DIRECTORATE FOR ROADS OF VIETNAM
PROJECT MANAGEMENT UNIT NO. 7

REPORT OF ENVIRONMENT IMPACT ASSESSMENT

PROJECT FOR REHABILITATION AND IMPROVEMENT OF NATIONAL HIGHWAY NO. 20 - SECTION FROM DONG NAI TO LAM DONG PROVINCE

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PROJECT MANAGEMENT UNIT NO. 7

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LIST OF ABBREVIATION

ATVSTP: Food safety and sanitation
Ban QLDA: Project Management Unit
BHYT: Health insurance
BOD_5: Biological oxygen demand measured at 20^0C after 05 days
BTCT DƯL: Pre-stressed reinforced concrete
BTCT: Reinforced concrete
BTN: Asphalt concrete
C4: Grade 4 (used in classification of soil according to the construction terrain)
COD: Chemical oxygen demand
CPĐD: Ballast aggregate
ĐBSCL: Mekong River Delta
DO: Dissolved oxygen
ĐTM: Environment Impact Assessment
DTW: Depth to Water
EC: Electrical conductivity (S/cm)
GDP: Gross Domestic Product
GPMB: Site clearance
GTVT: Traffic transportation
K95: Soil compactness reaching at 95% compared with standard compactness
K98: Soil compactness reaching at 98% compared with standard compactness
KHHGĐ: Family planning
KPHĐ: Undetectable
MNP: Maximum number possible
PKĐK: Polyclinic department
QLDA: Project Management
TSS: Total Suspension Solid
THCS: Secondary schoole
THPT: High school
T-N: Total Nitrogen
T-P: Total Phosphor
UBMTTQ: Fatherland Front Committee
UBND: People's Committee
UNESCO: United Nations Educational Sicentific and Cultural Organization
Vải ĐKT: Geo -technical fabric
WHO: World Health Organization
XDCB: Civil engineering

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PREFACE

1. ORIGIN OF THE PROJECT

National Highway 20starts from Km0 at Dau Giay T-junction located in Dong Nai province and ends at Km268 in Dran town, Don Duong district, Lam Dong province; the length of the entire route is 268 km, passing 75,6 km within Dong Nai province and passing 192,4 km within Lam Dong province. The road not only connects key economic regions Dong Nai and Lam Dong province, but also connects Da Lat City – a famous site-seeing with Ho Chi Minh City – Centre of economy, politic, culture of southern area.

The Ministry of Transport allowed some construction projects along National Highway 20 in order to strengthen the roads traffic and utilize advantages of Dong Nai and Lam Dong province in particular and that of the entire Eastern South area and highland area in general: Period 1998 - 2002, the investment on section Km0 - Km232 of National Highway 20 by capital loan and toll implementation for loan disposal; investment on the expansion of the section passing through Di Linh and Duc Trong town on National Highway 20; investment on improvement of section Da Lat - Don Duong on National Highway 20 by JBIC loan; investment on the BOT project to repair and expand some sections through towns on QL20, realized by Co. 7-5; investment on the maintenance of sections Km20 - Km62, Km79+800 - Km98 on National Highway 20 by WB4 loan. However, remaining sections have been in a situation of damage, crumbling and crevice and have been not in a good position for transport demand and traffic safety for more than 30 years of operation. The Dau Giay - Lien Khuong Highway project is planned to start after 2012, separating with National Highway 20. In the current period, it is necessary to rehabilitate and reform the National Highway 20 for the purpose of traffic safety and properly meeting the traffic demand.

1.1 Necessity of investment

According to the forecast of Construction Consultancy, Survey and Design Company – Ministry of Defense, traffic volume on National Highway 20 in 2015 and 2020 is forecasted based on the real traffic volume in 12/2009, as following (Table 0.1):

Table 0.1. Forcast of vehicle flow in the future

Time	Vehicle conversion (CPU/night and day)	
	Km108+800	Km243+100
2013	9.268	1.009
2015	11.214	1.221
2020	16.161	1.967
2025	21.627	3.168

The maximum capacity of traffic for a 2-lane road without separating trip where motorized and non-motorized vehicle share the same lane in the existing RN20 is from 9.200 to 11.000 PCU/night and day. Hence, the National Highway 20would retire among 2012 - 2014.

The investment on rehabilitation and reformation of National highway No. 20 - section from Dong Nai to Lam Dong province is matched the Decision No. 1327/QĐ-

TTg dated 24/8/2009 approving the Development Plan of Vietnam road transport traffic to 2020 and orientation to 2030; Decision No. 910/1997/QĐ-TTg dated 24/10/1997 of the Prime Minister on approving the overall plan for socio-economic development in eastern south Vietnam from now till the year 2010; Decision No. 73/2008/QĐ-TTg dated 04/6/2008 of the Prime Minister on approving the overall plan for socio-economic development in Dong Nai province till 2020; Decision No. dated 409/QĐ-TTg dated 27/5/2002 of the Prime Minister on approving the planning of Da Lat City, Lam Dong province and adjacent area till 2020.

The existing National Highway 20is a core route that connects the 3 areas Ho Chi Minh – southern economic center, Dong Nai and Da Lat. It is the main traffic bone of Dong Nai province. More than 30 years of operation has degraded the road quality; Although the Ministry of Transport has allowed the implementation of some construction investment projects at some sections, the traffic has still met difficulties since only road maintenance and reinforcement are not enough.

The investment on rehabilitation and reformation of National highway No. 20 - section from Dong Nai to Lam Dong province is strongly essential and urgent due to its important contribution to the socio-economic development of Dong Nai and Lam Dong province in particular and those of the eastern south area in general.

1.2 Advantages and disadvantages during project implementation

National Highway 20is an important traffic route of Dong Nai and Lam Dong province, which is constructed by complete asphalt pavement. Therefore, multi-works at different sections could be done at the same time. The scale of town planning has been finalized by local authorities and constructions in most of town along the road are basically implemented based on the planning such as Tan Phu town, Mada Gouil town, Bao Loc City, Di Linh town, Lien Nghia town, Da Lat City and hence, site clearance workload is small enough to enable more rapid progress of the project.

However, during the construction time, traffic could be a difficult issue since the existing road is the core route of both Lam Dong and Dong Nai province.

1.3 Legal basis for making of investment project

- Decision No. 1327/QD-TTg date 24/08/2009 of the Prime Minister on approving the Development Plan of Vietnam road transport traffic to 2020 and orientation to 2030.

- Official Correspondence No. 4610/CĐBVN-KHĐT dated 04/11/2008 of the Directorate for Roads of Vietnam on asking for permission to compile the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province".

- Decision No. 3696/QĐ-BGTVT dated 04/12/2008 of the Ministry of Transport on the assignment of responsibilities for compiling the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province";

- Decision No. 2868/QĐ-CĐBVN dated 04/12/2008 of the Directorate for Roads of Vietnam the assignment of responsibilities for managing the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province".

- Decision No. 775/QĐ-BGTVT dated 30/3/2009 of the Ministry of Transport on approving the proposal and cost estimation for exploration and compilation of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province".

- Decision No. 1142/QĐ-BGTVT dated 05/5/2009 of the Ministry of Transport on list of applied standards for the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province".

- Decision No. 3204/QĐ-UBND dated 27/11/2008 of the Lam Dong's People Committee on approving the Planning on connection points to NATIONAL HIGHWAY 20, 27, 28 and 55 that pass the area of Lam Dong province.

- Announcement No. 123/TB-BGTVT dated 01/4/2010 of the Ministry of Transport on the conclusion of the permanent Vice Minister Ngo Thinh Đuc at the meeting to handle issues related to implementing status of projects along NATIONAL HIGHWAY 20.

- Announcement No. 239/TB-TCĐBVN dated 16/4/2010 of the Directorate for Roads of Vietnam on the conclusion of the Vice General Director Nguyen Đuc Thang about on-site check of construction investment project.

- Announcement No. 395/TB-BGTVT dated 22/9/2010 of the Ministry of Transport on the conclusion of Vice Minister Le Manh Hung at the meeting to pass on the report of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province".

- Official Correspondence No. 2563/TCĐBVN-KHĐT dated 22/9/2010 of the Directorate for Roads of Vietnam on completing the records of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province".

- Decision No. 2552/QĐ-BGTVT dated 07/11/2011 of the Ministry of Transport on approving the amendment of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province" and the division of the project into 2 component projects, in which the component project I is featured by Build – Transfer contract.

2. LEGAL AND TECHNICAL OF ENVIRONMENT IMPACT ASSESSMENT (EIA)

The EIA report of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province" is compiled based on following legal and technical basis:

2.1 Legal basis

✓ ***Legal document relative to environmental protection***

- Environmental Protection Law of the XIth National Assembly of the Socialist Republic of Vietnam, at 8th session, passed on 29/11/2005;
- Decree No. 80/2006/NĐ-CP dated 09/8/2006 of the Government on detailing and guiding the implementation of a number of articles of the Law on environmental Protection;

- Decree No. 21/2008/NĐ-CP dated 28/02/2008 of the Government on amendment of and supplement to several Articles of the Decree No. 80/2006/NĐ-CP;
- Decree No. 29/2011/NĐ-CP dated 18/04/2011 of the Government on stipulating the strategic environmental assessment, environmental impact assessment and environmental protection commitment;
- Decree No. 67/2003/NĐ-CP dated 13/6/2003 on environmental protection charges for waste water;
- Decree No. 140/2006/NĐ-CP dated 22/11/2006 of the Government on stipulating the environmental protection at stages of elaboration, evaluation, approval and implementation of development strategies, planning, plans, programs and projects;
- Decree No. 81/2006/NĐ-CP dated 09/8/2006 of the Government on sanctioning of administrative violations in the domain of environmental protection;
- Decree No. 59/2007/NĐ-CP dated 09/4/2007 of the Government on solid waste management;
- Decree No. 04/2007/NĐ-CP dated 08/1/2007 of the Government on Amending and supplementing a number of articles of the Government's Decree No. 67/2003/ND-CP of June 13, 2003, on "environmental protection charges applicable to wastewater";
- Decree No. 117/2009/NĐ-CP dated 31/12/2009 of the Government on the handling of law violations in the domain of environmental protection;
- Circular No. 09/2010/TT- BGTVT, dated 06/04/2010 of the Ministry of Transport on stipulating the environmental protection in the development of transport infrastructure;
- Circular No. 26/2011/TT- BTNMT dated 18/7/2011 of the Ministry of Natural Resources and Environment on detailing a number of articles of the Government's Decree No. 29/2011/NĐ-CP stipulating the strategic environmental assessment, environmental impact assessment and environmental protection commitment;
- Circular No. 02/2005/TT-BTNMT dated 24/6/2005 of the Ministry of Natural Resources and Environment on guiding the issuance of permits for water resource exploration, exploitation and use, or for discharge of wastewater into water sources;
- Circular No. 12/2011/TT-BTNMT dated 14/4/2011 of the Ministry of Natural Resources and Environment on stipulating the hazardous waste management;
- Decision No. 64/2003/QĐ-TTg dated 22/4/2003 of the Prime Minister on approving the plan for thoroughly handling establishments which cause serious environmental pollution;
- Decision No. 1696/QĐ-BKHCN dated 28/7/2006 of the Ministry of Science and Technology on promulgating Vietnam Standards;
- Decision No. 23/2006/QĐ-BTNMT dated 26/12/2006 of the Ministry of Natural Resources and Environment on promulgating the list of hazardous wastes;
- Decision No. 22/2006/QĐ-BTNMT dated 18/12/2006 of the Ministry of Natural Resources and Environment on the compulsory application of Vietnam environmental standards;
- Decision No. 04/2008/QĐ-BTNMT dated 18/07/2008 of the Ministry of Natural Resources and Environment on promulgating the national technical regulations on environment;

- Decision No. 16/2008/QĐ-BTNMT dated 31/12/2008 of the Ministry of Natural Resources and Environment on promulgating the national technical regulations on environment;

✓ ***Legal document relative to land use***

- Law No. 13/2003/QH11 on Land dated 26/11/2003 of the National Assembly, the Socialist Republic of Vietnam;
- Decree No. 181/2004/NĐ-CP dated 29/10/2004 of the Government on detailing the implementation of the 2003 Land Law;
- Decree No. 197/2004/NĐ-CP dated 03/12/2004 of the Prime Minister on compensation when land is recovered by the State for the purpose of national defense, security, national and public interests;
- Decree No. 17/2006/NĐ-CP dated 27/01/2006 of the Prime Minister on the amendment of and supplement to several Articles of the Decree No. 197/2004/NĐ-CP;
- Decree No. 84/2007/NĐ-CP dated 25/5/2007 of the Prime Minister on “Additionally stipulating the grant of land use right Certificates, recovery of land, exercise of land use rights, order of and procedures for compensation, support and resettlement upon land recovery by the State and settlement of land-related complaints”;
- Decree No. 69/2009/NĐ-CP dated 13/8/2009 of the State on “Additionally providing for land use planning, land prices, land recovery, compensation, support and resettlement”;
- Circular No. 116/2004/TT-BTC dated 07/12/2004 of the Ministry of Finance on guiding the implementation of the Government's Decree No. 197/2004/ND-CP on compensation when land is recovered by the State for the purpose of national defense, security, national and public benefits;
- Circular No. 14/2009/TT-BTNMT dated 01/10/2009 of the Ministry of Natural Resources and Environment on “Detailing the compensation, support, resettlement, order of and procedures for land recovery, land allocation, land lease”;
- Circular No. 57/2010/TT-BTC dated 16/04/2010 of the Ministry of Finance on “Stipulating the estimation, funding usage and settlement in organizing compensation, support and resettlement when land is recovered by the State”;
- Decision No. 1665/TTg-CN dated 17/10/2006 of the Prime Minister on managing activities of site clearance and bomb, mine and explosive object sweeping to enable traffic construction projects;
- Decision No. 1856/QĐ-TTg dated 27/02/2007 of the Prime Minister on approving the Approving the plan on restoration of order in road and railway safety corridors;
- Decision No. 21/2010/QĐ-UBND dated 05/04/2010 of the Dong Nai’s People Committee on stipulating the order of and procedure for compensation, support, resettlement, land recovery, land allocation, land lease within the area of Dong Nai province;
- Decision No. 20/2010/QĐ-UBND dated 05/04/2010 of the Dong Nai’s People Committee on removal and resettlement policy when land is recovered by the State, applied within the area of Dong Nai province;

- Decision No. 88/2009/QĐ-UBND dated 23/12/2009 of the Dong Nai's People Committee on stipulating land price within the area of Dong Nai province;
- Decision No. 30/2008/QĐ-UBND dated 14/04/2008 of the Dong Nai's People Committee on unit price for property compensation when land is recovered by the State, applied within the area of Dong Nai province;
- Decision No. 46/2010/QĐ-UBND dated 16/12/2010 of the Lam Dong's People Committee on stipulating land price within the area of Lam Dong province for 2011;
- Decision No. 57/2009/QĐ-UBND dated 16/06/2009 of the Lam Dong's People Committee on unit price for compensation of plant damage when land is recovered by the State within the area of Lam Dong province;
- Decision No. 32/2010/QĐ-UBND dated 30/09/2010 Lam Dong's People Committee on stipulating the compensation, support and resettlement when land is recovered by the State within the area of Lam Dong province;
- Decision No. 90/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of Da Lat City, Lam Dong province for 2010;
- Decision No. 91/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of Bao Loc town, Lam Dong province for 2010;
- Decision No. 92/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of Duc Trong district, Lam Dong province for 2010;
- Decision No. 95/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of Don Duong district, Lam Dong province for 2010;
- Decision No. 97/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of Di Linh district, Lam Dong province for 2010;
- Decision No. 98/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of Bao Lam district, Lam Dong province for 2010;
- Decision No. 99/2009/QĐ-UBND dated 18/12/2009 Lam Dong's People Committee on stipulating land price within the area of DaHuoai district, Lam Dong province for 2010;

✓ ***Applied regulations, standards***

<u>*Set of Vietnam standards on air quality, noise:*</u>

- QCVN 05:2009/BTNMT – National technical regulation on ambient air quality;
- QCVN 06:2009/BTNMT - National technical regulation on hazardous substances in ambient air;
- TCVN 5970:1995 - Planning of ambient air quality monitoring;
- QCVN 19:2009/BTNMT - National technical regulation on industrial emission of dusts and inorganic substances;
- QCVN 20:2009/BTNMT - National Technical Regulation on Industrial Emission of Organic Substances;

- QCVN 26:2010/BTNMT - National Technical Regulation on Noise;
- TCVN 7210:2002 - Vibration and Shock by traffic means – Maximum levels for the environment of public and residential areas;
- QCVN 27:2010/BTNMT - National Technical Regulation on Vibration*;*

Set of Vietnam regulations on water quality:

- QCVN 08:2008/BTNMT - National technical regulation on surface water quality;
- QCVN 09:2008/BTNMT - National technical regulation on underground water quality;
- QCVN 14:2008/BTNMT - National Technical Regulation on Domestic Wastewater;
- QCVN 24:2009/BTNMT - National Technical Regulation on Industrial Wastewater;
- QCVN 01:2009/BYT - National technical regulation on drinking water quality;
- QCVN 02:2009/BYT - National technical regulation on domestic water quality.

