APPENDIX K

Air Dispersion Model Methodology

An air dispersion model was prepared to determine the nature and extent of any air pollution from the operational phase of the Project. The following describes the methodology used for the model.

1. Reference Pollutants - The levels of air pollution derived by the model should be verified against the standard permissive thresholds applied and officially provided and according to good practice and international standards. The computation is based on:

- Current background levels of air pollution (considered as safe thresholds, being the operating conditions of the existing road);
- Relevant standard thresholds set by EC;
- Relevant standard thresholds set by National Standards.

The following International Standards were applied:

- Dir. 96/62/EC [28] ("Main Directive)- In the evaluation and management of the quality of the air environment;
- Dir. 99 /30/CE[29] - Concerning the limit values for ambient air quality for sulphur dioxide, nitrogen dioxide, nitrogen oxides, particulate matter and lead;
- Dir. 2000 /69/CE [30] - Concerning the limit values for benzene and carbon monoxide in air air;
- Dir 2008/50/EC[31] - relative to the quality of the air environment and for a cleaner air in Europe.

Furthermore, the regulatory limits determined by EU Directive 2008/50/EC were applied for NO_x, dust, Benzene (C_6H_6) and for some heavy metals micro-pollutants of local interest (Ni, Zn, Cd, Pb). The pollutants kept into considerations are the ones characterizing the emissions from vehicles: **NO_2, NO_X, PM_{10}, $PM_{2,5}$, CO, SO_2 e C_6H_6**.

With regard to Nitrogen oxides (NO_x), it must be considered that they are composed mainly of nitrogen monoxide - NO and nitrogen dioxide - NO_2. These pollutants are produced in combustion at high temperature from the reaction of the oxygen and the nitrogen present in the air. The NO_x products in traffic emission are compounds in large part made of nitrogen monoxide, with low toxicity characteristics, which reacts in the atmosphere with oxygen forming nitrogen dioxide. The greatest source of pollution from NO_x are heavy vehicles with diesel engines, because they use combustion mixtures very poor in terms of fuel/air ratio. Nitrogen oxides in general can be considered as the most important atmospheric pollutants. The European limits set by the law for the protection of human health refers to NO_2, whereas model simulations consider the NO_x (the whole mixture of oxides of nitrogen).

Given the proximity of some points of interest from the pollutant source, it is evident that in the family of nitrogen oxides which are products of combustion at high

[28] Dir refers to EU Directive which is very restrictive
[29] Ibid.
[30] Ibid.
[31] Ibid.

temperature, the form NO represents the main share, (even over 90 %), but tends to decrease as while the air containing the gas is conveyed away from the source, resulting in the observation points generally between 25% and 75%.

To calculate the fraction of NO_2 as a function of the levels of NO_x, in line with the directions of the US-EPA, the method ARM2 was adopted, which reviews and corrects the method ARM ("Ambient Ratio Method"). The curve is applicable, according to the indications US-EPA, up to NO_x concentrations of about 500 µg/m3, range of validity that fully encompasses the calculated levels in this study.

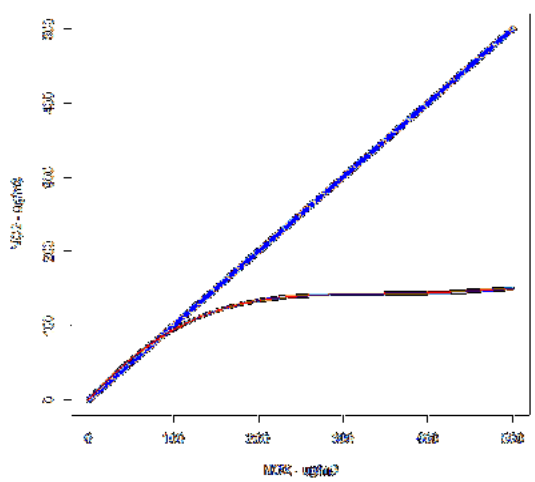
Being $[NO_2]$ the concentration of nitrogen dioxide (in ppb or µg/m^3) and $[NO_x]$ the concentration in the air of oxides of nitrogen (respectively in ppb or µg/m3 NO_2 - equivalent), it is possible to establish the following equivalence:

$$y = -1.1723 \cdot 10^{-17} x^6 + 4.2975 \cdot 10^{-14} x^5 - 5.8345 \cdot 10^{-11} x^4 + 3.4555 \cdot 10^{-8} x^3 - 5.6062 \cdot 10^{-6} x^2 - 2.7383 \cdot 10^{-3} x + 1.2441$$

Where “x” is the concentration of $[NO_x]$ and “y” and is the ratio between the concentrations $[NO_2]$ / $[NO_x]$ in the environment.

The below **Figure 1** depicts the shape of the curve used to calculate the realistic concentration of of NO_2 in the atmosphere (red) in comparison with the straight line that considers all the NO_x as NO_2 (blue), the two curves diverge as the concentration increases.

Figure 1: Relationship between the concentrations of NO_2 and NO_X whereas the two species are considered equivalent (blue line) compared with the theoretical curve US-EPA that implements the method ARM2 (red), used for this study.



2. Meteorological Data Used in the Modelling - The software requires to input beside the morphology, obtained by the DTM model, a accurate statistic analysis of meteo data obtained by hourly measurements for almost one year. The datasets including hourly measurements for the 2016 was purchased from MAIND ltd, (a Company providing meteorological database and software packages for data analysis and modelling). This is obtained by a downscaling a larger model based on the results of mathematical model of atmospheric circulation on a larger global scale (Reading model) using the input of nearby available SYNOP meteo stations.

Data have been reconstructed for the site into consideration by the processing of a large amount of areal data using the meteorological model MM5 (Mesoscale Model 5) from Pen-State University.

The MM5 model can reconstruct the meteorological characteristics of a site by the use of meteo data from local and international meteo network, such as the SYNOP-ICAO of the World Meteorological Organization, and other data from global simulation meteorological data such as the European model ERA-Interim from ECMWF. It allows to reconstruct the punctual meteo info for any selected point belonging to a point of the global net. By that it was possible to simulate a "virtual" synoptic meteo station in the vicinity of the studied area.

Model simulations carried requires the knowledge of the following meteorological variables for a point within the domain of calculation:

- Mean wind speed;
- Wind direction;
- Air Temperature;
- Class stability of Pasquill.

The hourly data, defined for a temporal interval of one year referring to the year 2016 are:

- Wind velocity;
- Wind direction;
- Class of stability (automatically calculated by the software on the basis of the meteorological data);
- Temperature; and
- Precipitations.

3. Air Quality - To define the potential exceeding of the Normative Limits regarding Air Quality, determined by the traffic, it was important to know the background levels of the considered pollutants in conditions ante-operam. Measurements were taken as described above under air quality monitoring.

4. Models for the Evaluation of Air Quality - Once the meteorological parameters and the background values to be inputted in the model are defined, with the background to be the baseline for the increment of pollution, the modelling procedure can be started.

The model has to consider as source "highway type traffic" which differs from punctual sources and urban traffic sources, for the below considerations are applied.
The modelling of the impact on the quality of the air has been carried out using the software package CALINE 4, software composed of a friendly graphical windows interface module and a Gaussian model consistent with the recommendations of the U.S. E.P.A. (U.S. Environmental Protection Agency).

The model is based on the modelling of four main groups of pollutants: CO, NOx, particulate and Inert gases (SF_6 -type). This latter option allows the modelling of any type of gas not reacting with the atmosphere, once that its parameters are inserted into the system. In case of NO2, the background values of Ozone should be considered.

