრივი. ეს იქნება - დარჩენილი ხმაურის გავრცელება, გამონაბოლქვი ემისიები, ზემოქმედების გარკვეული რისკი წყალქვეშა ცხოველებზე, დროებითი ზემოქმედება წყლის ხარისხზე(ძირითადად სიმღვრივის მომატება), შეჯახება
ლანდშაფტის და ვიზუალური	L-VL (დამოკიდებულია ადგილმდებარეობაზე), S, R, ადგილობრივი

ფუნქციონირება	
ჰაერის ხარისხის გაუარესება	დაბალიდან საშუალომდე, მოდელირების მონაცემების მიხედვით, ზემოქმედება არ არის მაღალი, შემამსუბუქებელი ზომები არ არის საჭირო
ხმაური და ვიბრაცია	დაბალიდან საშუალომდე .
წყლის ხარისხი	უმნიშვნელო - დაბინძურება ზედაპირული ჩამონარეცხით
ნიადაგის ხარისხის გაუარესება	დაბალიდან უმნიშვნელომდე - დაბინძურება ჩამონარეცხით
გეოლოგიური საშიშროებების განვითარება	უმნიშვნელო.
ზემოქმედება ფლორაზე/ მცენარეულობაზე	უმნიშვნელო.
ზემოქმედება ფაუნაზე	დაბალი. ხმაურის გავრცელება, გამონაბოლქვი ემისიები, ზემოქმედების გარკვეული რისკი წყლის ცხოველებზე წყლის ხარისხის გაუარესების გამო და კოლიზიის რისკი
ლანდშაფტის და ვიზუალური ცვლილება	მნიშვნელოვანი ცვლილება გზისა და ხიდების გამო

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#	ϑ_3 (∂)	#	ϑ_3 (∂)
01-AT	10,293	03-AT	13,222
01-TA	10,269	03-TA	13,200
02-AT	12,770	04-AT	13,636
02-TA	12,749	04-TA	13,614

კულვერტები

#	პკ (მ)	#	პკ (მ)	#	პკ (მ)	#	პკ (მ)
01-AT	50	14-AT	5,408	28-TA	11,223	40-AT	13,259
01-TA	50	16-TA	8,333	28-AT	11,245	42-TA	13,405
04-AT	190	16-AT	8,344	30-TA	11,567	42-AT	13,427
04-TA	190	18-TA	8,683	30-AT	11,579	44-TA	13,568
06-TA	620	18-AT	8,694	32-TA	12,183	44-AT	13,591
08-AT	755	20-TA	9,923	32-AT	12,204	46-TA	13,818
08-TA	760	20-AT	9,954	34-TA	12,428	46-AT	13,842
06-AT	615	22-TA	10,172	34-AT	12,449	48-TA	13,955
10-TA	4,639	22-AT	10,197	36-TA	12,489	48-AT	13,979
10-AT	4,661	24-TA	10,534	36-AT	12,510	50-TA	14,188
12-TA	5,021	24-AT	10,558	38-TA	12,975	50-AT	14,213
12-AT	5,049	26-TA	10,794	38-AT	12,997	52-TA	14,349
14-TA	5,391	26-AT	10,817	40-TA	13,236	52-AT	14,274

დამცავი კედლები

- კმ 0.00 to კმ 0.25
- კმ 4.36 to კმ 4.43 (შორაპანთან)
- კმ 8.63 to კმ 8.71
- კმ 8.84 to კმ 8.94

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