Set of Vietnam regulations on soil quality:

- QCVN 03:2008/BTNMT - National technical regulation on the allowable limits of heavy metals in the soils;
- QCVN 15:2008/BTNMT - National technical regulation on chemical residues of plant protection in the soils;
- TCVN 6696:2000 - Solid Waste, sanitary landfill, general requirements for environmental protection;
- QCVN 07:2009/BTNMT - National Technical Regulation on Hazardous Waste Thresholds.

2.2 Technical basis

- Temporary regulation on monitoring method – environmental analysis and data management in 1999 of the Department of Environment;
- Guidelines for making environmental impact assessment report in transportation construction projects (roads, railway, bridge). Department of Environment – Ministry of Science and Technology promulgated in 1999;
- Procedure for environmental impact assessment in the feasibility study project and design of transportation constructions, 22TCN 242 – 98 of the Ministry of Transport;
- Circular No. 10/2007/TT-BTNMT dated 22/10/2007 of the Ministry of Natural Resources and Environment on guiding the quality assurance and control in environment monitoring.

2.3 Source of technical data and documents for reference

The list of data, documents source for reference is as following:

Internal documents:

[1]. Ministry of Natural Resources and Environment (2008). Detailing the guidelines on erecting the environmental protection commitment form. Ministry of Natural Resources and Environment, Hanoi, 2008.

[2]. Le Van Nai (2000). Environmental protection in capital construction. Science and Technics publishing house, Hanoi, 2000 (*Referred to assessment method on water environment pollution; domestic wastes and management methods*).

[3]. Organization of roads works. Transport publishing house, Hanoi, 2002 (*referred to calculation of demand on site huts, domestic water of site workers*)

[4]. Le Trinh (2000). Environmental Impact Assessment – Methods and Application. Science and Technics publishing house, Hanoi, 2000 (*referred to method of assessment, identification of waste sources and their impacts*).

[5]. Pham Ngoc Dang (2003). Air environment. Science and Technics publishing house, Hanoi, 2003 (*referred to pollutant concentration calculation model in the air; traffic noise pollution and vehicle-flow noise assessment model).*

[6]. Statistical Yearbook 2009, Dong Nai province. Dong Nai Statistical Office, 2010 (*Referred to data on natural condition, socio-economic factors*).

[7]. Statistical Yearbook 2009, Thong Nhat district, Statistical Office of Thong Nhat district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[8]. Statistical Yearbook 2009, Dinh Quan district, Statistical Office of Dinh Quan district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[9]. Statistical Yearbook 2009, Tan Phu district, Statistical Office of Tan Phu district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[10]. Statistical Yearbook 2009, Lam Dong province. Lam Dong Statistical Office, 2010 (*Referred to data on natural condition, socio-economic factors*)

[11]. Statistical Yearbook 2009, Da Teh district, Statistical Office of Da Teh district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[12]. Statistical Yearbook 2009, Da Huoai district, Statistical Office of Da Huoai district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[13]. Statistical Yearbook 2009, Bao Lam district, Statistical Office of Bao Lam district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[14]. Trinh Xuan Lai (2000). Calculation and design of wastewater treatment works, Science and Technics publishing house, Hanoi, 2000. (*Referred to design of domestic waterwaste treatment system*).

[15]. Statistical Yearbook 2009, Di Linh district, Statistical Office of Di Linh district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[16]. Statistical Yearbook 2009, Duc Trong district, Statistical Office of Duc Trong district, 2010 (*Referred to data on natural condition, socio-economic factors*).

[17]. Tran Ngoc Chan, Air pollution and emission treatment, Science and Technics publishing house, Hanoi, 2002. (*referred to impact assessment and method of emission sources reduction*).

<u>*External documents on common waste sources*</u>*:*

[18]. World Health Organization, Assessment of Sources of Air, Water, and Land Pollution, A guide to rapid source inventory techniques and their use in formulating Environmental Control Strategies, Geneva, 1998. *(Referred to rapid assessment, pollution ratio for waste sources from traffic vehicles, work machines).*

[19]. Standard Methods for The Examination of Water and Wastewater - APHA, 1998. *(Referred to sampling procedure, sample analysis to identify the current status of environment).*

2.4 Source of technical data and documents made by Project Owner and Consultancy Unit

- Description of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province" made by Construction Consultancy, Survey and Design Company – Ministry of Defense.
- Basic design description of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province", section Km0+000 - Km76+700" made by Southern Traffic Construction Consultant Investment Joint Stock Company.
- Basic design description of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province", section Km79+800 - Km98 and Km108+458 - Km154+400" made by Civil Engineering Consultants Joint Stock Company No. 625.
- Basic design description of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province", section Km159+500 - Km172, Km176+500 - Km199, Km210 - Km234, Km240 - Km268" made by Construction Consultancy, Survey and Design Company - Ministry of Defense.
- Measurement and analysis data of air quality criteria in the project area (temperature, humidity, atmospheric pressure, wind speed, wind direction, CO, NO_2, SO_2, suspended dust and HC).
- Noise monitoring data (L_{eq}, L_{50}, L_{max}), vibration (speed, acceleration, vibration frequency).
- Measurement and analysis data of surface water quality criteria in the project area (Temperature, pH, turbidity, electric conductivity, DO, COD, BOD_5, suspended sediment - TSS, NH_3, NO_2^-, NO_3^-, PO_4^{3-}, Fe, Cu, Cd, Pb, Zn, Hg, As, lubricant, Coliform in total).
- Measurement and analysis data of underground water quality criteria in the project area (Temperature, pH, turbidity, hardness ($CaCO_3$), total solids, NH_3, NO_2^-, NO_3^-, SO_4^{2-},PO_4^{3-}, Cl^-, Fe, Cu, Cd, Pb, Zn, Hg, As, Fecal coli, Coliform).
- Measurement and analysis data of soil and sediment quality criteria in the project area (pH (H_2O), total organic, exchange acidity, total nitrogen, total phosphorus, Cl^-, SO_4^{2-}, As, Cd, Cu, Hg, Pb, Zn).

3. APPLICABLE METHODS DURING THE IMPLEMENTATION OF EIA

The environmental impact assessment in the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province" is conducted by following method:

❖ **Survey, field investigation**

- Collecting documents and real investigation, including:
  - + Toporaphy, geology, hydrography;
  - + Meteorology, hydrography;
  - + Socio-economic conditions;

  + Eco-systems.
- Collecting documents on infrastructure:
  + Drainage and water supply system;
  + Traffic system;
  + Telecommunication system;
  + Electrical supply system;
  + Solid wastes collection system.
- Survey on natural environment status in the project area:
  + Survey on air quality status;
  + Survey on surface water quality status;
  + Survey on underground water quality status;
  + Survey on soil quality status;
  + Survey on sediment quality status;

❖ **Modeling method**

- Semi-empirical model to assess the dust waste due to vehicle operation on roads (by Air Chief, US Environmental Protection Agency, 1995);
- Model to calculate emission concentration emitted from roads sources (adjusted version of Sutton model);
- Semi-empirical model to calculate the noise from vehicle flow.

❖ **Statistical method**

Statistically handle and analyse measurable and monitoring data on air quality, noise, soil and water environment quality at the operational area of the project.

❖ **Sample analytic method**

o ***Analytic method of air sample***

The analytic method of air sample follows the Vietnam Standard (TCVN – 1995) and technical regulation “Occupational Health and Environmental Hygiene” of the Ministry of Health - 1993, described in Table 0.2.

Table 0.2 Analytic method of standard criteria in air environment

Criteria	Method
Temperature	Thermometer and hygrometer
Humidity	Thermometer and hygrometer
Wind speed	Wind speed meter
Atmospheric pressure	Pressure meter
Suspended dust	TCVN 5067:1995
CO	Technical regulation, 1993
NO_2	TCVN 6137:1996
SO_2	TCVN 5971:1995
HC	Gas Chromatography method
Noise	Integrating Noise Level Meter (Anh), CR

Criteria	Method
	831B
Vibration	Vibration meter, VM–82, RION

- ***Analytic method of underground water sample***

The analytic method follows the Standard Methods for The Examination of Water and Wastewater (APHA, 1998). Table 0.3 shows more information.

Table 0.3 Analytic method of standard criteria for underground water

Criteria	Method
Temperature	Thermometer
pH	TCVN 6492-1999
Turbidity	TCVN 6184-1996
Hardness	TCVN 2672-78
Sediment in total	TCVN 4560-1988
NO_3^-	TCVN 6180-1996
SO_4^{2-}	APHA 4500 – TCVN 4567-88
Cl^-	TCVN 6194-1996
Fe, Cu, Cd, Pb, Zn	TCVN 6193-1996
As	TCVN 6626-2000
Hg	APHA 3500
CN^-	TCVN 6181-1996
Fecal-coli	APHA 9221
Coliform	APHA 9221

- ***Analytic method of surface water sample***

The analytic method follows the Standard Methods for The Examination of Water and Wastewater, APHA 1998, 1995, described in Table 0.4. Criteria pH, DO is measured on-site.

Table 0.4 Analytic method of standard criteria for surface water

Criteria	Method
Temperature	Thermometer
pH	TCVN 6492-1999
Turbidity	TCVN 6184-1996
Electricity conductivity	APHA 2510 (electricity conductivity meter)
DO	TCVN 5499-1995
COD	TCVN 6491-1999
BOD_5	TCVN 6001-1995
TSS	TCVN 6625-2000
Total phosphorus	TCVN 6202-1996
Total nitrogen	TCVN 6638-2000
Fe, Cu, Cd, Pb, Zn	TCVN 6193-1996
Hg	APHA 3500/AOAC 97
As	TCVN 6626-2000

Lubricant	APHA 5520
NO_3^-	TCVN 6180-1996
CN^-	TCVN 6181-1996
Coliform	TCVN 6187-1:1996 (Membrane filtration)

- ***Analytic method of bottom mud sample***

Table 0.5 Analytic method of bottom mud sample

Criteria	Method
pH	pH met
Total organic substances	Chemical method
Exchange acidity	Standard and pH met
T-N	Keldan method
T-P	Colorimetric method
Cl^-	Standard
SO_4^{2-}	BS 1377-1990
As, Cu, Zn, Cd, Hg, Pb	AAS

- ***Analytic method of soil sample***

Table 0.6 Analytic method of soil sample

Criteria	Method
pH	pH met
Total organic substances	Chemical method
Exchange acidity	Standard and pH met
T-N	Keldan method
T-P	Colorimetric method
Cl^-	Standard
SO_4^{2-}	BS 1377-1990
As, Cu, Zn, Cd, Hg, Pb	AAS

❖ **Listing method**

- List every environment impact due to construction activities of the project;
- List every environment impact due to internal processes in the project, including environment pollutants: wastewater, emission, solid wastes, labour safety, fire and explosion, environment sanitation;
- Forecast on natural, socio-economic environment impact within the area affected by the project activities.

❖ **Comparison method**

Comparison between ecomomic and technical interests is an input to select and propose solutions to reduce the impact of the project activities on environmental, socio-econimic factors.

❖ **Rapid assessment method**

Pollution load calculation and assessment of impact of polluted sources are based on emission ratios of the World Health Organization (WHO). This method is really useful for environmental impact assessment, especially in case that specific variables are failed to calculate.

❖ **Expert method**

Knowledge and experience on environmental science of permanent experts and collaborators at Environmental Research Centre, Analytic Centre and Biology Technology Department - Nuclear Research Institute are utilized.

4. ORGANIZATION FOR IMPLEMENTATION OF EIA

The report on environmental impact assessment of the project "Rehabilitation and Reformation of National highway No. 20 - section from Dong Nai to Lam Dong province" is led by the Project Management Unit No. 7 under the consultancy of Environmental Research Centre – Nuclear Research Institute.

❖ **Project owner:**

- Investor : Directorate for Roads of Vietnam
  Headed by : Mr. Nguyen Ngoc Dong – Vice Minister cum General Director
  Address : 106, Thai Thinh - Dong Da Dist. - Hanoi.
  Tel : 04-38571444
  Fax : 04-38571440
- Investor representative: Project Management Unit No. 7
  Headed by : Mr. Nguyen Thanh Nam – General Director
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❖ **Consultancy unit**:

- Consultancy Unit: Nuclear Research Institute
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  Represented by : Nguyen Nhi Dien
  Position : General Director

❖ **Key members:**

Full name		**Organization**	**Position**
Engineer	Nguyen Khac Quan	PMU No. 7	Deputy General Director
Engineer	Đang Viet Hung	PMU No. 7	Deputy General Director
Engineer	Phan Cong Khanh	PMU No. 7	Deputy Head ĐHDA3
Engineer	Bui Quoc An	PMU No. 7	Specialist of KTKH department
Master	Phan Son Hai	Nuclear Research Institute	Director of Environment Centre (TTMT)

Full name		Organization	Position
Master	Nguyen Trong Ngo	-ditto-	Deputy Director of TTMT
Master	Truong Y	-ditto-	Deputy Director of TTMT
Master	Tran Que	-ditto-	Head of Biology Technology
Bachelor	Mai Van Ai	-ditto-	Environmental Impact Assessment
Bachelor	Nguyen Dao	-ditto-	Environmental Impact Assessment
Master	Nguyen Giang	-ditto-	Director of Analytic Centre
Bachelor	Tran Van Hoa	-ditto-	Environmental Impact Assessment
Bachelor	Tran Dinh Khoa	-ditto-	Environmental Impact Assessment
Master	Nguyen Thi Linh	-ditto-	Environmental Impact Assessment
Bachelor	Nguyen Thi Mùi	-ditto-	Environmental Impact Assessment
Master	Nguyen Van Phuc	-ditto-	Environmental Impact Assessment
Bachelor	Nguyen Dinh Tung	-ditto-	Environmental Impact Assessment
Master	Le Nhu Sieu	-ditto-	Environmental Impact Assessment
Bachelor	Nguyen Van Thang	-ditto-	Environmental Impact Assessment
Master	Tran Thi Thuy	-ditto-	Environmental Impact Assessment

CHAPTER 1
BRIEF DESCRIPTION OF PROJECT

1.1 NAME OF PROJECT

Project for Rehabilitation and Improvement of national highway no. 20 - Section from Dong Nai to Lam Dong province.