The measured background could inputted too, it could be stack to the final level or handled in different ways.

In our case the background- mostly coming from the existing road- will be deeply and positively modified by the service of the new one, the commuter traffic is very limited and will provide only residual contribution to the air pollution.

The Gaussian models of diffusion are based on the "mixing zone" model defined as a volume of the emitting linear pollution source "having the width of the road + 3 metres on both sides to account for the dispersion generated by the turbulence and aerodynamic effects of the traffic and a height defined by the operator".

Inside this area it is assumed that turbulence and emission are constant (for discrete intervals of time) and only determined by the presence of moving vehicles ad by the thermal differences generated by the vehicle and road (road microclimate).

The vertical dispersion of the pollutant is function of the turbulence and it has been demonstrated that the vertical initial dispersion of the pollutants is independent by the number of vehicles (inside the range 4000 to 8000 vehicles/h and velocity range 50-90 km/h) because the increment of thermal turbulence is balanced by a lower aerodynamic turbulence associated to the velocity. The Vertical Initial Dispersion (SGZ1) is, at the contrary, dependent by the Time of Residence (TR) of the pollutant in the "mixing zone" which mainly function of the wind speed according to:

- SGZ1[m] = 1.8+0.11*TR[sec] (General Motors data relative to TR up to 30')

According to the above, the SGZ1 is corrected, by means of dedicated formulas, for values shorter than 30'.

In general, during nighttimes and in low wind conditions (< 1 m/s) the height of the "mixing zone" will be reduced and the model applies the Pasquill and Draxler formulations which requires the standard deviation of wind direction and other parameters to be inputted into the calculations.

The software uses a metric coordinates system (X,Y) (X positive = Est; Y positive = Nord) ; the wind direction is assumed (0°= North wind direction).

The above configuration permits any orientation of the ma: Random North, magnetic, Absolute, selected angle).

Altitude quota are relative to a selected datum plane (soil level) or any other reference plane.

Data can be exported in UTM or any other coordinate system.

Max number of receptors: 10,000.

Basic equations of the Gaussian model are the classic ones to describe the rectilinear dispersion of a plume in stationary conditions. Such equations, with some modifications, are used to treat different types of sources, which can be grouped into three main categories: sources of punctual type, sources of areal type and sources of the linear type.

The Gaussian equation is based on a point source with stationary plume, used for the calculation of the concentration average hourly to a downwind distance x and a lateral distance y following:

$$\chi = \frac{QKVD}{2\pi u_s \sigma_y \sigma_z} \cdot e^{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}$$

Where:

C	Hourly concentration (mass per unit volume)
Q	Rate of emission (mass per unit of time)
K	Coefficient for transformation of the concentrations to the desired units of measure
V	Term of vertical dispersion
D	Term of decay
S_y	Standard deviation of the distribution side of the concentrations (m)
S_z	Standard deviation of the vertical distribution of concentrations (m)
u_s	Average wind speed at the height of release (m/s)

5. Scenarios and time frame of the model - The modelling has been developed for each of the below scenarios:

- Scenario year 2019
- Scenario year 2034.

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 (paragraph 5.2).

Spatial domain of the model and discrete 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 3 at the north and south of the road. They have been used for the considerations in terms of respect or excess of allowable limits.

Figure 2 - Sensitive receptors (in yellow)

Table 1 - Coordinates of receptors

Receptors	Coord.UTM
Public School of Verkvichchala	360.305 m E, 4.663.054 m N
Public School of Vashlevi	362.610 m E, 4.662.872 m N
Khunevi School	364.957 m E, 4.662.637 m N
Boriti School	356.853 m E, 4.663.333 m N
Church	358.885 m E, 4.663.562 m N

6. **Vehicles and traffic flow** - The following Figures *(***Figure 3** and **Figure 4***)* show the flow of vehicles and the vehicles partitions supposed to circulate in the road; flow is subdivided in macro-categories and divided into different time intervals.

Figure 3: Composition of traffic at year 2017 and 2034

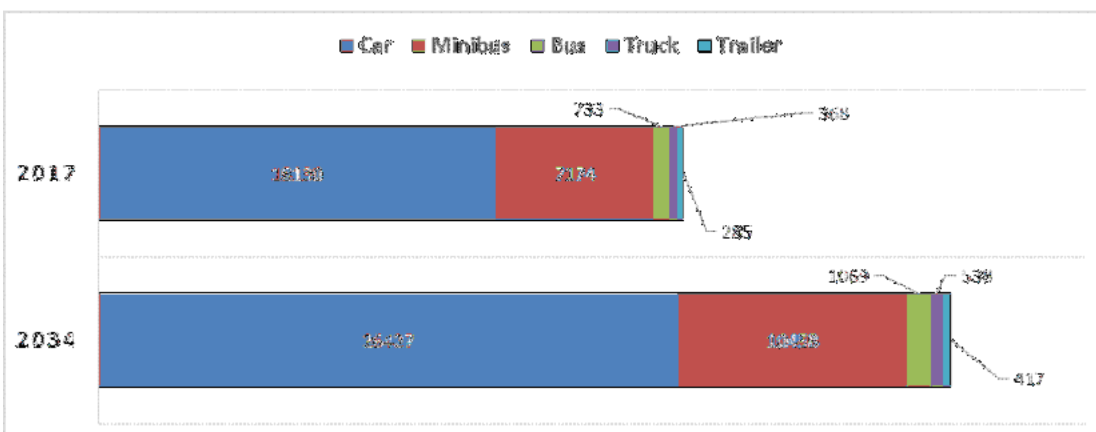
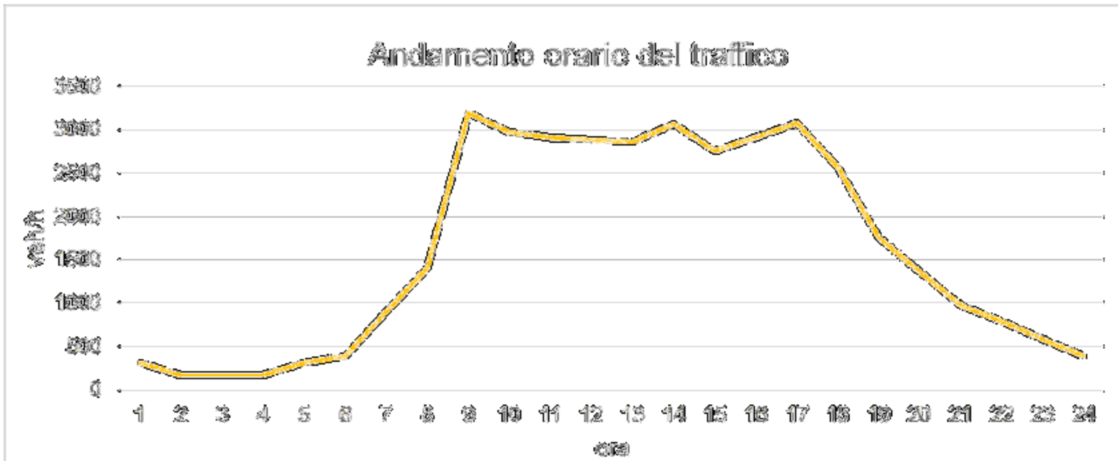


Figure 4: Daily variation of traffic flow



Once the traffic flow is defined, the factor emissions have to be considered; for this task the software COPERT 4 v. 11.3, has been used.