1.2 PROJECT OWNER

- Investor : Directorate for Roads of Vietnam
  Headed by : Mr. Nguyen Ngoc Dong – Vice Minister cum General Director
  Address : 106, Thai Thinh - Dong Da Dist. - Hanoi.
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- Investor representative: Project Management Unit No. 7
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1.3 GEOGRAPHICAL POSITION OF PROJECT

1.3.1 Location overview

The location overview of the Project conducted at Dong Nai and Lam Dong province is as following:

- Dong Nai province:
  - Geographical coordinate: $10^0$10’ - $11^0$40’ N; $107^0$10’ - $107^0$40’ E;
  - East to Binh Thuan, North East to Lam Dong;
  - North West to Binh Phuoc;
  - West to Binh Duong province;
  - South to Ho Chi Minh City and Ba Ria - Vung Tau province.
- Lam Dong province:
  - Geographical coordinate: $11^0$12’30” - $12^0$26’00” N; $107^0$15’00” - $108^0$45’00” E;
  - East to Ninh Thuan, North East to Khanh Hoa;
  - North to Dak Lak, North West to Dak Nong;
  - West to Binh Phuoc province;
  - South to Dong Nai and Binh Thuan province.

1.3.2 Specific location

a. In the area of Dong Nai province:

The length of the road section which is located within the area of Thong Nhat dist., Dong Nai province is 76,7 km, starting from Km0 at Dau Giay cross-road (cutting NR1 at Km1832+400), Dong Nai province.

The project road is planned to mainly run along the current NR20, passing through 21 communes and towns: Bau Ham 2, Quang Trung, Gia Kiem, Gia Tan 1, Gia Tan 2, Gia Tan 3 (within Thong Nhat dist.); Phu Tuc, Phu Cuong, Tuc Trung, La Nga, Phu Ngoc, Ngoc Dinh, Dinh Quan, Phu Vinh, Phu Loi, Phu Tan (within Dinh Quan dist.); Tan Phu, Phu Thanh, Phu Lam, Phu Trung, Phu Sơn (within Tan Phu Dist.).

b. In the area of Lam Dong province:

The road section running through Lam Dong province is 151,2 km in length, starting from the joint point with Dong Nai province on NR20 (Km76+700), along the NR20 and ending at Km268 within Dran town (intersection QL27 at Km200, within Don Duong dist., Lam Dong province).

The project road section passes through 27 following communes, wards, towns: Mađaguoi, Ha Lam, Da M'ri (in Da Hoai dist.); Loc An (in Bao Lam dist.); Dam Bri, Dai Lao, Loc Chau, B'Lao, Loc Tien, Loc Son, Loc Nga (in Bao Loc city); Dinh Trang Hoa, Lien Dam, Di Linh town, Tan Nghia, Dinh Lac, Gia Hiep, Tam Bo (in Di Linh dist.); Ninh Gia, Phu Hoi, Lien Nghia, Hiep An (in Duc Trong dist.); Ward 10, ward 11, Xuan Tho, Xuan Truong (in Da Lat City); D'Rane (Don Duong dist.).

1.4 REAL STATUS OF NATIONAL HIGHWAY NO. 20

1.4.1. Real status of the old road

A majority out of 268 km of NR 20 has obtained IV- or III-type standard; the last Section (Km240 - Km268) was scored at V-type road standard; some sections located in towns were upgraded to regional road type, described as following:

Table 1.1. Real status of National highway no. 20

No	Chainage	Length (km)	Real status			
			Pavement width (m)	Traveled way width (m)	Sideway width, sidewalk (m)	Old pavement
1	Km0 - Km20	20	9 – 12	7 - 8	2 – 5	BTN
2	Km20 - Km62	42	9 – 11	9 - 10	0.5 – 1	BTN
3	Km62 - Km76+700	14.7	10	7 - 8	2 – 3	BTN
4	Km76+700 - Km79+800	3.1	25	15	5 x 2 = 10	BTN
5	Km79+800 - Km98+00	18.2	9	7	1 x 2 = 2	BTN
6	Km98+00 - Km108+458	10.45	9	8	0.5 x 2	BTN
7	Km108+458 - Km118+900	10.44	9 – 12	7 - 8	2 – 5	BTN
8	Km118+900 - Km123+100	4.2	27.0	15	6 x 2	BTN
9	Km123+100 - Km154+400	31.3	10 - 13	7 - 8	2 – 5	BTN
10	Km159+500 - Km172	12.5	11.5 - 13.5	7 - 8	2.5 - 5.5	BTN
11	Km172 - Km176+500	4.5	12	11	0.5 x 2	BTN
12	Km176+500 - Km199	22.5	10.5 - 11.5	7 - 8	2.5 - 4.5	BTN
13	Km199 - Km205+317	6.32	25	17	4 x 2	BTN
14	Km205+317 - Km210	4.68	17	16	0.5 x 2	BTN
15	Km210 - Km219+100	9.1	9.0 - 10.0	7 - 8	1.0 - 3.0	BTN
16	Km219+100 - Km222+800	3.7	45.00	15	15 x 2	BTN
17	Km222+800 - Km230+300	7.5	9.0	6.0 - 7.0	2.0 - 3.0	BTN
18	Km230+300 - Km232	1.7	23.0	15	4 x 2	BTN

19	Km232 - Km234	2	17.0	12	2.5 x 2	BTN
20	Km240 - Km268	28	6.0 - 7.0	3.5 - 4	2.5 x 2	Asphalt cover
	Total	***268***				

(Figure 1.1. Diagram of project position)

1.4.2. Real status of the old bridge

The entire NR20 has 26 bridges whose actual status is drawn in the following table:

Table 1.2. Real status of bridge in the existing route

No	Bridge name	Chainage	Length (m)	Width (m)	Carriage width (m)	Load (tone)		Status	Note
						Plan	Actual		
1	Gia Duc	Km1 + 540	19.3	9.95	7.71	H30	25T	Fair	
2	La Nga	Km35+707	283.10	10	7.50	H30	25T	Fair	
3	Phuong Lam	Km64 + 850	17.85	12.8	12	H30	30 T	Fair	
4	Mada Goui	Km77+200	33.80	21.6	14.5	HL93			BOT project
5	Darieu	Km86 + 700	37.4	13.5	12.5		30 T	Good	
6	Dai Quay	Km88 + 550	70	9.5	7.4		30 T	Good	
7	Dam rhé	Km97 + 900	31.5	10.4	7.5		30 T	Good	
8	Bao Loc 1	Km104 + 300	26.46	12.5	11.5	HL93			BOT project
9	Bao Loc 2	Km105 + 530	9.6	7.85	7.25		25 T	Fair	BOT project
10	Dai Lao	Km112 + 950	50.15	12	11.5	H30	30 T	Good	New
11	Minh Rong	Km125 + 120	50.15	12	11.5	H30	30T	Good	New one, propose for continual use
12	Dai Nga	Km129 + 500	76.54	9.5	7.5		30 T	Fair	
13	Dinh Trang Hai	Km139 + 300	16.1	10.6	7.6		30 T	Fair	
14	Lien Dam	Km149 + 303	25.3	8.7	7.2		25 T	Fair	
15	Hiep Thanh	Km174 + 350	25.1	9.6	8.6		30 T	Good	BOT project
16	Dar le	Km177 + 700	25.3	10.2	7.5		30 T	Fair	
17	Hiep Thuan	Km183 + 400	12.6	10.6	8.1		30 T	Fair	
18	Dai Ninh	Km189 + 100	159.9	10.47	7.47		30 T	Fair	
19	Xom Trung	Km194 + 990	8.5	9.5	7.5		20 T	Fair	
20	Dinh An I	Km217+810	9.2	7.7	7.2		25 T	Fair	
21	Dinh An II	Km220+100							Finished, Da Lat - Lien Khuong Highway project
22	Prenn	Km221+980							In process, Da Lat - Lien Khuong Highway project
23	Suoi Duc	Km251+450	33.63	9.1	8.1	H30		Good	New
24	Cau Dat	Km254+430	17.50	7	6		25 T	Fair	
25	Cau Treo	Km262+500	68.79	10.4	7.5		25 T	Fair	
26	Cau Xeo	Km263+100	9.25	6.50	4.5		25 T	TB	

1.5 MAIN CONTENTS OF THE PROJECT

The project purpose is rehabilitation and improvement of 227,9 km which is featured by delta scale III, moutainous area scale III and IV (out of 268-km length of the entire NR20); 16 new bridges which include 2 large ones, 4 medium ones and 10 small ones are planned to construct.

1.5.1 MAIN CONTENTS AND TECHNICAL STANDARDS

1.5.1.1 Section of road

1.5.1.1.1. Type of road:

The entire length of 227,9 km is divided into different scales, including delta scale III, moutainous area scale III and IV, lessening the TCVN4054-2005.

The existing road sections (through Bao Loc and Da Lat city) were constructed following urban scale, therefore rational investment on pavement reinforcement, drainage system maintenance, kerb replacement, sidewalk tiling and traffic safety system are only taken into account. Details of scale could be found in the following table:

Table 1.3. Construction scale for road sections in N.H no. 20

No.	Chainage	Length (km)	Design scale
1	Km0 - Km20	20	Delta scale III
2	Km20 - Km62	42	Mountainous area scale III
3	Km62 - Km76+700	14.7	Mountainous area scale III
4	Km79+800 - Km98	18.2	Mountainous area scale III
5	Km108+458 - Km118+900	10.442	Mountainous area scale III
6	Km118+900 - Km123+100 (section through Bao Loc City)	4.2	Retain the existing urban roads (B_n = 27m, B_m = 2 x 7,5 = 15m, B_{vh} = 6 x 2 = 12m), only pavement improvement
7	Km123+100 - Km154+400	31.3	Mountainous area scale III
8	Km159+500 - Km172	12.5	Mountainous area scale III
9	Km176+500 - Km199	22.5	Mountainous area scale III
10	Km210 - Km222+800	12.8	Mountainous area scale III
11	Km222+800 - Km230+300	7.5	Mountainous area scale IV
12	Km230+300 - Km232 (section through Bao Loc City)	1.7	Retain the existing urban roads (B_n = 23m, B_m = 2 x 7,5 = 15m, B_{vh} = 4 x 2 = 8m), only pavement improvement
13	Km232 - Km234 (section through Bao Loc City)	2	Retain the existing urban roads (B_n = 17m, B_m = 2 x 6 = 12m, B_{vh} = 2 x 2,5 = 5m), only pavement improvement
14	Km240 - Km268	28	Mountainous area scale IV

1.5.1.1.2. Cross-section scale and technical standard:

(a) Standard for road at delta scale III:

- Design speed: V_{tk} = 80 km/h
- Pavement width: B_n = 12 m

- Traveled way width: B_m = 2 x 3.5 = 7 m
- Sideway: $B_{lề}$ = 2 x 2.5 = 5 m
  + Reinforced sideway B_{gcl} = 2 x 2.0 = 4 m
  + Soil sideway $B_{lề\ đất}$ = 2 x 0.5 = 1 m.
- Main technical standard:
  + Maximum super-high slope: $I_{sc} \leq 8\%$.
  + Minimum semi-diameter of horizontal curve: R_{min} = 250 m
  + Minimum semi-diameter of vertical curve: $R_{lồi}$ = 4.000 m; $R_{lõm}$ = 2.000 m
  + Maximum gradient: i_{max} = 5%.
  + Braking visibility: 100 m.
  + Visibility toward opposite direction: 200 m
  + Overtaking sight distance: 550 m
  + Complete design of traffic safety system.

(b) Standard for road at mountainous area scale III:

- Design speed: V_{tk} = 60 km/h
- Pavement width: B_n = 9 m
- Traveled way width: B_m = 2 x 3 = 6 m
- Sideway: $B_{lề}$ = 2 x 1.5 = 3 m
  + Reinforced sideway B_{gcl} = 2 x 1.0 = 2 m
  + Soil sideway: $B_{lề\ đất}$ = 2 x 0.5 = 1 m.
- Main technical standard:
  + Maximum super-high slope: $I_{sc} \leq 7\%$.
  + Minimum semi-diameter of horizontal curve: R_{min} = 125 m
  + Minimum semi-diameter of vertical curve: $R_{lồi}$ = 2.500 m; $R_{lõm}$ = 1.000 m
  + Maximum gradient: i_{max} = 7%.
  + Braking visibility: 75 m.
  + Visibility toward opposite direction: 150 m
  + Overtaking sight distance: 350 m
  + Complete design of traffic safety system.

(c) Standard for road at mountainous area scale IV:

- Design speed: V_{tk} = 40 km/h
- Pavement width: B_n = 7.5 m
- Traveled way width: B_m = 2 x 2.75 = 5.5 m
- Sideway: $B_{lề}$ = 2 x 1 = 2 m
  + Reinforced sideway B_{gcl} = 2 x 0.5 = 1 m
  + Soil sideway: $B_{lề\ đất}$ = 2 x 0.5 = 1 m.
- Main technical standard:

+ Maximum super-high slope $I_{sc} \leq 6\%$.
+ Minimum semi-diameter of horizontal curve: R_{min} = 60 m, lessening R_{cc} = 30m
+ Minimum semi-diameter of vertical curve: $R_{lồi}$ = 2.500m; $R_{lõm}$ = 1.000m
+ Maximum gradient: i_{max} = 8%, lessening i_{cc} = 10%
+ Braking visibility: 40 m.
+ Visibility toward opposite direction: 80 m
+ Overtaking sight distance: 200 m
+ Complete design of traffic safety system.

Diagrams of typical cross section of different scale of road sections are shown from Figure 1.2a to 1.2g.

1.5.1.1.3. Pavement:

The whole-mess stability, sufficient strength, strength stability (resistance to destructive factors toward the life of pavement and its strength reduction) are mainly considered factors for pavement design. Shoulder level following the calculation frequency of bridge, culvert:

+ $H_{vđ} \geq$ P4% + 0.5m (for culvert, small bridge)
+ $H_{vđ} \geq$ P1% + 0.5m (for large bridge)

(a) Embankment:

- The geology investigation shows no weak embankment in the entire road section.

- Embankment is normally linked to slope 1/1,5.

- The compaction (K) of the 50cm-thickness aggregate soil used for the embankment and that under the pavement base (expansion section and reinforced sideway) shall be equal to or more than 0,98. The compaction to density (K) of the remaining layers of the embankment, natural foundation shall be equal to or more than 0,95.

- Backfilling on the old pavement slope of 20% requires handwork; the minimum width is 1,0 m. It is necessary to remove the soil layer that is not appropriate for embankment (organic soil). According to instructions of consulting engineer, the inappropriate soil shall be replaced by a type of proper physics- criteria soil before compacting upon embankment compaction requirements. Embankment is mainly done by mechanical machines. However, upon the engineer's instructions, bishop shall be used instead where compactor could not be applied.

- High embankment or embankment that goes along the river, big lake shall be reinforced by rubble stone, mortar 10 MPa, 25cm in thickness, that is above the ballast layer, 10cm in thickness for anti-erosion purpose.

(b) Cutting:

- The cutting is excavated toward inner direction of 10% slope, to create gutter for water reduction spreading over the cutting slope.

- Slope of cutting is stipulated in Table 1.4.