Its development has been coordinated by the European Environmental Agency in the framework of the activities of the Agency of European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM). The estimations have been developed on the base of multi national data about the dimensions, composition, type of paths (urban, extra urban, highways), average fuel consumption, average use and other particular peculiarities of the vehicles. Emission factors are calculated in respect to the age (number of km) and fuel consumption, type of limiting emission devices (EURO 2 to 5).

Emissions from engines (exhaust) are separated from non-engine emissions (tyre consumption, asphalt wear, etc). Regarding the emissions of Non methane volatile components (NMVOC) generated by gasoline vehicles, the quota of emission by evaporation are specified (**Table 2**).

Table 2: Emission factors (average) for different classes of vehicles and roads: extra-urban= present day situation (a Highway = road in service)

pollutant	Vehicle highway	Heavy vehicle highway	Vehicle extra-urban	Heavy vehicle extra-urban
PM10	0.024 g/km	0.147 g/km	0.030 g/km	0.171 g/km
PM2.5	0.022 g/km	0.129 g/km	0.023 g/km	0.141 g/km
CO	0.467 g/km	1.256 g/km	0.275 g/km	1.236 g/km
NO2	0.192 g/km	0.562 g/km	0.132 g/km	0.583 g/km
NOX	0.503 g/km	4.619 g/km	0.367 g/km	4.825 g/km
SO2	0.0006 g/km	0.0028 g/km	0.0006 g/km	0.0027 g/km
C6H6	0.003 g/km	0.0002 g/km	0.003 g/km	0.0002 g/km

Air quality impacts were assessed against GoG guidelines and IFC standards (see **Table D.3**)

APPENDIX L

Noise Model Methodology

A noise model was prepared to assess the impacts of the operational phase of the Project on noise levels in the Project area. The following describes the methodology used.

1. General - 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).

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:

Information considered in the development of the model **– Table 1** shows the requirements for specifying a noisy environment:

Table 1: 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 as this is not 'typical'**

		condition, explosion, etc.)
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).**

634. 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.
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.

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).

2. Variability - 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 2** gives examples of variations considered in the developed model.

Table 2: 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

Component	Examples of component variations
	receiver location, and localized regions affected by reflections (not of capital importance in tour case due to linear modelization of traffic)

3. Algorithms for Outdoor Sound Propagation - 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

4. Standards, regulations and guidance notes - 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.

5. Simulation parameters - 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.

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.

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 3**).

Table 3: 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**

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 that vehicle levels in Georgia will most probably change by 2037 with the consequence of having lower emissions than predicted in the project design documents and used in this modelling. This will potentially 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).

6. **Numeric model -** 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.

7. **Receptors to be investigated -** 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 two floors, and their distance from the source, there is no need to make a multi level computation at different heights.

8. **Traffic forecasts -** 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.

According to German regulation BNPM[32], 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 4**.

Table 4: Traffic Flux Per Day, 2017

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

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

[32] BNPM = Basic Noise Prediction Model (DIN 18005) is the most common practice -best practice used for the development of predictive noise models.

calculated by taking the root ^{nth} of the total percentage growth rate, where "n" is the number of years in the period being considered.

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.

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.

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 5**). 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 5: Night Traffic

Year	Car (70%)	Mini Buses<15, Pick-up (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

APPENDIX M

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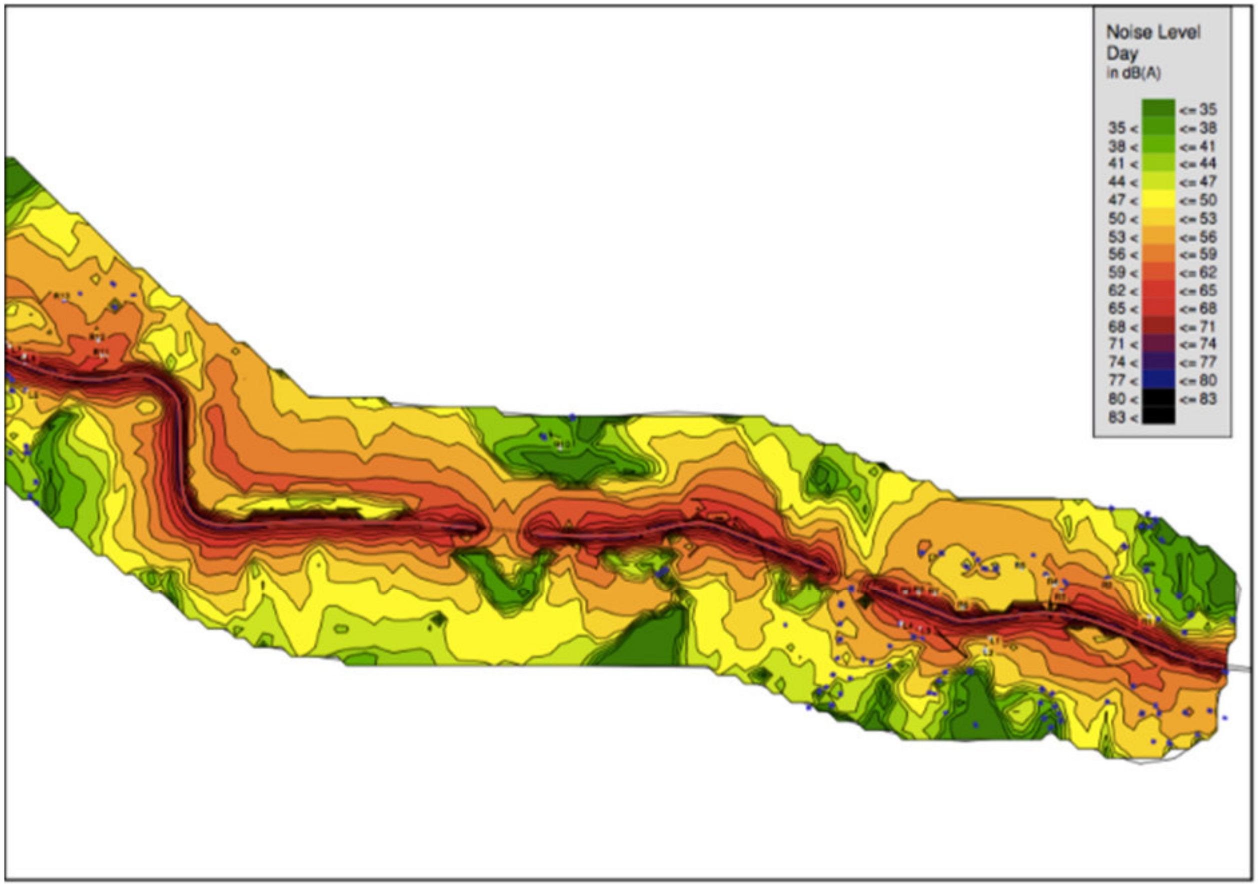
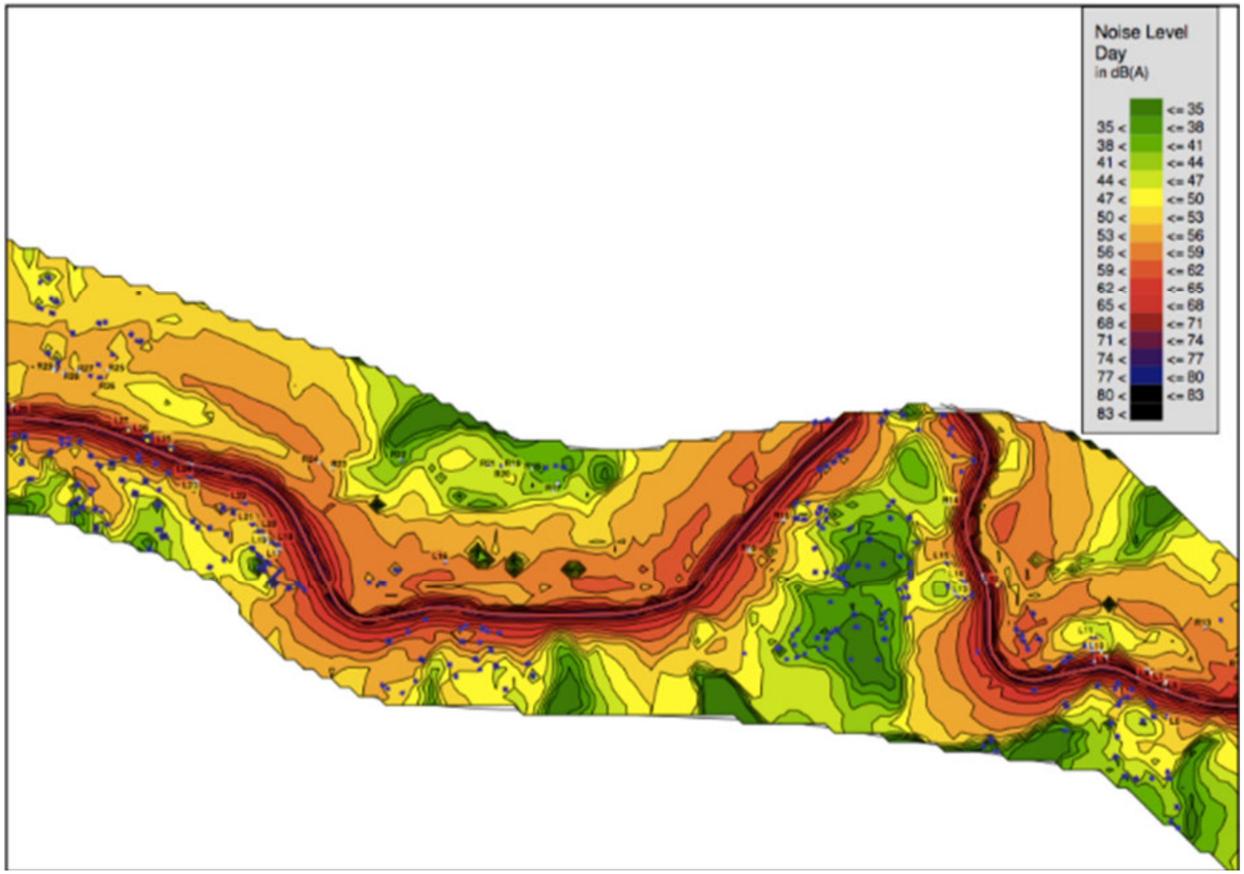
APPENDIX N