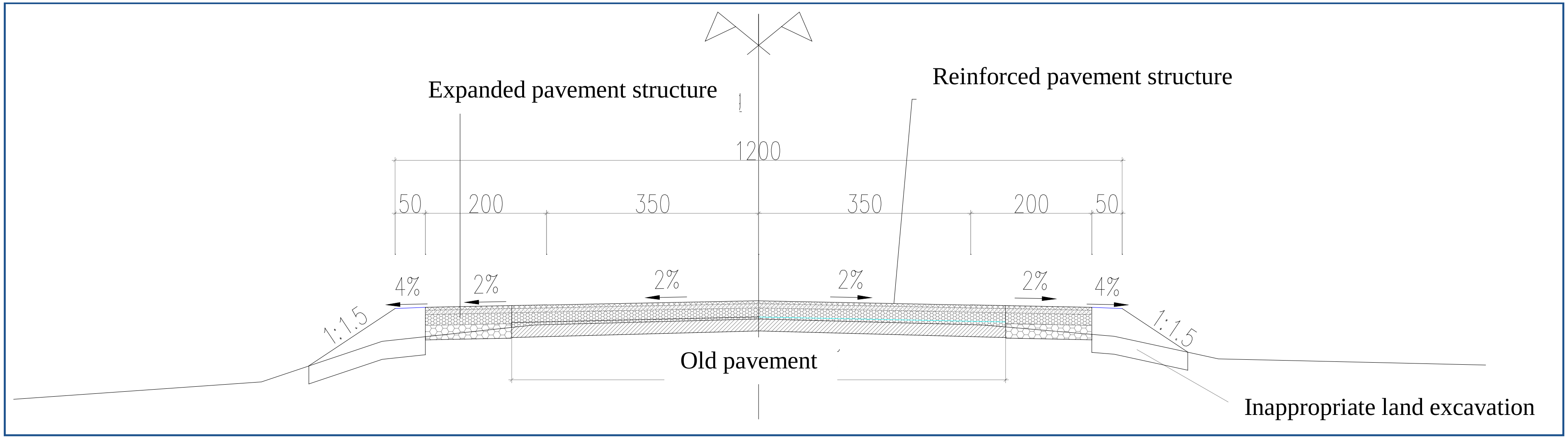


Figure 1.2a. Typical cross section of road section with delta scale III (B_n = 12 m, B_m = 7 m)

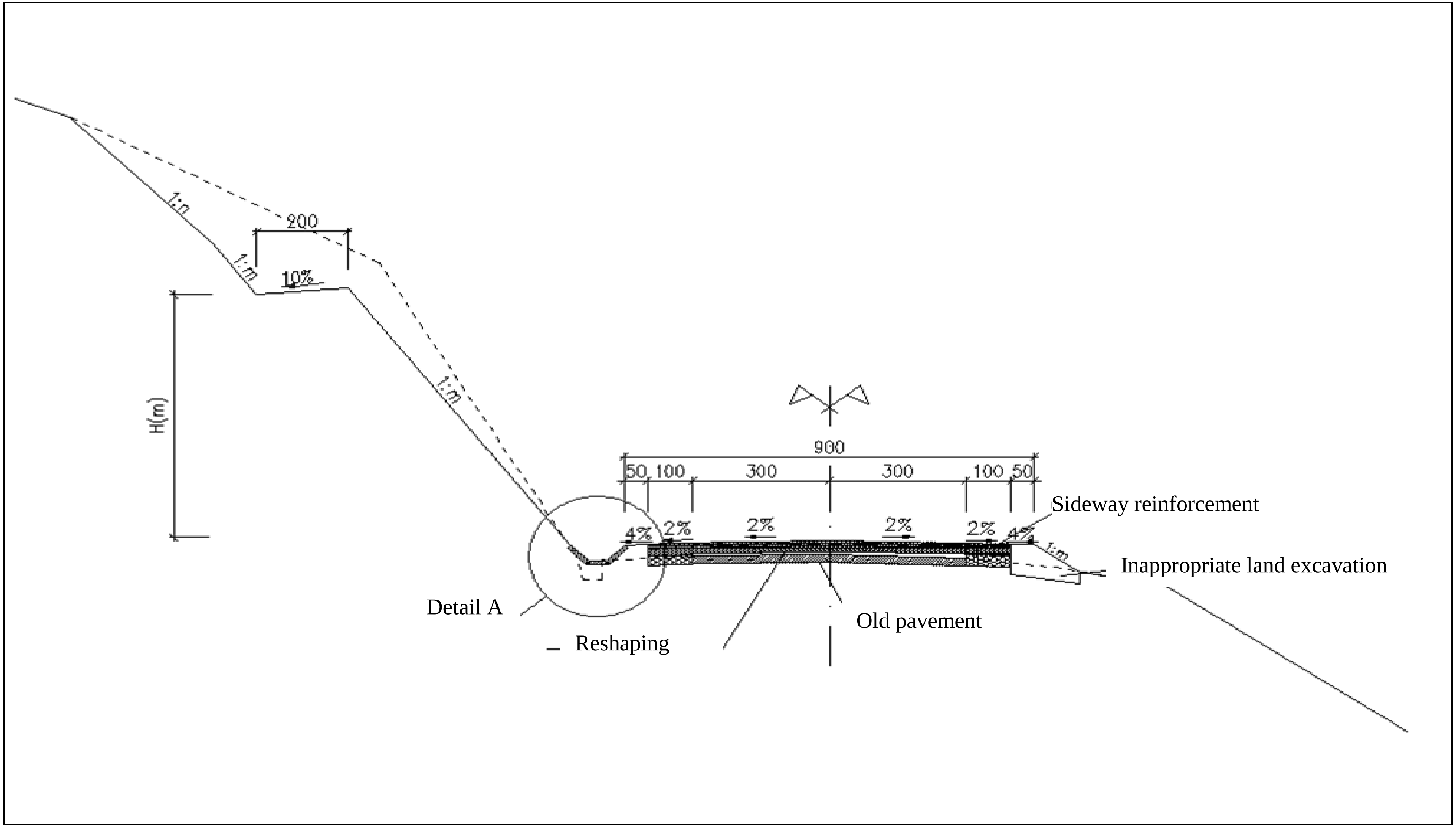


Figure 1.2b. Typical cross section of road section with mountainous area scale III (B_n = 9 m, B_m = 6 m)

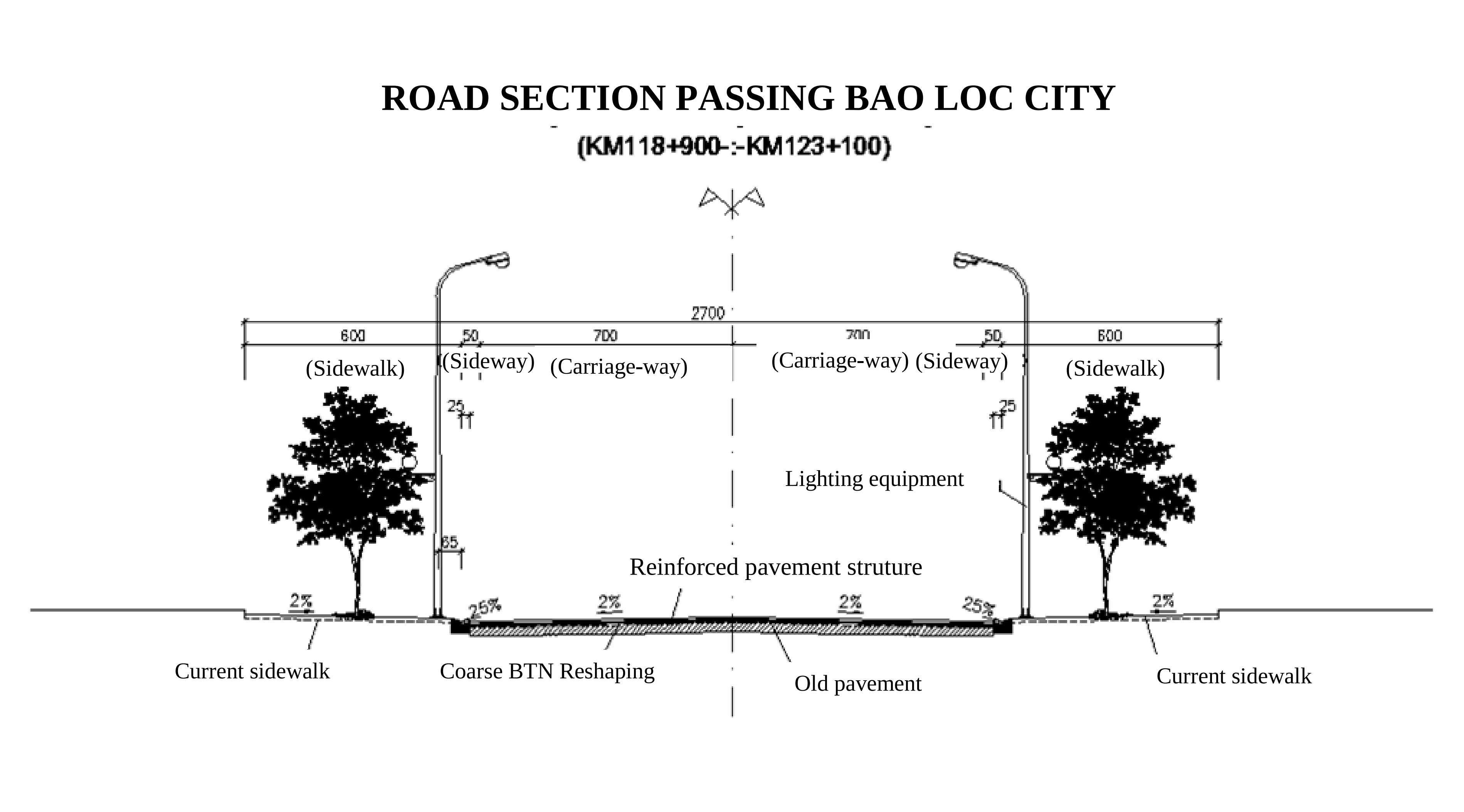


Figure 1.2c. Typical cross section of road section passing Bao Loc City

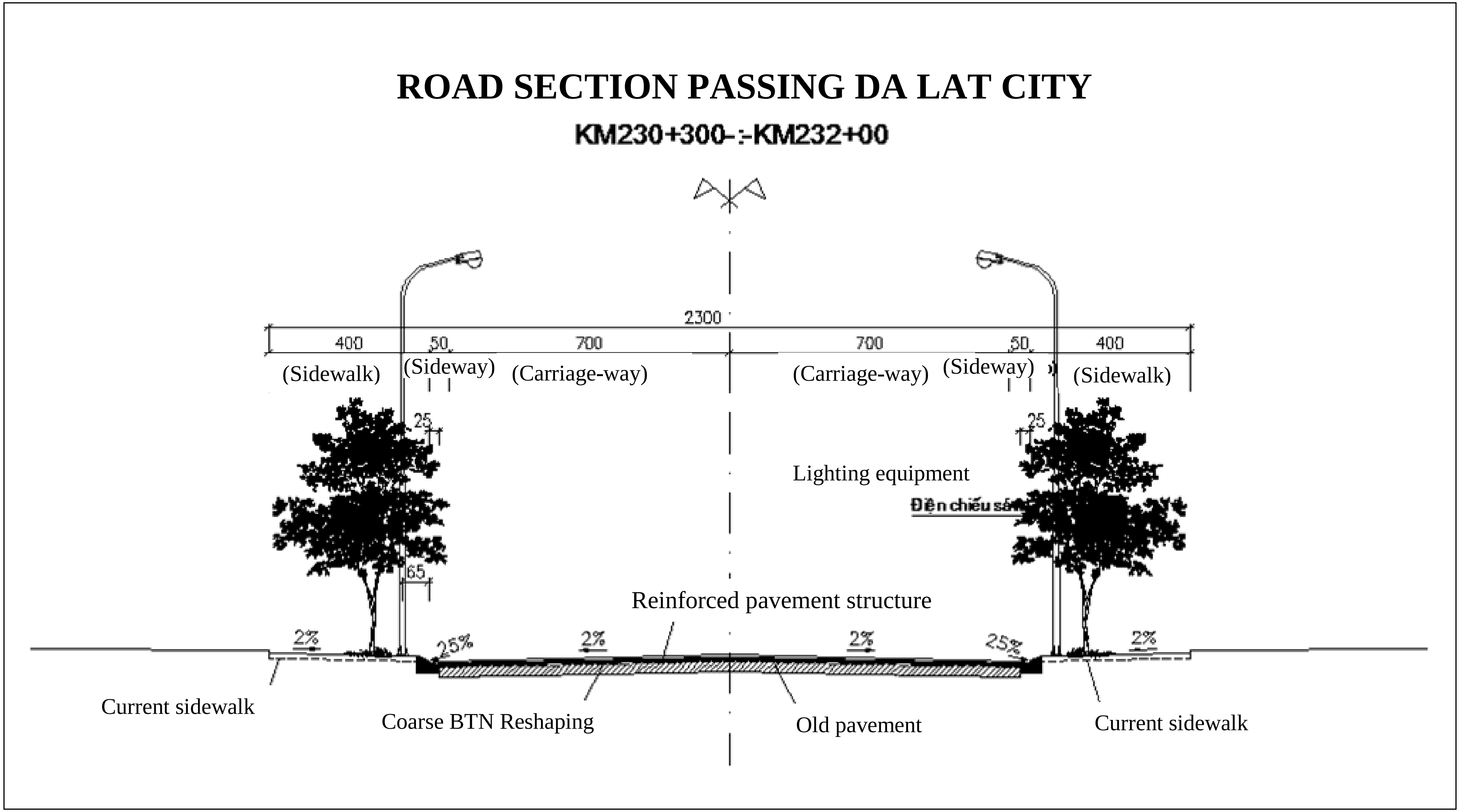


Figure 1.2d. Typical cross section of road section passing Da Lat City

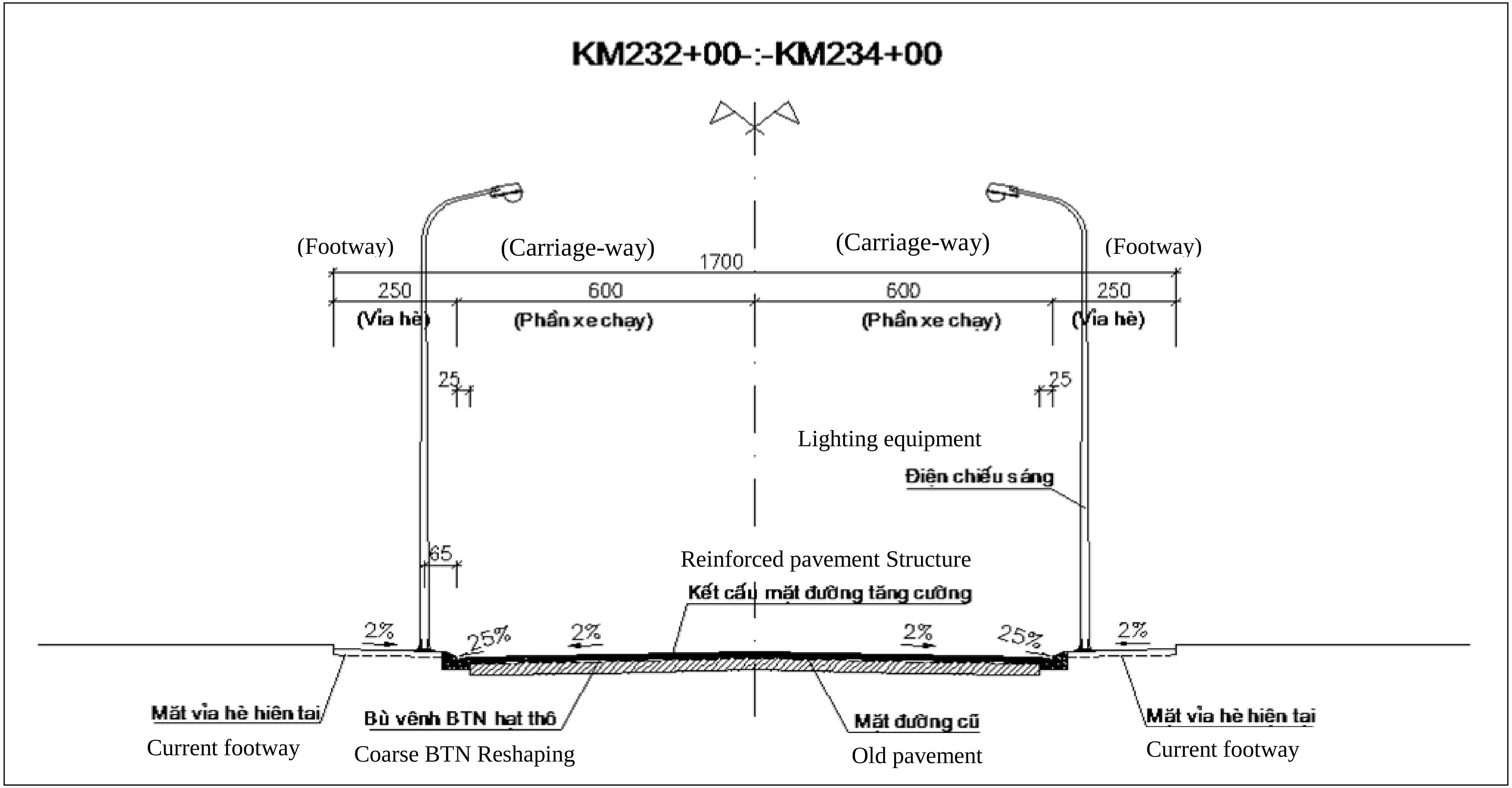


Figure 1.2e. Typical cross section of road section passing Da Lat City

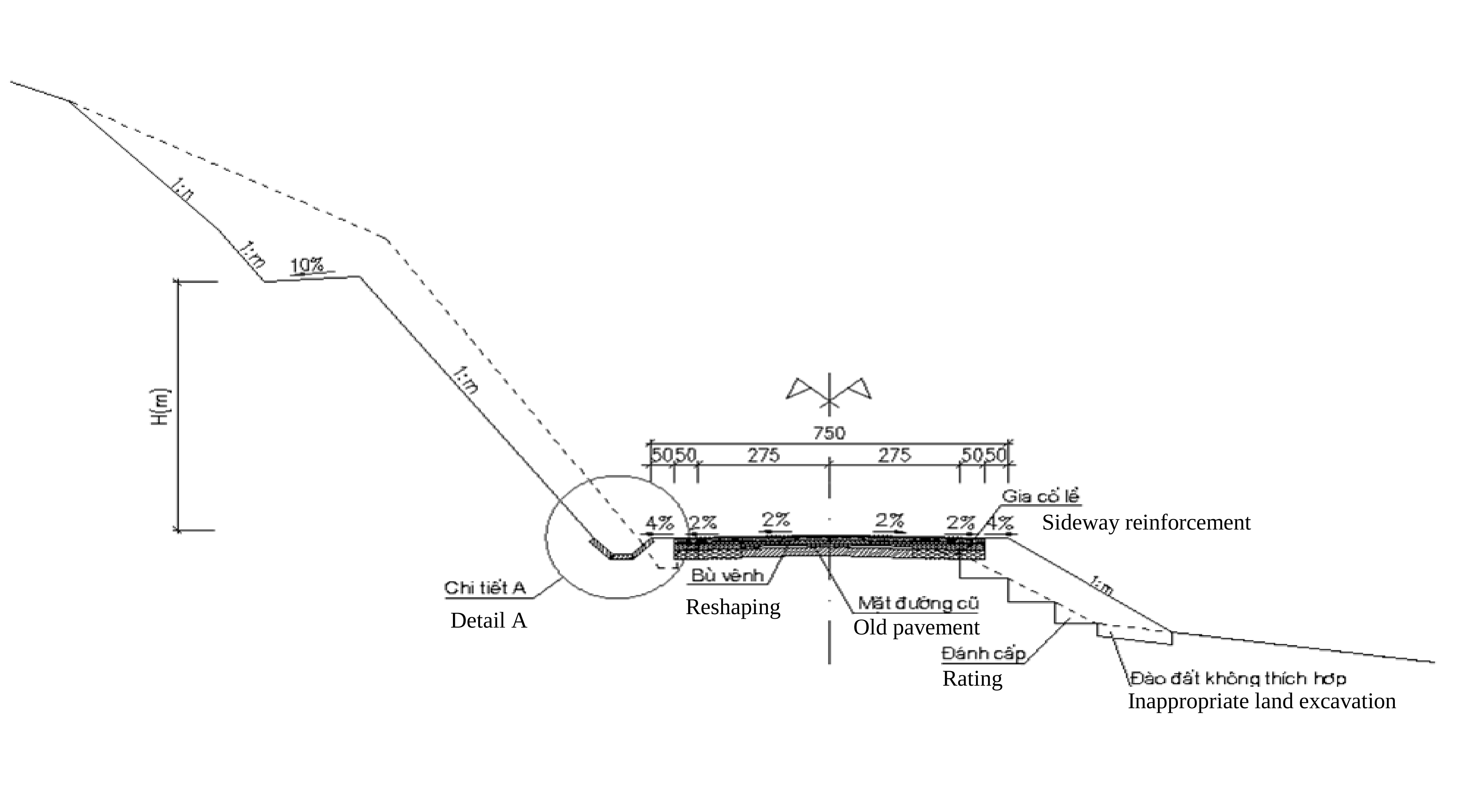


Figure 1.2g. Typical cross section of road section with mountainous area scale IV (B_n = 7.5 m, B_m = 5.5 m)

Table 1.4. Slope of embankment, relative to type of soil and height of slope

Type and status of soil	Slope of embankment, relative to different height of slope	
	≤ 12 m	> 12 m
- Cohesive or less-cohesive soil in a status from moderate to strong compaction	1 : 1,0	1 : 1,25
- Cohesionless soil	1 : 1,50	1 : 1,75
- Low decomposed hard stone	1 : 0,3	1 : 0,5
- Strongly decomposed hard stone	1 : 1,0	1 : 1,25
- Low decomposed soft stone	1 : 0,75	1 : 1,0
- Strongly decomposed soft stone	1 : 1,00	1 : 1,25

1.5.1.1.4. Pavement structure:

Pavement foundation has a common modulus of elasticity $E_{yc} \geq 140$ MPa, except the section Km240 - Km268 with $E_{yc} \geq 130$ MPa.

- **Structure I: Embankment and renewal**
  + 5 cm asphalt concrete, strong compaction, fine-grained, hot laid.
  + Tak coat asphalt 0.5 kg/m^2
  + 7 cm asphalt concrete, strong compaction, medium-grained, hot laid.
  + Prime coat asphalt 1.0 kg/m^2
  + 18 cm ballast aggregate type I.
  + 25 cm ballast aggregate type II.
- **Structure II: Old road reinforcement**
  + 5 cm asphalt concrete, strong compaction, fine-grained, hot laid.
  + Tak coat asphalt 0.5 kg/m^2
  + 7 cm asphalt concrete, strong compaction, medium-grained, hot laid.
  + Prime coat asphalt 1.0 kg/m^2
  + Ballast aggregate type I, thickness depending on the E_{chm} of the old road.

According to the investigated data on the modulus of elasticity of the old road, here is selected list of pavement structure, relative to E_{chm}:

Table 1.5. Thickness of ballast aggregate, type I according to E_{chm} of the old road

No.	E_{chm} of the old road	Thickness CPĐD type I (cm)	Note
1	60 MPa < E_{chm} ≤ 75 Mpa	25	
2	75 MPa < E_{chm} ≤ 90 Mpa	20	
3	90 MPa < E_{chm} ≤ 105 Mpa	15	
4	105 MPa < E_{chm} ≤ 130 Mpa	12	
5	Echm ≥ 130 MPa		Reshaping coarse-grained BTN

- Structure III: Section Km240 - Km268 with Eyc ≥ 130 MPa

The old pavement of that section has gained a modulus of elasticity of around 40 - 43 MPa, therefore the old pavement reinforcement structrure and the new pavement structure produce a same result, in detailed:

+ Medium-grained asphalt concrete, 7cm in thickness.
+ Prime coat asphalt 1.0 kg/m^2
+ Ballast aggregate type I, 18 cm in thickness.
+ Ballast aggregate type II, 25 cm in thickness.

- **Sideway reinforcement structure:** for the purpose of traffic performance, the sideway reinforcement structure is the same as that of the newly created pavement.

1.5.1.2 Drainage works

1.5.1.3.1. Cross drainage:

The cross drainage system is built based on following rules:

- On-road culvert is planned to be permanent, load H30-XB80, having the same width as that of pavement;
- Design frequency P = 4%;
- An old culvert could be continually used, provided that it is considered as under good condition or joint;
- A broken culvert or an iron-pipe culvert shall be replaced by new ones;
- Culvert could be added for drainage performance, if necessary;
- Pipe culvert: typical design 533-01-01; 533-01-02, pre-casted culvert pipe, built in rubble stone, mortar XM 10 MPa.
- Boxing culvert:
  + Span ≤ 2 m: By sectional BTCT, 16 MPa, built in rubble stone, mortar XM M100.
  + Span > 2 m: By BTCT, on-site casting, 25 MPa, built in rubble stone, mortar XM 10 MPa.

Design output:

- Total culvert: 298 pieces/3923,1 m
  + Continual used : 35 pieces
  + Joint: 56 pieces /393,2m
  + Repaired: 6 pieces
  + Replaced, added: 201 pieces /3038,1m

1.5.1.3.2. Vertical drainage:

(a). Top gutter: At any section which is featured by thick mantle and slip, gutter is arranged on the top of the pavement where rock or soil excavation happens to reduce the water volume from the slope in order to prevent water from spreading over the slope. Steps located at the end of the top gutter are created for energy removal.

(b). Vertical gutter (toe-gutter): is arranged above the excavated or low-embankment. Drainage happens within the pavement scale. Gutter is reinforced by sectional concrete to apply at sections whose slope is more than 3%. Concrete 10 MPa is used to reshape the asperity area at the gutter excavated by explosion.

Vertical gutter consists of:

- Trapezium gutter: Width of the bottom b = 0.4m, depth h = 0.4m, gutter slope 1:1; applied for embankment, longitudinal slope i ≤ 3%.
- Trapezium reinforcement gutter: Width of bottom b = 0.4m, depth h = 0.4m, gutter slope 1:1, built by rubble stone, mortar XM M100, 25cm in thickness; Applied for embankment, longitudinal slope i > 3%.
- Triangular gutter (0.4+0.8) x 0.4 m: applied for firm stone embankment C3, C2.

(c). Vertical culvert:

The drainage vertical culvert system located at resident-intensive areas is featured by pipe culvert system Φ1.0m below the sidewalk; drainage is limited to water on pavement; BTCT boot system along the sidewalk is put in an average distance of 28 m from one to another.

- Culverts under sidewalk is installed by allowed load H10 pipe
- Culverts under road is installed by allowed load H30 - XB80 pipe
- Vaulted boot, by BTCT 16 MPa, on the sidewalk, covered by a plane BTCT 20 MPa.
- Bearing shoe by BT 20MPa, installed above the culvert foundation by stone 4x6

1.5.1.3 Other auxiliary works

1.5.1.3.1. Slope revetment:

At a small fill slope section with high cross slope, the section expansion is just land strip or hard strip, the old pavement has been stabilized through durable operation and was designed as 1:1 or 1:0.75 fill slope method. Rubble stone is tightly arranged inside while the cut-off dike is built by rubble stone outside, mortar XM 10 MPa. Sections with slope reinforcement are summarized in Table 1.6.

Table 1.6. Summary of volume for slope reinforcement

No	Chainage	Distance (m)	No	Chainage	Distance (m)
	Section: Km210+00 - Km234+00			**Section: Km240+00 - Km268+00**	
1	Km219+491,51 - Km219+500	8,49	6	Km248+0 - Km248+52,68	52,68
2	Km222+955,39 - Km222+964,39	9	7	Km248+255 - Km248+268,88	13,88
3	Km223+105,1 - Km223+115	9,9	8	Km248+347,26 - Km248+362,32	15,06
4	Km223+226,74 - Km223+240	13,26	9	Km249+941,48 - Km249+950,53	9,05
5	Km223+430 - Km223+436,97	6,97	10	Km250+587,96 - Km250+615,56	27,6
6	Km223+592,77 - Km223+598	5,23	11	Km251+535,48 - Km251+551,48	16
7	Km223+704,92 - Km223+766,86	61,94	12	Km252+0 - Km252+27,89	27,89
8	Km223+900,02 - Km223+904,35	4,33	13	Km252+773,95 - Km252+800	26,05
9	Km224+600 - Km224+620	20	14	Km252+891,9 - Km252+918,18	26,28

No	Chainage	Distance (m)	No	Chainage	Distance (m)
10	Km224+655 - Km224+669,5	14,5	15	Km253+85 - Km253+100	15
11	Km225+298,19 - Km225+300	1,81	16	Km253+485 - Km253+500	15
12	Km226+332,72 - Km226+340,72	8	17	Km255+151,38 - Km255+160,38	9
13	Km226+453,69 - Km226+493,67	39,98	18	Km255+254,75 - Km255+300	45,25
14	Km226+588,46 - Km226+595	6,54	19	Km255+600 - Km255+615	15
15	Km226+800,01 - Km226+816,25	16,24	20	Km255+700 - Km255+713,55	13,55
16	Km226+704,23 - Km226+706,23	2	21	Km255+748,39 - Km255+818,45	70,06
17	Km226+789,27 - Km226+800	10,73	22	Km259+788,47 - Km259+812	23,53
18	Km227+11,38 - Km227+50	38,62	23	Km260+472,42 - Km260+482,42	10
19	Km227+107,28 - Km227+112,28	5	24	Km260+533,91 - Km260+553,91	20
20	Km227+250,73 - Km227+259,32	8,59	25	Km261+148,69 - Km261+179,04	30,35
21	Km228+11,38 - Km228+50	38,62	26	Km261+465,15 - Km261+480,15	15
22	Km228+105 - Km228+112,28	7,28	27	Km261+590,82 - Km261+595,82	5
23	Km228+250,73 - Km228+259,32	8,59	28	Km261+703,26 - Km261+706,26	3
24	Km228+467,84 - Km228+504,68	36,84	29	Km262+622,15 - Km262+632,15	10
25	Km229+600 - Km229+606,41	6,41	30	Km263+394,45 - Km263+396,45	2
26	Km229+690 - Km229+694,84	4,84	31	Km263+479,74 - Km263+502,82	23,08
27	Km229+855,16 - Km229+860,16	5	32	Km263+723,14 - Km263+765,5	42,36
28	Km229+900 - Km229+943,21	43,21	33	Km263+800 - Km263+818,88	18,88
29	Km230+57,4 - Km230+72,55	15,15	34	Km264+91,56 - Km264+100	8,44
Total		**457,07**	35	Km264+213,69 - Km264+216,19	2,5
	Section: Km240+00 - Km268+00		36	Km264+320,47 - Km264+335,47	15
1	Km244+672,04 - Km244+700	27,96	37	Km264+410,67 - Km264+433,67	23
2	Km246+286,3 - Km246+292	5,7	38	Km265+25,46 - Km265+37,16	11,7
3	Km246+660 - Km246+672,54	12,54	39	Km266+849,92 - Km266+908,03	58,11
4	Km247+138,76 - Km247+148,76	10	40	Km267+445,68 - Km267+448,68	3
5	Km247+794,78 - Km247+862,92	68,14		**Total**	**914,14**

1.5.1.3.2. Retaining wall:

The expansion of road width by altering the old road at highly sloping areas may lead to pavement instability or depression. The retaining wall is planned to render pavement stability. The design of 86-06X shaped method is applied to the retaining wall. It is built by concrete 16 MPa, on-site casting. The information of the retaining wall is described as following:

Table 1.7. Summary of volume for retaining wall

No	Chainage	Distance (m)	No	Chainage	Distance (m)
1	Km35+857 - Km36+240	332,3	1	Km123+880 - Km123+990	110
2	Km44+320 - Km44+736	416	2	Km142+850 - Km142+950	100
3	Km80+557 - Km80+577	20	3	Km143+650 - Km143+700	50
4	Km80+854 - Km80+874	20	4	Km144+250 - Km144+400	150
5	Km82+438 - Km82+468	30	5	Km145+000 - Km145+200	200
6	Km82+468 - Km82+640	172	6	Km147+700 - Km147+820	120
7	Km83+305 - Km83+339	34	7	Km246+266.25 - Km246+300.00	33,75
8	Km83+375 - Km83+400	25	8	Km248+349.32 - Km248+375.32	24,89

No	Chainage	Distance (m)	No	Chainage	Distance (m)
9	Km83+462 - Km83+482	20	9	Km252+403.9 - Km252+422.9	19
10	Km83+491 - Km83+511	20	10	Km263+138.7 - Km263+192.34	53,64
11	Km84+262 - Km84+589	327	11	Km263+384.52 - Km263+413.38	28,86
12	Km109+950 - Km109+990	40	12	Km263+713.14 - Km263+728.14	15
13	Km123+780 - Km123+840	60	13	Km264+834.17 - Km265+24.16	64,93

1.5.1.4 Safe traffic works

1.5.1.4.1. Safe traffic works along the road:

Peg, safety fence, corrugated iron, sign board shall be in compliance with the Land Road Signals Regulation No. 22TCN-237-01. The workload of safe traffic works is as following:

- Sign board: 2.153 pieces
- Pillar Km: 220 pillars
- Peg: 9.910 pegs
- Curved safety fence: 5.018 m
- Paint marking: 58.560 m^2
- Convex spherical mirror: 15 pieces

1.5.1.4.2. Escape ramp:

Location of escape ramp:

Escape ramp is built at 2 gap-crossing sections which are featured by unfavorable terrain, curved and sloping sections with small semi-diameter that might cause accidents due to failure in brake, gear-changing v.v… Escape ramps are designed following the document 22TCN 218-94, published in conjunction with the Decision No. 1412/QĐ/KHKT dated 31/8/1994 of the Ministry of Transport. Further information is described as following:

Table 1.8. Position for construction of escape ramp

No	Chainage	Location	No	Chainage	Location
1	Km223+252.09	Left	4	Km260+816.83	Right
2	Km228+102.28	Left	5	Km264+355.29	Left
3	Km255+151.38	Left			

Overview of escape ramp:

- Escape ramp consists of: Main road, a road that gradually separated from the main one, a main energy-consumption road, protective sand dune and the last safety fence.
- Plan and longitudinal design of the escape ramp following the requirements of 22TCN 218-94
- Cross-section of the escape ramp: Escape ramp is reached by turning from the road type III, having pavement width as B_n = 12m, B_m = 7.0m

- Structure of the escape ramp:
  + The first 10m has the same structure as that of the main road.
  + Main structure of the escape ramp: 25cm by bulk material like ballast 4 x 6, without compacting.
  + The 20-m section is done by coarse-grained sand, 40cm in thickness, to slow down any vehicle.
  + The last sand dune is 1.2m in height, foot of slope 1:1, surface is filled by an asphalt layer to prevent sand from eroding, drifting, flying.
  + If the terrain at the end of the escape ramp is not leaned against mountain, for safety purpose, a retaining wall by BTCT 16 Mpa shall be built at the end of the road.

1.5.1.5 Intersection, cross-road

1.5.1.5.1. Intersection point:

There are 5 intersection points in the project:

- Intersection NR1 at Dau Giay T-junction, Km0+000
- Intersection NR55 at Bao Loc town, Km123+900
- Intersection NR20B (Mimôsa road), Km222+350
- Intersection NR20B (Mimôsa road), Km233+950
- Intersection NR27 at Dran T-junction, Km268+000

Any intersection point along the road is contour and channelized by traffic island.

1.5.1.5.2. Intersection road:

- **Intersection at national/provincial road (NR/PR):**
  + Intersection QL1 at: Km00
  + Intersection QL55 at: Km122+310
  + Intersection QL28 at: Km153+650 and Km154+400
  + Intersection QL27 at: Km206+390 and Km268
  + Intersection PR 762: Km6+900
  + Intersection PR 763: Km22+535
  + Intersection PR Thanh Son–Xuan Bac: Km40+663
  + Intersection PR Cao Cang: Km47+520
  + Intersection PR 721: Km77+680
  + Intersection PR 713: Km93+880
- **Intersection at civil road:**
  + There are 665 intersection points between civil roads and the project road.
  + Roads led to residential area, public offices is tapered with turning semi-diameter of 5 - 12m.

1.5.1.6 Flow over bridge

The project is planned by building 16 new bridges which include 2 large bridges, 4 medium bridges and 10 small bridges along the road. Features of those bridges are described in Table 1.9.

1.5.1.6.1. Main specification:

- Permanent bridge built by normal BTCT and BTCT DƯL.
- Planned load: HL-93, walk-on-foot 0,003MPa.
- Bridge width: B_c = 12 m; section Km240 - Km268, B_c = 9 m.
- Mat foundation or cast-in-situ concrete pile, depending on each bridge geology.
- Design frequency for small bridge P = 4%, for medium and large medium P = 1%.

1.5.1.6.2. Work structure:

(a). Superstructure:

- Span L < 18m: Plate beam span structure by BTCT DƯL.

- Span 18 < L < 33m: I-beam span structure I by BTCT DƯL.

- Span 33 < L < 40m: Super T beam span structure by BTCT DƯL.

- Pre-stressed cable, beam by using type Φ12.7mm and Φ15.2mm which has low sag rate, following the standard ASTM A416 Grade 270.

- Cross-beam, bridge deck by BTCT, 30Mpa, on-site casting.

- Galvanized steel handrail.

- Pavement has 3 layers :

+ Asphalt concrete is 7cm in thickness.

+ Spread tak coat asphalt 0.5kg/m^2.

+ Waterproof layer Radcon7.

- Bearing shoe by steel-core elastomeric pad.

- Elastic joint: saw-tooth elastic joint or rubber elastic joint.

(b). Substructure.

- Bridge abutment, pier by BTCT, on-site casting, 30MPa.

- Abutment, pier foundation: Depending on the actual geology condition, a bridge could be handled with mat foundation, BTCT pile or cast-in-situ concrete pile.

(c). Approach embankment:

- Approach embankment is 10m in length from each side and has the same as that of the project road.

Table 1.9. Bridges to be constructed in the project

No	Bridge name	Chain_ age	Width (m)	Length (m)	Map KCN	Naviga _tion	Construction type	Superstructure	Substructure
1	Gia Duc	Km1 + 880	12	24.70	1 x 24	Unnavi_ gable	New construction	- Single-span bridge, simple beam BTCT DƯL; there are 12 hollow plate beams, 1m from one to another, hollow plate beam BTCT DƯL, concrete 40Mpa, beam height: 0,65m. - Beam joint by pre-stressed cable 5-4. - Framed connection layer by BTCT 30Mpa, on-site casting, 10cm in thickness. - Bearing shoe: steel-core elastomeric pad.	- Abutment by BTCT 30MPa, goat leg abutment type. Abutment is perpendicular to the centerline. - Abutment foundation includes 4 cast-in-situ concrete piles BTCT, on-site casting, planned length is 23m/pile, 1m in diameter. - Behind abutment, there is bản quá độ by BTCT 30MPa, 3,0m in length, 10,0m in width across the bridge. - Galvanized steel railing put on the wing wall having similar shape like that of bridge.
2	La Nga	Km35+7 12	12	342.00	10x33	Unnavi_ gable	New construction	- 10-span bridge of 33m, beam BTCT DƯL 40MPa made in factory. There are 5 I-beams, 2.4m from one to another; beam height 1,65m. - Bridge deck by BTCT 30Mpa, on-site casting, 20cm in thickness. - Bearing shoe: steel-core elastomeric pad.	- Abutment by BTCT 30MPa, wall abutment type. Abutment foundation includes 6 cast-in-situ concrete piles BTCT, on-site casting, L = 60m, D = 1.2m. - Pier foundation T1, T2, T3, T7, T8, T9 includes 6 cast-in-situ concrete piles BTCT, on-site casting, L=60m, D=1.2m. - Pier foundation T4, T5, T6, includes 6 cast-in-situ concrete piles BTCT, on-site casting, L = 60m, D = 1.5m

No	Bridge name	Chain_ age	Width (m)	Length (m)	Map KCN	Naviga _tion	Construction type	Superstructure	Substructure
3	Phuong Lam	Km65 + 056	12	15.90	1 x 15	Unnavi_ gable	New construction	- Single-span bridge, simple beam BTCT DƯL; there are 12 hollow plate beams, 1m from one to another, hollow plate beam BTCT DƯL, concrete 40Mpa, beam height: 0,55m. - Beam joint by pre-stressed cable 5-4. - Framed connection layer by BTCT 30Mpa, on-site casting, 10cm in thickness. - Bearing shoe: steel-core elastomeric pad.	- Abutment by BTCT 30MPa, goat leg abutment type. Abutment is perpendicular to the centerline. - Abutment foundation includes 4 cast-in-situ concrete piles BTCT, on-site casting, planned length is 23m/pile, 1m in diameter. - Behind abutment, there is bản quá độ by BTCT 30Mpa, 3,0m in length, 10,0m in width across the bridge. - Galvanized steel railing put on the wing wall having similar shape like that of bridge.
4	Darleu	Km86+700	12	45.00	1x33	Unnavi_ gable	New construction	Single-span bridge of 33m; cross-section includes 5 I-beams by pre-stressed BTCT, Beam L= 33m, Beam H= 1.65m.	Mat by BTCT, on-site casting.
5	Dai Quay	Km88+850	12	111.00	3x33	Unnavi_ gable	New construction	Three-span bridge of 33m; cross-section includes 5 I-beams by pre-stressed BTCT, Beam L= 33m, Beam H= 1.65m..	Mat by BTCT, on-site casting.
6	Damrhe	Km97+900	12	45.00	1x33	Unnavi_ gable	New construction	Single-span bridge of 33m; cross-section includes 5 I-beams by BTCT DƯL, Beam L= 33m, Beam H= 1.65m.	Mat by BTCT, on-site casting.
7	Dai Nga	Km129 + 500	12	82.00	24+33 +24	Unnavi_ gable	New construction	Three-span bridge, I-beam (24 + 33 + 24 m) BTCT DƯL post tensioning; cross-section includes 5 I-beams by BTCT DƯL.	Mat pier; Abutment on cast-in-situ concrete foundation BTCT; cast-in-situ concrete piles D=1200mm, L=12m.
8	Dinh Trang	Km139 + 300	12	24.9	1 x 24	Unnavi_	New	Single-span bridge, I-beam of 24m	Mat by BTCT, on-site casting.

No	Bridge name	Chain_ age	Width (m)	Length (m)	Map KCN	Naviga _tion	Construction type	Superstructure	Substructure
	Hoa					gable	construction	BTCT DƯL post tensioning; cross-section includes 5 I-beams by BTCT DƯL.	
9	Lien Dam	Km149 + 303	12	24.9	1 x 24	Unnavi_ gable	New construction	Single-span bridge, I-beam of 24m BTCT DƯL post tensioning; cross-section includes 5 I-beams by BTCT DƯL.	Mat by BTCT, on-site casting.
10	Darle	Km177 + 800	12	35.115	1 x 24	Unnavi_ gable	New construction	Single-span bridge, I-beam of 24m BTCT DƯL 40Mpa; cross-section includes 5 I-beams H= 1.45m. Span structure has 4 cross beams by BTCT 30Mpa. Rubber expansion joint, bearing shoe by steel-core elastomeric pad.	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation by mat, put into blue grey powdered stone.
11	Hiep Thuan	Km183 + 376	12	20.11	1 x 12	Unnavi_ gable	New construction	Single-span bridge of 12m, beam by BTCT DƯL 40Mpa, L=12m; cross-section includes 12 beams H= 0.52m. Rubber expansion joint, bearing shoe by steel-core elastomeric pad.	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation by cast-in-situ concrete piles D=1m, L = 8 m (5 piles for each abutment).
12	Dai Ninh	Km189 + 200	12	145.30	5 x 33	Unnavi_ gable	New construction	Five-span bridge of 33m; I-beam by BTCT DƯL 40MPa, L=33m. Cross-section includes 5 beams H= h=1.65m, beam centreline of 2.4m. Span structure has 5 cross beams by BTCT 30Mpa. Rubber expansion joint, bearing shoe by steel-core elastomeric pad.	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation by cast-in-situ concrete piles D=1m, L = 36 m. - Solid pier, foundation, shaft by concrete 25MPa, pier cap by concrete 30MPa. Pier on 6 cast-in-situ concrete piles D=1m, L=35m.
13	Xom Trung	Km194 + 771	12	17.05	1 x 9	Unnavi_ gable	New construction	Single-span bridge of 9m, beam by BTCT DƯL 40MPa, L=9m. Cross-section includes 12 beams H= 0.4m. Bitum expansion joint, bearing shoe by steel-core elastomeric pad.	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation by mat, put into laterite layer.

No	Bridge name	Chain_ age	Width (m)	Length (m)	Map KCN	Naviga _tion	Construction type	Superstructure	Substructure
14	Dinh An I	Km217+ 810	12	17.10	1 x 9	Unnavi_ gable	New construction	Single-span bridge of 9m, beam by BTCT DỦL 40Mpa, L=9m. Cross-section includes 12 beams H= 0.4m.Bitum expansion joint, bearing shoe by steel-core elastomeric pad..	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation includes cast-in-situ concrete piles D=1m, L = 29m (5 piles for each abutment).
15	Cau Dat	Km254+ 254	9	28.11	1 x 18	Unnavi_ gable	New construction	Single-span bridge of 18m, beam by BTCT DỦL 40Mpa, L=18m. Cross-section includes 12 beams H= 0.65m. Rubber expansion joint, bearing shoe by steel-core elastomeric pad.	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation includes cast-in-situ concrete piles D=1m, L = 19.5m (5 piles for each abutment).
16	Cau Xeo	Km263+ 100	9	28.15	1 x 18	Unnavi_ gable	New construction	Single-span bridge of 18m, I-beam by BTCT DỦL 40Mpa, L=18m; Cross-section includes 5 beams H=1.2. Rubber expansion joint, bearing shoe by steel-core elastomeric pad.	- 2 U-shaped abutments, wall body by BTCT 25MPa. - Abutment foundation by mat, put into coarse-grained pack sand, in tight form.