Baseline Noise Maps

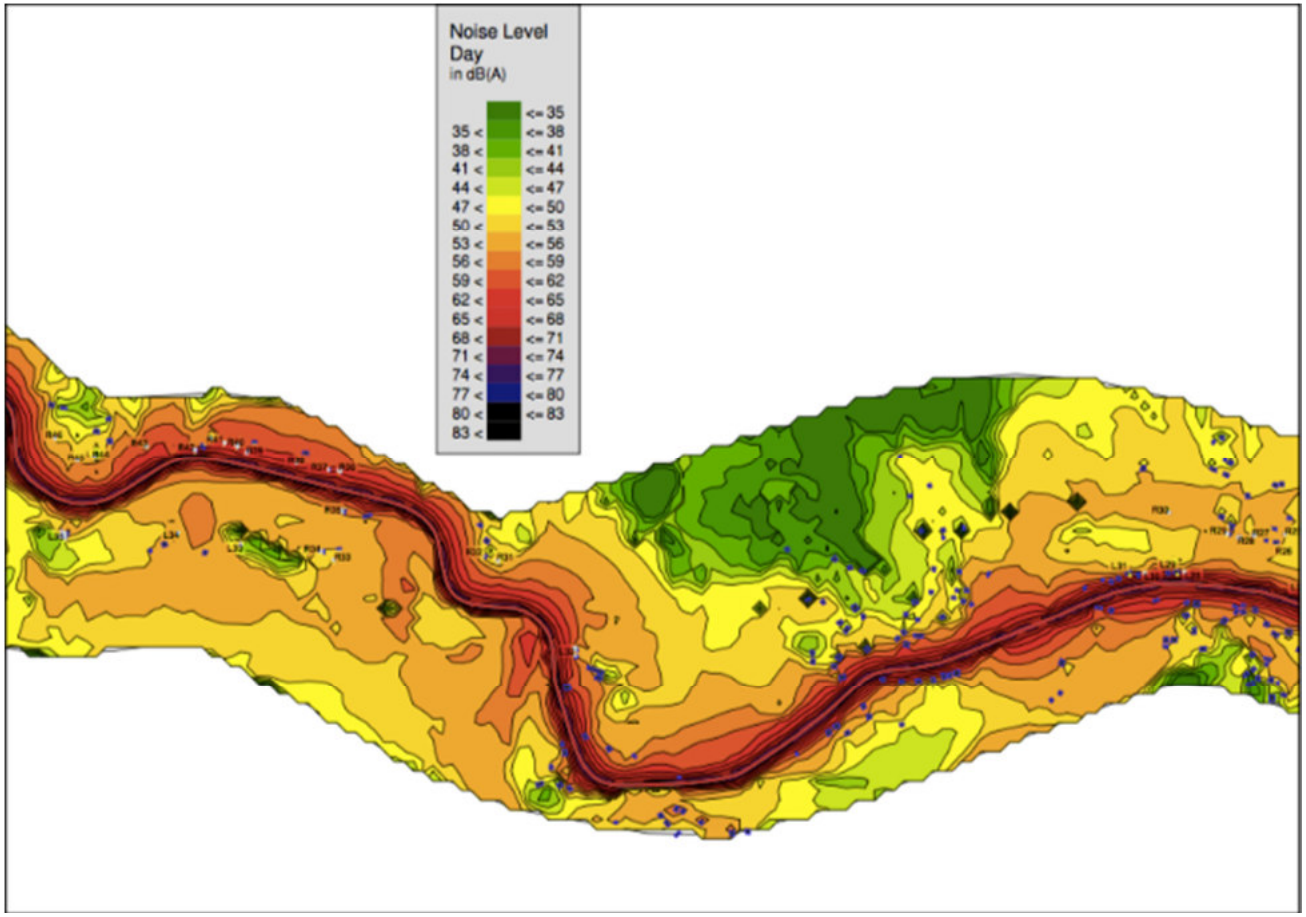
Portion 1: Daytime



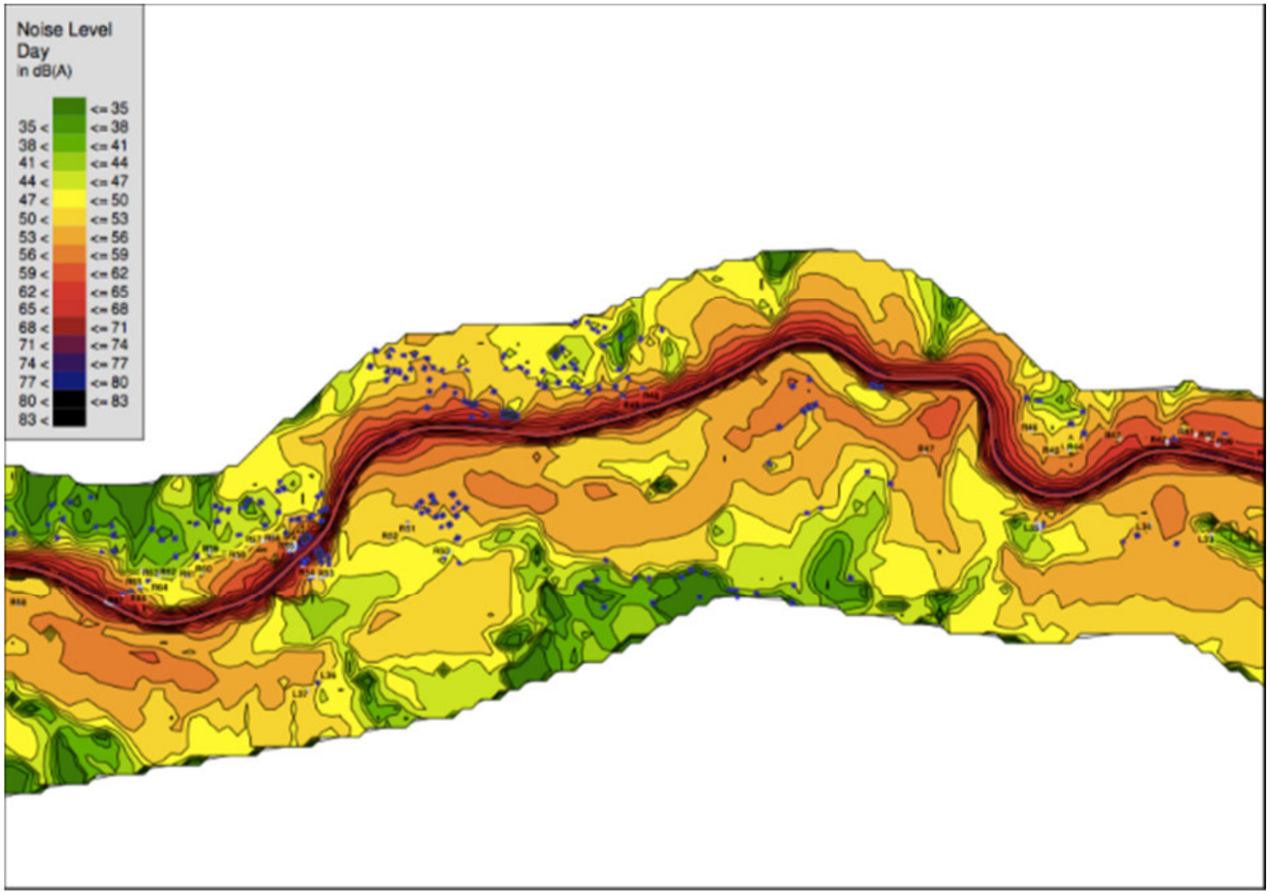
Portion 2: Daytime



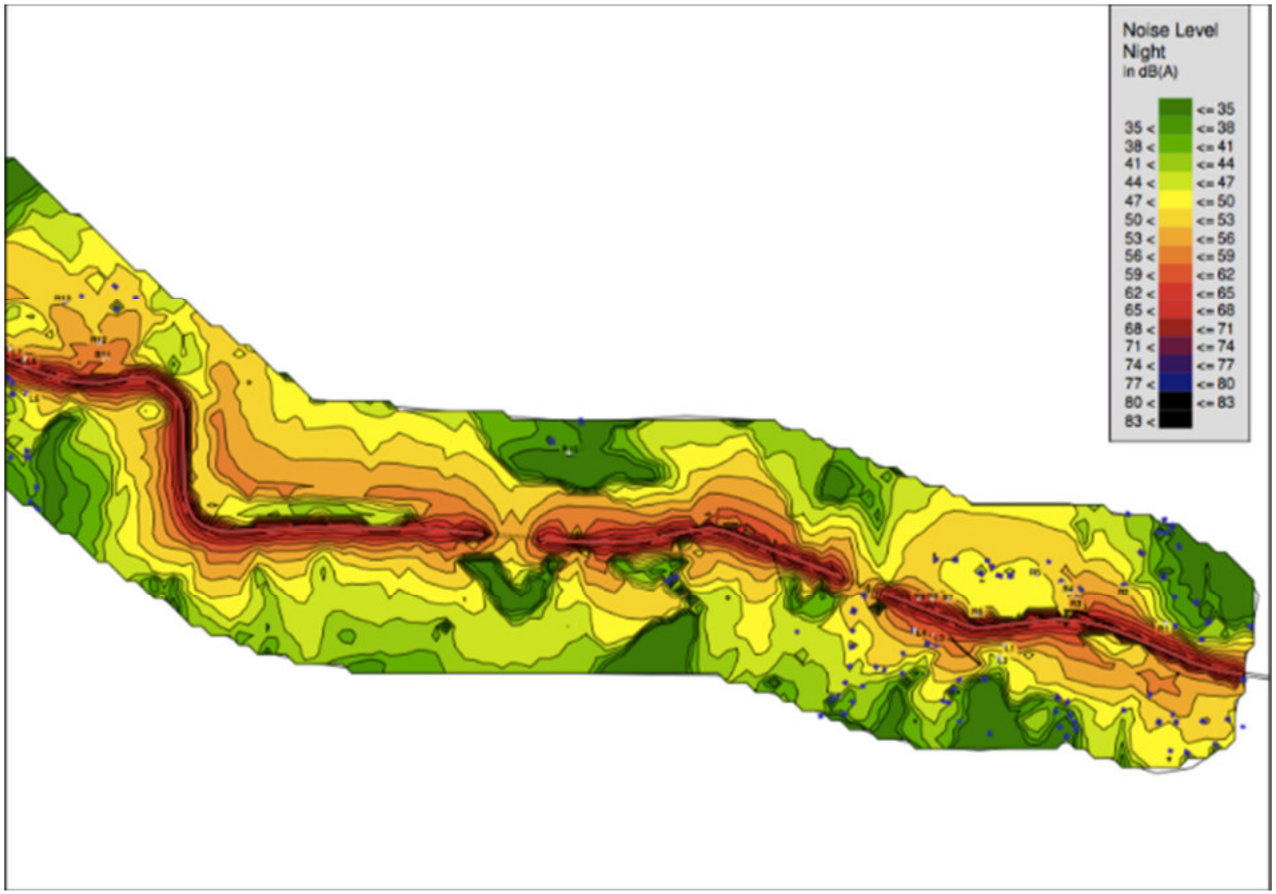
Portion 3: Daytime



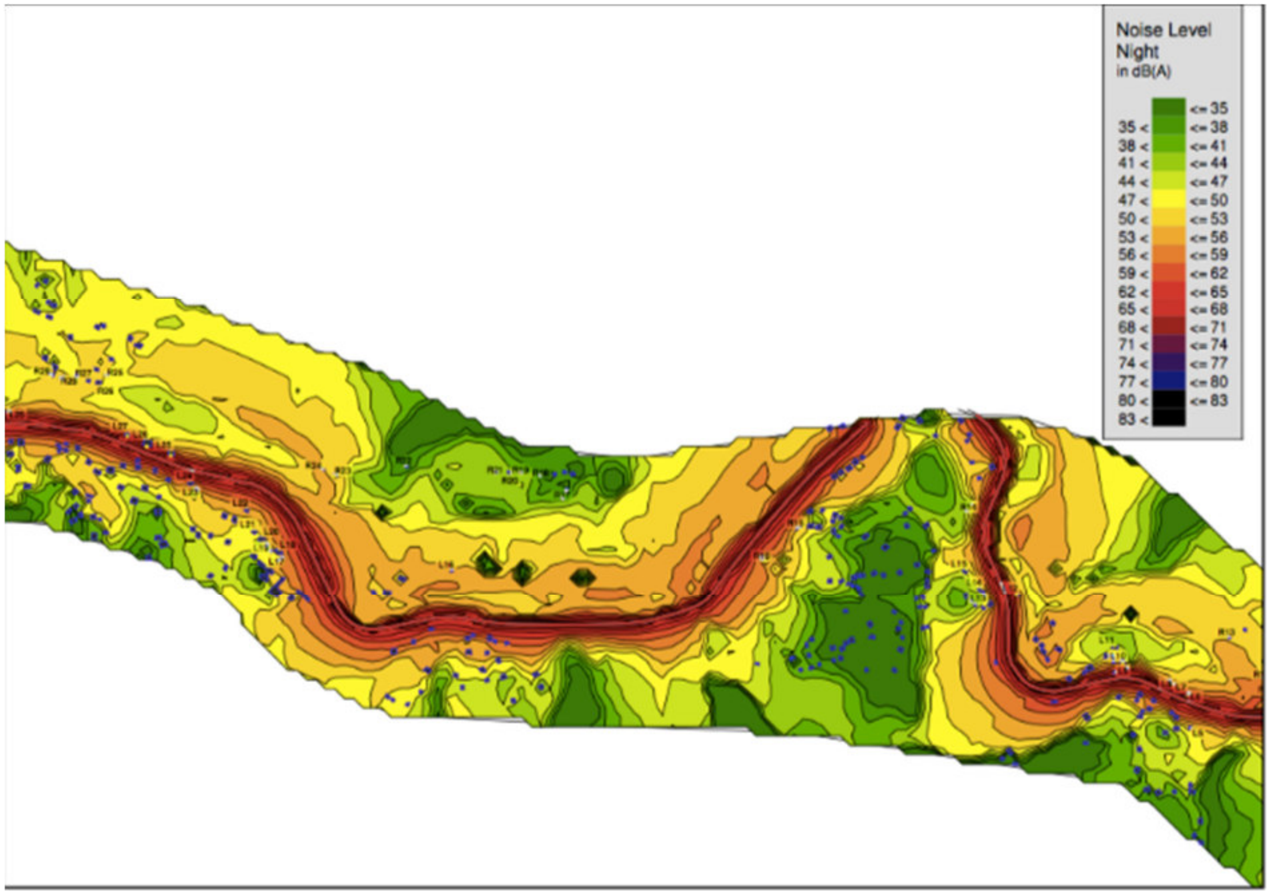
Portion 4: Daytime



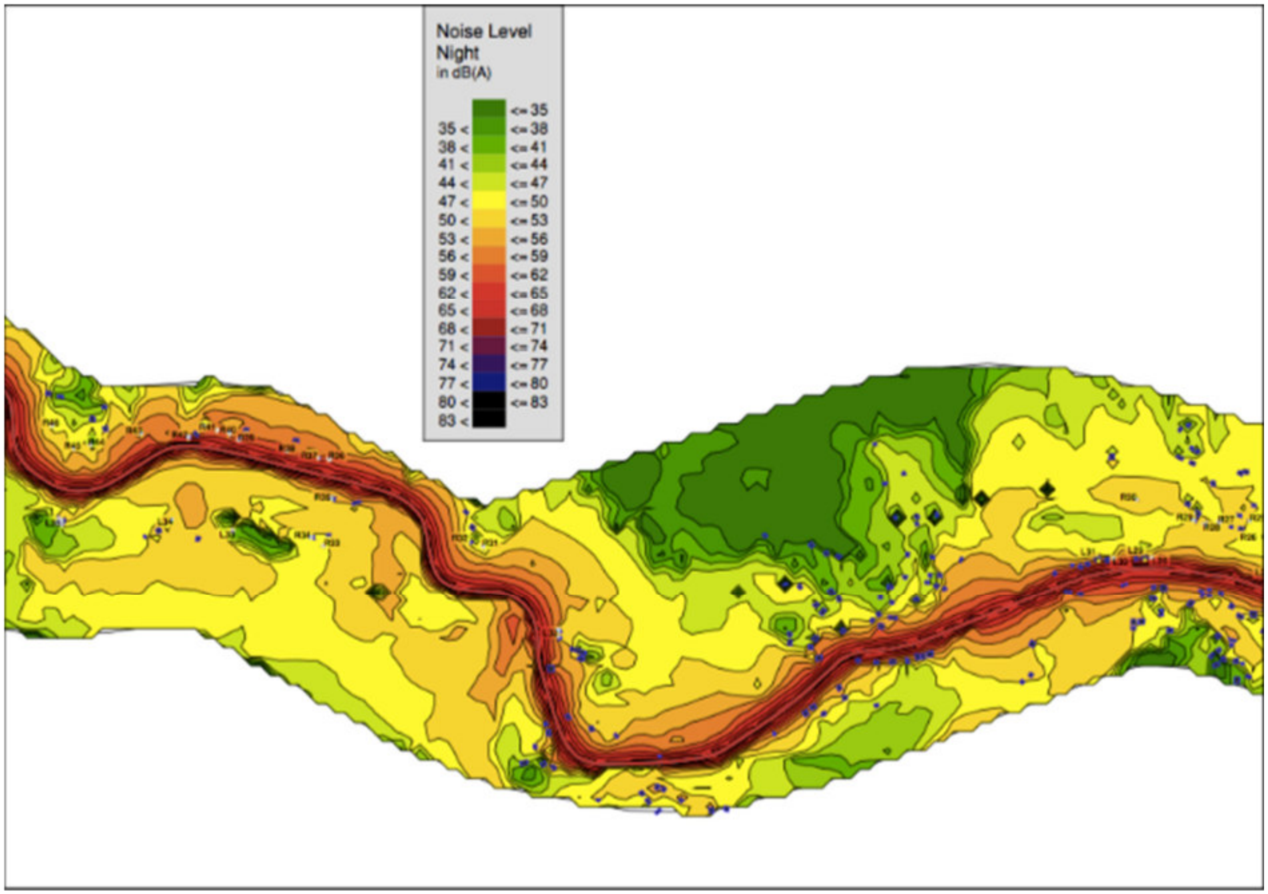
Portion 1: Night time



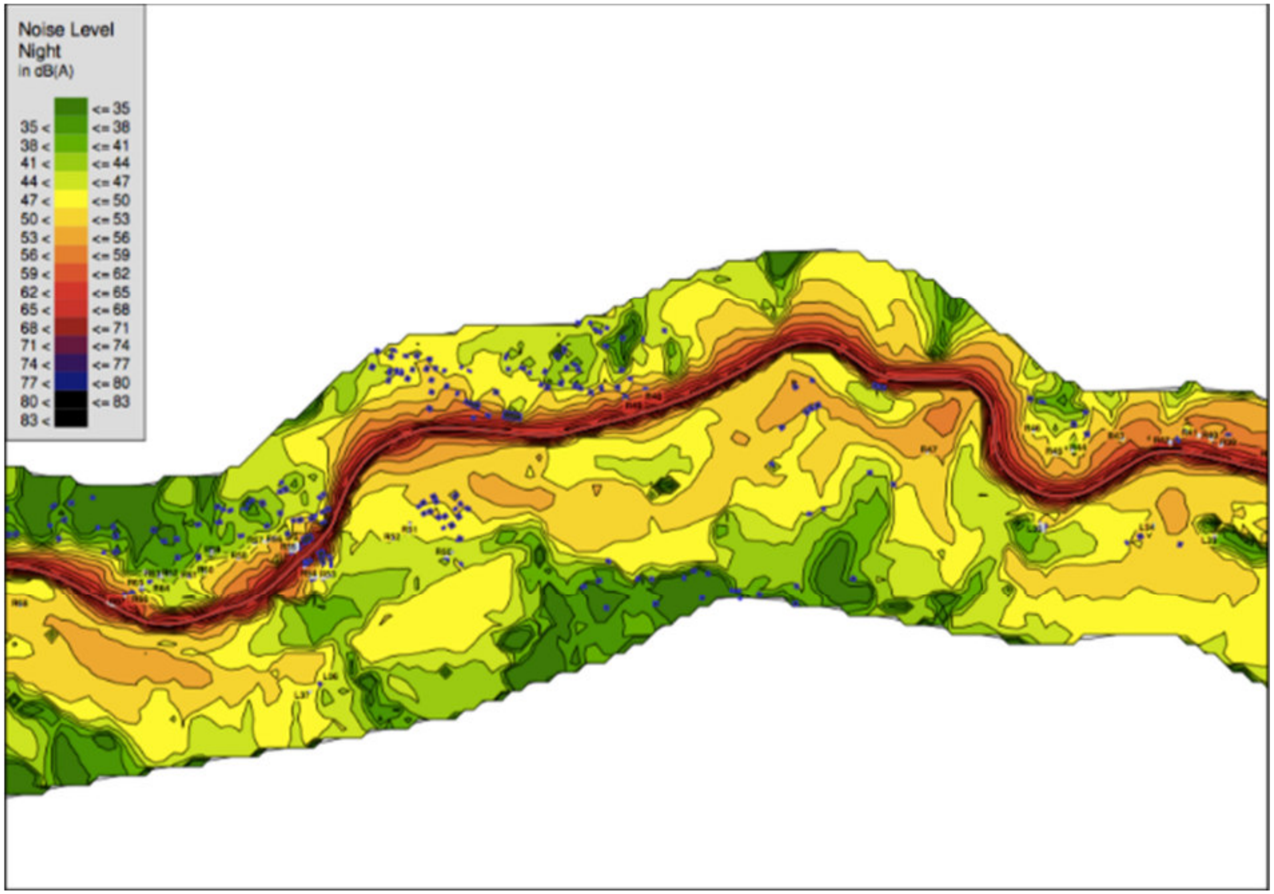
Portion 2: Night time



Portion 3: Night time



Portion 4: Night time



APPENDIX O

Spoil Disposal Plan Template

1. Purpose

This assessment outlines the technical characteristics of the Spoil Disposal Site(s) that CONTRACTOR proposes for use for spoil disposal during construction of the E60 Highway Section F2, Georgia.

The spoil disposal site will be considered as an associate facility by ADB and as such ADB are required to complete due diligence on the site to confirm that the site selected is appropriate and the level of assessment is sufficient to meet ADB safeguards requirements.

Therefore, this assessment, prepared by the CONTRACTOR, requires approval from the ADB and RD PIU prior to the application of licenses and approvals for the site and its subsequent use.

The CONTRACTOR shall ensure that the disposal of excess spoil material will be undertaken in a manner that verifiably minimises environmental and social risks.

2. Site Screening

<u>Screening Summary</u>