1.5.2 MAIN VOLUME OF CONSTRUCTION

1.5.2.1 Total volume of construction – Road part

Table 1.10. Summary of volume for road part

No.	Items	Unit	Volume
1	**Pavement**		
1.1	Site clearing	m^2	367.117,4
1.2	Pavement cutting	m^3	1.241,1
1.3	Make road form	m^3	75.796,5
1.4	Make drainage gutter	m^3	5.309,2
1.5	Excavation	m^3	35.359,2
1.6	Soil excavation KTH	m^3	256.956,0
1.7	Foundation soil backfilling K 95	m^3	604.151,5
1.8	Foundation soil backfilling K98	m^3	67.677,4
1.9	Pavement grubbing	m^2	773.500,0
1.10	Soil excavation C3	m^3	98.059,2
1.11	Soil excavation C4	m^3	10.419,4
1.12	Reshaping by Ballast aggregate	m^3	154.283,9
1.13	Ballast aggregate type I	m^3	307.505,4
1.14	Ballast aggregate type II	m^3	165.020,1
1.15	Soil backfilling for wayside	m^3	174.275,2
1.16	Soil excavation for backfilling	m^3	633.168,1
1.17	Rock sorting	m^3	17.063,8
1.18	Rock excavation C3	m^3	9.817,4
1.19	Rock excavation C4	m^3	101.321,8
2	**Pavement**		
2.1	Roughen the old road carpet	m^2	509.665,5
2.2	Spread the tak coat asphalt 0.5kg/m^2	m^2	1.907.688,5
2.3	Spread the tak coat asphalt 1.0kg/m^2	m^2	2.086.948,4
2.4	BTN fine-grained pavement, 5cm in thickness	m^2	1.782.167,6
2.5	BTN medium-grained pavement, 7cm in thickness	m^2	1.548.116,8
2.6	Make fine-grained BTN	Tone	492.329,1
2.7	Make medium-grained BTN	Tone	562.306,9
2.8	Make coarse-grained BTN	Tone	11.728,9
2.9	Reshaping by CPĐD	m^3	91.592,8
2.10	Reshaping by BTN	m^2	100.937,4
3	**Tapered spur road**		
3.1	Pavement cutting	m^3	327,4
3.2	Reshaping by CPĐD	m^3	950,9
3.3	Ballast aggregate type I	m^3	1.783,5
3.4	Make fine-grained BTN	Tone	3.338,9
3.5	Spread the tak coat asphalt 0.5kg/m^2	m^2	8.582,0
3.6	Spread the tak coat asphalt 1.0kg/m^2	m^2	16.694,0
3.7	Fine-grained BTN, 5cm in thickness	m^2	16.694,0
3.8	Medium-grained BTN, 7cm in thickness	m^2	8.582,0
3.9	Double surface dressing 3kg/m^2	m^2	4.310,0
4	**Vertical gutter, hollow**		

No.	Items	Unit	Volume
4.1	Land gutter excavation C3	m^3	9.656,1
4.2	Rock excavation C3	m^3	171,0
4.3	Flat concrete BT gutter 10 Mpa	m^3	87,8
4.4	Install flat concrete	M	5.051,0
4.5	Rock for slope roof, mortar 10Mpa	m^3	10.690,7
4.6	Pipe culvert BTCT of all kinds	piece	12445
4.7	Pipe culvert BTCT F 1.0 m, L=1m	piece	4552
4.8	Cross draw-off	point	41
4.9	Vertical gutter BTXM trapezium	M	17243
4.10	Triangular gutter	M	570
5	**Horizontal drainage culvert:**		
5.1	Make use to make further joint	piece/m	56 / 420,27
5.2	+ Pipe culvert BTCT D1.00 m	piece/m	27 / 219,24
5.3	+ Pipe culvert BTCT 2D1.00 m	piece/m	9 / 40
5.4	+ Pipe culvert BTCT 3D1.00 m	piece/m	4 / 13
5.5	+ Pipe culvert BTCT D1.50 m	piece/m	12 / 121
5.6	+ Pipe culvert BTCT 2D1.50 m	piece/m	2 / 12
5.7	+ Pipe culvert BTCT 3D1.50 m	piece/m	1 / 11
5.8	+ Box culvert BTCT (2.0x 2.0) m	piece/m	1 / 4,03
5.9	Design for replacement, supplementary	piece/m	201 / 3030,86
5.10	+ Pipe culvert BTCT 2D0.80 m	piece/m	2 / 43
5.11	+ Pipe culvert BTCT D1.00 m	piece/m	135 / 1797,9
5.12	+ Pipe culvert BTCT 2D1.00 m	piece/m	15 / 319,6
5.13	+ Pipe culvert BTCT D1.50 m	piece/m	21 / 324,29
5.14	+ Pipe culvert BTCT 2D1.50 m	piece/m	11 / 228,31
5.15	+ Box culvert BTCT (2.0x 2.0) m	piece/m	7 / 139,07
5.16	+ Box culvert BTCT 2(2.0x 2.0) m	piece/m	4 / 96
5.17	+ Box culvert BTCT (3.0 x 3.0) m	piece/m	5 / 70,09
5.18	+ Box culvert BTCT 2(3.0 x 3.0) m	piece/m	1 / 12,6
6	**Sidewalk**		
6.1	Stone curb concrete m250 1x2	m^3	2.925,2
6.2	Steel form	$100m^2$	285,0
6.3	Mortar M100, 2cm in thickness	m^2	693,5
6.4	8-side lining brick tiling	m^2	50.433,8
6.5	Curb concrete, gutter, separating strip 20Mpa	m^3	936,2
6.6	Foundation concrete 10 Mpa	m^3	1.785,5
6.7	Plastering 10 Mpa	m^2	155,0
6.8	Ballast packing-block	m^3	0,0
6.9	Sand for sidewalk tiling	m^3	2.083,1
6.10	Organic soil backfilling	m^3	295,1
6.11	Grass planting	$100m^2$	14,8
6.12	8-side interlocking brick, 6cm in thickness	m^2	16.445,6
6.13	Pipe culvert F100 make use to make further joint	M	8,1
6.14	Pipe culvert F100 make use to make head wall	Piece	1,0
6.15	Pipe culvert F100 to replace outside resident-intensive area	M	584,3
6.16	Pipe culvert F100 to replace inside resident-intensive area	M	95,7

No.	Items	Unit	Volume
6.17	Pipe culvert F100 to replace outside resident-intensive area	M	166,5
6.18	Box culvert 2.0x2.0 for replacement	M	79,3
7	**Slope reinforcement**		
7.1	Volume of ashlar stone	m^3	6.354,8
7.2	Build waste pack M100	m^3	460,5
7.3	Install plastic pipe D=100	M	17,3
7.4	Stone for slope roof, mortar 10Mpa	m^3	1.166,9
7.5	Stone for cut-off dike, mortar 10 Mpa	m^3	752,4
7.6	Ballast packing-block	m^3	104,3
7.7	Soil excavation C3	m^3	1.469,5
7.8	Soil backfilling	m^3	717,0
7.9	K95 soil backfilling by machine	m^3	226,3
7.10	Excavation for soil backfilling	m^3	810,3
7.11	Soil backfilling by jumping jack compactor	m^3	419,1
7.12	Grass planting	$100m^2$	3.547,9
8	**Wall for ditch of cut-off dike**		
8.1	Stone concrete for retaining wall 15 Mpa 1x2	m^3	6.697,5
8.2	Ashlar stone for cut-off dike, mortar XM 10MPa	m^3	2.871,8
8.3	Mortar XM 15Mpa	m^3	393,7
8.4	Soil backfilling (using excavated land)	m^3	2.394,0
8.5	Steel CT3 for retaining wall	tone	2,3
8.6	Stone for slope roof, mortar 10Mpa	m^3	82,7
8.7	Plastering 10Mpa	m^2	208,0
8.8	Ballast packing-block	m^3	101,8
8.9	Clay backfilling	m^3	57,2
8.10	Plastic pipe PVC	M	546,6
8.11	Wall painting	m^2	37,8
8.12	Wooden form for retaining wall	m^2	3.312,2
8.13	Break the stone masonry	m^3	99,7
8.14	Soil excavation for backfilling	m^3	921,5
8.15	Rock sorting	m^3	6,5
8.16	Soil excavation C3	m^3	1.484,1
8.17	Rock excavation C3	m^3	1.234,8
8.18	Rock excavation C4	m^3	521,1
8.19	Soil backfilling	m^3	2.532,7
9	**Traffic safety**		
9.1	Signboard		
9.2	+ Triangular	Piece	1728
9.3	+ Rectangular	Piece	71
9.4	Pillar Km	Pillar	208
9.5	Peg	Peg	11050
9.6	Curved safety fence	M	5018
9.7	Paint marking	m^2	84112,68507
9.8	Convex spherical mirror	Piece	15
9.9	Escape ramp	Point	5

1.5.2.2 Total volume of construction – Bridge part

The project workload on bridge construction is described in Table 1.11.

Table 1.11. Summary of volume for bridge part in the project

No.	Item	Unit	Volume
I	**Superstructure**		
	Beam BTCT DƯL I 33m, post-tensioning	beam	7
	Beam BTCT DƯL I 24.54m, post-tensioning	beam	20
	Trussed girder BTCT DƯL, 40Mpa, L = 12m	beam	5
	Trussed girder BTCT DƯL, 40Mpa, L = 18m	beam	12
	Trussed girder BTCT DƯL, 40Mpa, L = 24m	beam	10
	Trussed girder BTCT DƯL, 40Mpa, L = 9m	beam	37
	Trussed girder BTCT DƯL, 40Mpa, L=15m	beam	24
	I-Beam TCT DƯL 40MPa, L=18m	beam	12
	I-Beam BTCT DƯL 40MPa, L=24m	beam	12
	I-Beam BTCT DƯL 40MPa, L=33m	beam	37
	Asphalt concrete, 5cm in thickness	m^2	7.709
	Standard tack coat asphalt 0.5 kg/m2	m^2	7.709
	Water proofing layer	m^2	7.709
	Stone concrete C30 1x2 of deck, cross-beam	m^3	1.939
	Bar of deck, cross-beam	Kg	227.154
	Concrete C30, railing foundation	m^3	286
	Ring steel of all kinds	Kg	191.647
	Steel railing	Kg	48.618
	Shrinkage bolt D16, 20cm in length	piece	1.877
	Mortar XM C30, non-shrinkage	m^3	24
	Shrinkage rubber piece	M	352
	Tole piece, 1mm in thickness	Kg	4.622
	Asphalt oiled paper, 5mm in thickness	m^2	589
	Form of deck, cross-beam	m^2	9.450
	Form of railing	m^2	1.812
	Drainage pipe PVC Φ150. L=1,75m	Pipe	235
	Conducting pipe PVC	M	1.401
	Cement milk sweeping for railing foundation	m^2	2.157
	Lane marking reflection painting	m^2	420
	Band iron, 2mm in thickness, 50mm in width	Kg	1.760
	Flat steel, 15mm in thickness	Kg	0
	Corbel piece I33m, post-tensioning	Piece	75
	Corbel piece I24.54m, post-tensioning	Piece	213
	Concrete C25	m^3	509
	Sub-concrete C10	m^3	277
	Concrete C30	m^3	39

No.	Item	Unit	Volume
	Mortar XM, non-shrinkage	m^3	1
	Steel pipe, 3mm in thickness	Kg	2.700
II	**Substructure**		
2.1	**Abutment**		
	Concrete C30	m^3	6.615
	Sub-concrete C10	m^3	3.669
	Ring steel of all kinds	Kg	562.269
	Cast-in-situ concrete pile D = 1200, L = 12m	Pile	36
	Cast-in-situ concrete pile D = 1000, L = 20m	Pile	12
	Cast-in-situ concrete pile D = 1000, L = 23m	Pile	16
	Abutment form	m^2	10.349
	Coarse sand backfilling behind the abutment	m^3	8.131
	Excavating for abutment casting	m^3	138.991
	Soil backfilling for foundation ditch	m^3	129.080
2.2	**Pier**		
	Cast-in-situ concrete pile D = 1000, L = 29m	Pile	50
	Cast-in-situ concrete pile D = 1000, L = 35m	Pile	48
	Cast-in-situ concrete pile D = 1000, L = 36m	Pile	18
	Cast-in-situ concrete pile D = 1000, L = 8m	Pile	12
	Cast-in-situ concrete pile D = 1200, L = 60m	Pile	5
	Cast-in-situ concrete pile D = 1500, L = 60m	Pile	15
	Concrete C30	m^3	2.503
	Ring steel of all kinds	kg	337.919
	Sub-concrete C10	m^3	3.082
	Soil excavation	m^3	22.744
	Soil backfilling	m^3	18.377
2.3	**Abutment road reinforcement**		
	Soil backfilling by quarter-cone	m^3	8.672
	Stonework with mortar C10 for cut-off dike :	m^3	685
	Air brick tiling, 10cm in thickness	m^2	7.868
	Grass planting	m^2	2.611
	Compacting ballast, 10cm in thickness	m^3	59
	Inverted filter layer Ballast	m^3	59
	Drainage pipe	m	1.045
	Excavation for cut-off dike	m^3	1.369
	Soil backfilling for completion	m^3	1.039
	Melaleuca leucadendra, 4m in length per tree	m	114.091
III	**Approach embankment**		
	Asphalt concrete C10, 5cm in thickness	m^2	79.198
	Asphalt concrete C25, 7cm in thickness	m^2	79.198
	Standard prime coat asphalt 1kg/cm^2	m^2	79.198

No.	Item	Unit	Volume
	Ballast aggregate type I, 15cm in thickness, K98	m^3	11.880
	Ballast aggregate type II, 20cm in thickness, K98	m^3	15.840
	Soil backfilling K >=98	m^3	39.599
	Soil backfilling K >=95	m^3	75.874
	Excavation	m^3	2.230
	Rubble stone for vertical channel	m^3	7.560
IV	**Protection wall, peg**		
	Tole song	m	1.029
	Concrete C10	m^3	30
	Concrete C20	m^3	53
	Steel pile U160x160	Piece	384
	Steel bar U160x160	Piece	384
	Delineator	Piece	192
	Peg	Piece	640

1.5.3 MAIN PERSONNEL AND CONSTRUCTION MACHINE USED IN BUILDING

The volume of workforce, main equipment/machine, machine shift for project implementation are listed in Table 1.12.

Table 1.12. Personnel, main equipment and machine to be used

No.	Workforce/ Type of machine	Unit	Volume
I	**Workforce**	Hour	1.051.900
II	**Main machine, equipment**		
1	Right compressed air hammer	Shift	29
2	Welder of 23KW	Shift	1.478
3	Curve shear of 5KW	Shift	257
4	Jumping jack compactor	Shift	14.732
5	Vibratory plate compactor 1KW	Shift	361
6	Needle vibrator of 1,5KW	Shift	4.052
7	Drill of 2,5KW	Shift	8
8	Hand drill of Ø 32 -42	Shift	343
9	Self-percussive rotary drill of Ø 76	Shift	738
10	Grinder of 2,7KW	Shift	8
11	Electric motor air compressor of 270m^3/h	Shift	1.928
12	Diesel air compressor of 120 m^3/h	Shift	738
13	Diesel air compressor of 360m^3/h	Shift	11
14	Diesel air compressor of 660m^3/h	Shift	117
15	Digger of 1.25m^3	Shift	6.688
16	Mechanical rammer of 16T	Shift	4.901
17	Compactor of 10T	Shift	6.614

No.	Workforce/ Type of machine	Unit	Volume
18	Tyre-wheel compactor of 16T	Shift	2.809
19	Vibration compactor of 25T	Shift	1.621
20	Spreader of 130 -140CV	Shift	2.221
21	Spreader of 50-60 m^3/h	Shift	775
22	Blader of 110CV	Shift	741
23	Mixer of 250 liter	Shift	5.792
24	Mixer of 80 liter	Shift	6
25	Bulldozer of 110CV	Shift	3.942
26	Bulldozer of 140CV	Shift	486
27	Excavator of 1,6 m^3	Shift	1.679
28	Truck 2.5T	Shift	810
29	Asphalt sprinkling truck of 7T	Shift	3.857
30	Water sprinkling truck of 5 m^3	Shift	1.624
31	Mixing plant of 60T/h	Shift	1.679
32	Lift of 0.8T	Shift	186
33	Hoisting jack of 150 T	Shift	1.874
34	Bridge launching crane of K33-60	Shift	1.914
35	Drill hammer of VRM 1500/800HD	Shift	1.272
36	Mobilised electric generator of 75 kW	Shift	2.927
37	Truck 10T carrying along the road for land co-ordination	Shift	72
38	Truck 10T carrying cohesive soil for slope	Shift	13
39	Truck 10T carrying C3 land to fill 3 km	Shift	219
40	Truck 10T carrying C3 land to fill 8 km	Shift	5.579
41	Truck 10T carrying C3 land to fill 10 km	Shift	756.243
42	Truck 10T carrying C3 land to fill 24 km	Shift	987.354
43	Truck 10T carrying KTH land + to remove 6 km	Shift	1.312
44	Truck 10T carrying KTH land, over-land to remove 1 km	Shift	2.962
45	Truck 10T carrying KTH land, over-land to remove 2 km	Shift	1.552
46	Truck 10T carrying KTH land, over-land to remove 3 km	Shift	373
47	Truck 10T carrying KTH land, over-land to remove 7 km	Shift	2.937
48	Truck 10T carrying C3 land to remove 10 km	Shift	43.669
49	Truck 10T carrying KTH land, over-land to remove 13 km	Shift	18.339
50	Truck 10T carrying BTN, distance 4 km	Shift	6.504
51	Truck 10T carrying BTN, distance 6 km	Shift	2.913
52	Truck 10T carrying BTN, distance 23 km	Shift	19.079
53	Truck 10T carrying BTN, distance 32 km	Shift	39.287
54	Truck 10T carrying BTN, distance 34 km	Shift	576.224
55	Truck 10T carrying BTN, distance 54 km	Shift	367.374

1.5.4 USED LAND AREA

- Land under permanent appropriation: 263,12 ha, in which:
  + Residential: 31,76 ha
  + Agriculture: 184,24 ha
  + Forest: 47,12 ha
- Land under temporary appropriation: 5900 m^2, in which:
  + Dong Nai province: 1.200 m^2
  + Lam Dong province: 4.700 m^2

1.5.5 VOLUME OF SITE CLEARANCE

1.5.5.1 Site clearance scope

- Site clearance scope is measured from the toe of slope of embankment or the top of slope of the cutting or the outer edge of a construction to a length of 2m or 1m towards every side for designed sections of road type III or road type IV, respectively. For any section that crosses urban area, site clearance is done within the construction scope.
- The scope of road safety corridor is stipulated by state regulations.