A screening assessment of potential sites for spoil disposal has been undertaken by the CONTRACTOR. The CONTRACTOR sub-contracted a specialist national environmental expert to undertake the screening exercise.

The following table indicates the sites assessed.

Table 113: Sites Screened

#	Site Name	GPS Coordinates	Nearest Village

The following Figure indicates the location of each site.

Figure 165: Location of Screened Sites

The CONTRACTOR used the Rapid Environmental Assessment Checklist to summarise the potential impacts of the site. The completed checklists for each site are provided as **Appendix A**.

The following table summarises the findings of the checklists.

Table 114: Summary of Screening Activity

Site	Air quality Impacts	Hydrology Impacts	Topography Issues	Soils Impacts	Flora Impacts	Fauna Impacts	Protected Area Impacts	Access Issues	Impacts to Local Community	Safety Issues	Noise Impacts	Archaeology / PCR Issues

The results of the screening exercise indicate that the following sites were ***UNSUITABLE*** for use:
XXX
XXX
XXX
The results of the screening exercise indicate that the following sites are ***SUITABLE*** for use:
XXX
XXX
XXX

3. Site specific Environmental and Social Assessment

Following the rapid screening exercise, the locations considered for use as disposal site/s (including their access roads) have been inspected by CONTRACTOR personnel from project different disciplines, including:
Name / Position
Name / Position

The characteristic of the selected dump site is described in the following paragraphs

Name of Disposal Site

TO BE COMPLETED

Location/s

PROVIDE SITE COORDINATES

PROVIDE SITE BOUNDARY OVERLAID ON ORTHOPHOTO

PROVIDE ACCESS ROAD/S OVERLAID ON ORTHOPHOTO

PROVIDE FOR MULTIPLE SITES IF APPLICABLE

Cross sections of the sites (at 25 meter intervals) are provided in **Appendix B**.

A photographic record of the site pre-construction is provided by **Appendix C.**

3.1 Site Area And Estimated Volume Available

Estimated volume of material

Approximately 1.9 million cubic meters of material will be generated during the Project. The following table indicates the amount of material to be placed at each spoil disposal site and the volume of material allowed for disposal at each site according to their license.

Table 115: Available Site Areas

#	Site Name	Proposed Spoil Volume (m^2)	Volume Available According to License (m^2)

3.2 Social Issues

Access Arrangements, Route Selection and Traffic Management

The following figure/s provides the access routes for the site/s. These routes are also included in the CONTRACTORS Traffic Management Plan. No works shall start until the Traffic Management Plan and the access routes have been approved by the Engineer.

Figure 166: Access Roads

The route selection process was based on the following principles:

- Avoidance of natural hazards;
- Avoidance of populated areas; and
- No ban for travelling of HGV.

The route from the E60 to the spoil disposal site has a total length of XXX Km.

A summary condition survey of the access road has been undertaken and is included as **Appendix D**.

The route will pass through the following populated areas:
XXX
XXX

The following sensitive receptors were located along the route:

Table 116: Sensitive Sites

#	Type and Name	Coordinates	Distance to Route

The following upgrading works will be undertaken on the access road prior to its use:
XXX
XXX

Routine spraying of the access road with water will be undertaken during dry periods to limit dust impacts.

A speed limit of XXX has been set on the access roads.

Access to the site will be strictly controlled and will be fenced during the construction works to prohibit unauthorized access.

Warning signs will be places around the site to inform the local community of the safety issues.

3.3 Stakeholder Engagement

As part of the site selection process the CONTRACTOR has undertaken consultations with the local community regarding the use of the site and access roads.

The following table indicates the comments received during the consultations.

Table 117: Summary of Consultations

#	Village	Comment	Reply

A list of those present in the meeting is provided by **Appendix E**.

The attendees were informed during the meeting of the Grievance Redress Mechanism, and were provided a copy along with contact numbers for complaints.

3.4 Surface Water and Drainage and Groundwater

The following surface water features have been identified in the area:

Table 118: Surface Water Features

#	Name	Location

Outline if any crossings of these water courses will be necessary and if adequate crossing are available.

Outline here what site drainage will be installed, include designs, if relevant.

3.5 Reinstatement and Landscaping at Completion

The spoil disposal site shall be re-instated upon completion of works at the site.

Where practical, the site has been re-instated with similar species as those removed as part of the site clearance.

CONTRACTOR to provide full details of the reinstatement plan here, including area to be reinstated, schedule, types of plants and maintenance program.

Appendix F provides the profiles of the reinstated site.

3.6 Services Infrastructure & Plant On Site

The CONTRACTOR will use the following equipment on-site:

Table 119: Site Equipment

#	Type of Equipment	Number

XXX number of staff will be located at the site, they include:

Table 120: Staff

#	Staff Positions	Number

The site will be equipped with first aid facilities, mobile communications and toilets.

3.7 Biodiversity

A survey of flora and fauna was undertake at the site by a national specialist. The findings of the survey indicate that:
XXX
XXX

3.8. Archeology and PCR

A walkover survey of the site was undertake at the site by a national specialist. The findings of the survey indicate that:
XXX
XXX

3.9 Proposed Preventive Measures

Appendix G provides the mitigation actions required for the operation and reinstatement of the site.

4. Conclusions & follow up actions

4.1 Conclusions

Based upon the results of this Assessment and on the basis that CONTRACTOR implements the mitigation measures under his responsibility and follow up actions identified, the following conclusions can be made with respect to proposed use of the disposal site assessed in this report:

- CONTRACTOR SEMP contains general mitigation measures to address the risks identified in this E&S Assessment;
- Where necessary, additional site-specific mitigation measures have been identified in this Assessment (see **Appendix G**), which provide further assurance to ADB that CONTRACTOR can meet its environmental and social Project Requirements;
- If implemented appropriately, the mitigation measures outlined in CONTRACTOR SEMP and this assessment will result in appropriate avoidance for reduction of impacts to an appropriate level;
- This assessment has taken into consideration all requirements of the EIA and EMP and CONTRACTOR SEMP;
- Where necessary, CONTRACTOR has highlighted additional actions to be undertaken, which will allow appropriate mitigation of environmental and social impacts (see **Appendix G**);
- CONTRACTOR will implement and monitor proposed use of the disposal site and amend mitigation measures as required to ensure they are effective.

4.2 Licenses and Approvals

Upon approval of this assessment by the ADB and the RD PIU, CONTRACTOR will complete his Spoil Disposal Plan. 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.

The CONTRACTOR shall also prepare and submit his EIA for the site which will be approved by MoEPA.

4.3 Follow-up

In addition to the implementation of those measures outlined in this report, the following Actions have been identified for addition to CONTRACTOR Action Tracking System, in order to close out issues identified in this PCS that require non-routine follow up action;

Table 121: Follow-up Actions

Action	Responsible
Periodic (Monthly) inspections/audits will be undertaken on the selected site to verify the respect of project requirements, as considered appropriate by the Engineer, the PIU and ADB	Contractor
Review of Grievance Reports relating to dump truck movements delivering spoil to the dump site. Address any grievances as required.	Contractor
Periodic inspections of dump truck movements on the approved route corridor to observe whether Project related vehicles are contributing to traffic delays, hold ups or incidents.	Contractor

LIST OF APPENDICES

APPENDIX A – SCREENING REPORTS

APPENDIX B – SITE CROSS SECTIONS

APPENDIX C – PHOTOGRAPHIC RECORD OF THE SITE/S

APPENDIC D – ACCESS ROAD CONDITION SURVEY

APPENDIX E – CONSULTATIONS

APPENDIX F – SITE PROFILES

APPENDIX G - PROPOSED MITIGATION MEASURES

APPENDIX P

Baseline Noise Model Iterations

Baseline noise model iterations were made based on the following:

- Noise measurements have been conducted for 24 hours, this may be non representative of road traffic conditions.
- The baseline noise measurements were not performed simultaneously but in different days for the different locations, and this, in addition to short duration of measurements, can greatly affect representativeness. Imagine that point "A" is recorded on Monday and point "B" on Sunday, clearly there will be different levels of traffic/noise for the two points but the model is based on HOMOGENOUS TRAFFIC flow.
  We do not have details about noise sources other than traffic, e.g. river noise, that are included in the measurements.
- The best fitting traffic condition that minimizes the gap between measured and calculated values is the same for the whole road extension, no traffic variation sections have been considered for lack of information about that. We have no differential traffic measurements.
- The positions of receptors (where noise level has been calculated) may not be exactly the same of the measurement points while in calculations we MUST assume they are coincident.
- About noise maps, they are calculated at 4 m height at 1 m distance from the receiver wall. The numeric input values reported in excel files are instead calculated at 1.5 m height and 1 m from the wall. The measurements are to be compared with numeric calculated values as measurements were taken at 1.5 m height too.

The best fitting scenario is SIMULATION 1 (in yellow).

Data has been purged by anomalous field measurements (these measurements seems to be affected by anomalous environmental constraints)

There is a good correlation between receptors L7, L26, L32, L34, R15, R28, R45., for the other ones L2, R1, R14, R15, R53 correlation is acceptable.

The correspondence on receptors L7, L26, L32, L34, R15, R28, R45 can be even improved if we decrease about 2 dBA caused by the noise reflected by the facade of the buildings.

Measurements	**L2**	**L7**	**L26**	**L32**	**L34**	**L36**	**R1**	**R14**	**R15**	**R28**	**R45**	**R53**	**T6**		
Lday	**52.7**	**53.4**	**66.8**	**57.6**	**52.9**	**45.0**	**53.7**	**52.1**	**52.3**	**54.3**	**56.5**	**57.3**	**57.6**		
Lnight	**49.0**	**53.3**	**64.0**	**56.0**	**50.1**	**45.9**	**51.4**	**49.7**	**50.8**	**50.9**	**52.1**	**49.9**	**56.0**		
Simulation 1															
Ld	**48.3**	**60.2**	**68.6**	**61.0**	**55.6**	**52.3**	**51.2**	**48.7**	**54.9**	**56.4**	**57.7**	**50.3**			
Ln	**44.9**	**56.8**	**65.2**	**57.6**	**52.2**	**48.9**	**47.8**	**45.3**	**51.5**	**53.0**	**54.3**	**46.9**			
Difference														Total	Ave.
Lday	**4.4**	**-6.8**	**-1.8**	**-3.4**	**-2.7**	**-7.3**	**2.5**	**3.4**	**-2.6**	**-2.1**	**-1.2**	**7.0**		**-10.7**	**-0.9**
Lnight	**4.1**	**-3.5**	**-1.2**	**-1.6**	**-2.1**	**-3.0**	**3.6**	**4.4**	**-0.7**	**-2.1**	**-2.2**	**3.0**		**-1.4**	**-0.1**
Lday	**4.4**	**6.8**	**1.8**	**3.4**	**2.7**	**7.3**	**2.5**	**3.4**	**2.6**	**2.1**	**1.2**	**7.0**		45.2	3.8
Lnight	**4.1**	**3.5**	**1.2**	**1.6**	**2.1**	**3.0**	**3.6**	**4.4**	**0.7**	**2.1**	**2.2**	**3.0**		31.6	2.6