1.5.5.2 Volume of site clearance

Table 1.13. Cost estimate of volume for site clearance according to each province

No.	Item	Unit	Volume
A	**Dong Nai province**		
I	**Accommodation**	**m^2**	**1.098,24**
1	House Type 4	m^2	451,22
2	Floor building	m^2	8,99
3	Temporary building	m^2	638,03
II	**Land**	**m^2**	**223.680,20**
1	Residential	m^2	157.891,41
2	Agriculture	m^2	9.612,24
3	Vegetation	m^2	47.222,98
4	Forest	m^2	51.453,57
III	**Plant**		
1	Industrial	Tree	8.573
2	Long-lived fruit tree	Tree	6.565
3	Short-lived fruit tree	Tree	232
IV	**Other construction**		

1	Electric pillar	Pillar	299
2	Transformer station	Station	-
3	Optical cable	M	148,51
4	Fencing wall	M	702,04
V	**Household under removal**	**Household**	**32**
VI	**Household under removal in part**	**Household**	**330**
B	**Lam Dong province**		
I	**Accommodation**	**m^2**	**11.130,00**
1	House Type 4	m^2	1.935
2	Floor building	m^2	1.510
3	Temporary building	m^2	2.788
4	**Land**	m^2	4.897
II	Residential	**m^2**	**2.125.785,00**
1	Agriculture	m^2	130.761
2	Vegetation	m^2	1.618.049
3	Forest	m^2	376.974
III	**Plant**		
1	Industrial	Tree	15.799
2	Long-lived fruit tree	Tree	3.074
3	Short-lived fruit tree	Tree	8.017
IV	**Other construction**		
1	Electric pillar	Pillar	927
2	Transformer station	Station	-
3	Optical cable	M	58.747
4	Fencing wall	M	530
V	**Household under removal**	**Household**	**32**

1.5.6 SOLUTION FOR RESETTLEMENT

According to the Document No. 1665/TTg-CN dated 17/10/2006 of the Prime Minister on Site Clearance for traffic construction projects, the site clearance activities of the project would be separated into independent sub-project led by the People's Committee of Dong Nai and Lam Dong province.

Regulation:

- Resettlement land allocation shall be done in a manner of transparency, democracy, fairness.

- Legal documents and regulations shall be fulfilled.

- Resettlement form shall be in compliance with livelihood conditions of residents whose land are required to be cleared.

- The cost compensation for site clearance out of the total investment capital of the project is at the investor's expense.

Resettlement form:

Due to the low workload of resettlement and highly available land fund, the project for rehabilitation and improvement of NR20 is mainly operated by on-site scattered resettlement method.

1.5.7 MATERIAL SUPPLY SOURCE

The deposit of a majority of filled soil pits is fairly moderate and their locations are scattered along the NR20 running through Dong Nai và Lam Dong province.

Sand pits could be used for concrete production, featured by small deposit, good quality and equal allocation along the NR20 running through Dong Nai và Lam Dong province. The material source for concrete is mainly extracted from flowing rivers. The exploited output is restrained due to the fact that the exploitation may alter the river flows and enable bank landslide (especially for Dong Nai river's sand).

Quarries are featured by their huge deposit, good quality and equal allocation along the NR20 running through Dong Nai và Lam Dong province.

1.5.7.1 Filled soil pit

15 local soil pits have been investigated within the project. During the implementation process, any pit which is near the sections and enables a comfortable exploitation would be under priority; further pits are also under consideration in case of material insufficiency.

❖ **Filled soil pit No. 1:**

Filled soil pit at Km186+520, 3.7km from the road to the left; the pit is exploited under private operation. Deposit is estimated to 200.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the head of the 159+500 is about 30.5 km (through the asphalt NR20). The pit is within Ninh Gia commune, Duc Trong dist., Lam Dong province. Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

❖ **Filled soil pit No. 2:**

Filled soil pit at Km221+100, 70m from the road to the left; the pit is currently under operation for the construction of Da Lat - Lien Khuong Highway. Deposit is estimated to 300.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the head of the Km159+500 is about 63 km (through the NR20). The pit is within Hiep An commune, Duc Trong dist., Lam Dong province. Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

- **Filled soil pit No. 3:**

Filled soil pit at Km148+520, 100m from the road to the right, has not been exploited. Deposit is estimated to 150.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the end of the Km268 is about 19.5 km (through the NR20). The pit is within Xuan Tho commune, Da Lat City, Lam Dong province. Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

- **Filled soil pit No. 4:**

Filled soil pit at Km251+920, 25m from the road to the right, has not been exploited. Deposit is estimated to 100.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the end of the Km268 is about 16 km (through the NR20). The pit is within Xuan Tho commune, Da Lat City, Lam Dong province. Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

- **Filled soil pit No. 5:**

Filled soil pit at Km258+450, 15m from the road to the left, has not been exploited. Deposit is estimated to 150.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the end of the Km268 is about 2.3 km (through the NR20). Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

- **Filled soil pit No. 6:**

Filled soil pit at Km261+900, 15m from the road to the left, has not been exploited. Deposit is estimated to 150.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the end of the Km268 is about 2.3 km (through the NR20). Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

- **Filled soil pit No. 7:**

Filled soil pit at Km265+700, 15m from the road to the left, has not been exploited. Deposit is estimated to 200.000 m^3 whose quality is good enough for road-bed cover. 0.5m equivalent to the tree root cover is removed. Delivery distance from the pit to the end of the Km268 is about 2.3 km (through the NR20). The pit is within Xuan Truong commune, Da Lat City, Lam Dong province. Official working document with local authority is available. Doing business with local authority for detailed instructions on site clearance compensation shall be fulfilled by implementing organization.

- **Filled soil pit No. 8:**

Location: Filled clay pit Tay Kim, ward Tay Kim, Gia Kiem commune, Thong Nhat dist., Dong Nai province, exploited by Thinh Tan Co., Ltd.

The estimated area of the pit is about 2.6 ha; exploitation could reach the depth of 3-7m. Estimated deposit is around 70.000 - 150.000 m^3.

Exploitation condition: easily exploit by stripping from 0.3 to 1 m to remove the topsoil.

Component: Clay in brown grey, brown yellow.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 5 km. From the pit, the delivery passes through 2.6-km soil road of 4m in width, another 2,4-km asphalt concrete road of 4m in width before arriving the Km11+000.

❖ **Filled soil pit No. 9:**

Location: Pit located at Gia Tan commune, Thong Nhat dist., Dong Nai province. The pit is an object of the mineral planning. The exploitation license (using height reduction method) is currently asked for by an organization.

The estimated area of the pit is about 85 ha; exploitation could reach the depth of 10-20m; The exact deposit of the pit is currently unknown (estimated to 8 - 15 triệu m^3).

Exploitation condition: easily exploit by stripping from 0.5 to 1 m to remove the topsoil.

Component: Clay in white grey, brown red.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 2,5 km. From the pit, the delivery passes through 1.5-km soil road of 3 - 4m in width, another 1-km soil road of 7-8m in width before arriving the Km15+500.

❖ **Filled soil pit No. 10:**

Location: Filled clay pit Ben Nom 2, Phu Cuong commune, Dinh Quan dist., Dong Nai province, exploited by Le Thuan private enterprise.

The estimated area of the pit is about 3 - 10 ha; exploitation could reach the depth of 3 - 5 m through height reduction method. Estimated deposit is around 100.000 - 300.000 m^3.

Exploitation condition: easily exploit by stripping from 0.3 to 0.5 m to remove the topsoil.

Component: Clay in brown yellow, white grey, brown red, mixed by laterite.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 2,2 km. From the pit, the delivery passes through 0.6-km soil road of 4 - 5m in width, another 1,6-km asphalt concrete road of 6-7m in width before arriving the Km18+800.

❖ **Filled soil pit No. 11:**

Location: Filled clay pit Tuc Trung, ward Dong Xoai, Tuc Trung commune, Dinh Quan dist., Dong Nai province. The pit is an object of the mineral planning and has not been exploited.

The estimated area of the pit is about 2 - 3 ha; exploitation could reach the depth of 3 - 7 m. The exact deposit of the pit is currently unknown (estimated to 60.000 - 200.000 m^3).

Exploitation condition: easily exploit by stripping from 0.3 to 0.5 m to remove the topsoil.

Component: Clay in brown yellow, brown red, mixed by laterite.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 2,2 km. From the pit, the delivery passes through 0.6-km soil road of 4 - 5m in width, another 1,6-km asphalt concrete road of 6m in width before arriving the Km18+800.

❖ **Filled soil pit No. 12:**

Location: Filled clay pit Dong Kim, ward Dong Kim, Gia Kiem commune, Thong Nhat dist., Dong Nai province, exploited by Thinh Tan Co., Ltd.

The estimated area of the pit is about 2.9 ha; exploitation could reach the depth of 3 - 7 m. Estimated deposit is around 80.000 - 200.000 m^3.

Exploitation condition: easily exploit by stripping from 0.3 to 0.5 m to remove the topsoil.

Component: Clay in brown yellow, brown grey.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 7 km. From the pit, the delivery passes through 7-km asphalt concrete road 763 of 4 - 5m in width before arriving the chainage Km11+000.

❖ **Filled soil pit No. 13:**

Location: Filled clay pit Suoi Nho, ward 5, Suoi Nho commune, Dinh Quan dist., Dong Nai province. The pit is an object of the mineral planning and has not been exploited.

The estimated area of the pit is about 5 - 8 ha; exploitation could reach the depth of 5 - 7 m. The exact deposit of the pit is currently unknown (estimated to 150.000 - 400.000 m^3).

Exploitation condition: easily exploit by stripping from 0.3 to 0.7 m to remove the topsoil.

Component: Clay in yellow grey, brown grey, brown red.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 3,5 km. From the pit, the delivery passes through 3,5-km asphalt concrete road 763 of 5 - 7m in width before arriving the chainage Km17+340.

❖ **Filled soil pit No. 14:**

Location: Filled clay pit La Nga, La Nga commune, Dinh Quan dist., Dong Nai province. The pit is an object of the mineral planning and has not been exploited.

The estimated area of the pit is about 15 ha; exploitation could reach the depth of 5 - 7 m. The exact deposit of the pit is currently unknown (estimated to 700.000 - 1000.000 m^3).

Exploitation condition: easily exploit by stripping from 0.5 to 1m to remove the topsoil.

Component: Clay in yellow grey, brown grey, brown red, mixed by laterite.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 14 km. From the pit, the delivery passes through 8-km soil road of 5 - 6m in width, another 2,4-km stone road of 5-6m in width, turning into the 3,5-km asphalt concrete road 763 of 5 - 7 m in width before arriving the Km17+340.

❖ **Filled soil pit No. 15:**

Location: Filled clay pit Gia Canh, ward 8, Gia Canh commune, Dinh Quan dist., Dong Nai province. The pit is an object of the mineral planning and has not been exploited.

The estimated area of the pit is about 5 ha; exploitation could reach the depth of 3 - 5 m. The exact deposit of the pit is currently unknown (estimated to 150.000 - 200.000 m^3).

Exploitation condition: easily exploit by stripping from 0.3 to 0.5m to remove the topsoil.

Component: Clay in brown red, brown yellow, brown grey.

Quality: Fairly good quality, could be used as a cover material (K95) for road-bed.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 7 km. From the pit, the delivery passes through 7-km asphalt concrete road of 6 - 7m in width (Thac Mai road) before arriving the chainage Km34+200.

1.5.7.2 Sand pit

14 local sand pits have been investigated within the project. During the implementation process, any pit which is near the sections and enables a comfortable exploitation would be under priority; further pits are also under consideration in case of material insufficiency.

❖ **Sand pit No. 1:**

Sand for concrete casting, construction is extracted from Dran river at ward Rom Be, Lac Xuan commune, Don Duong dist., Lam Dong province. Sand is stored by the bank river at Km201(NR27), 6.3 km from the road centerline to the right. Average deposit is about 5.000 m^3/day and is continually fostered. Quality is good enough for construction. Delivery distance from the pit to the end of Km268 is around 7.5Km (delivered through asphalt road).

❖ **Sand pit No. 2:**

Sand for concrete casting, construction is extracted from Da Nhim river at ward Suoi Thong, Don Duong dist., Lam Dong province. Sand is stored by the bank river at Km182 (NR27), 5.1 km from the road centerline to the right. Average deposit is about 5.000 m^3/day and is continually fostered. Quality is good enough for construction. Delivery distance from the pit to the end of Km268 is around 23.1 km (delivered through NR27).

❖ **Sand pit No. 3:**

Location: Sand pit Lam Ha, ward Dinh Van, Lam Ha dist., Lam Dong province, exploited and collected from small exploitation units by Muoi Le Co., Ltd..

Sand exploitation is done at Suoi Cat river; the output amount accounts for about 2.000 m^3/month.

Component: Large grain in white grey, brown yellow.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to the road is about 12 km. From the pit, the delivery passes through 12-km of NR27 before arriving the Km201+300.

- ❖ **Sand pit No. 4:**

Sand for concrete casting, construction is extracted from Da Buon river at ward Tan Hung, Tan Thanh commune, Duc Trong dist., Lam Dong province. Sand is stored by the bank river at Km193+500, 10.5 km from the road to the left. Average deposit is about 150.000 m^3/year and is continually fostered. Quality is good enough for construction. Delivery distance from the pit to the head of Km159+500 is around 44.5km (3.5 km through soil road, 3 km through aggregate road, 28 km through NR20).

- ❖ **Sand pit No. 5:**

Sand for concrete casting, construction is extracted from Bong Lai river at ward Bong Lai, Hiep Thanh commune, Duc Trong dist., Lam Dong province. Sand is stored by the bank river at Km206, 4 km from the road to the right. Average deposit is about 3.000 m^3/day and is continually fostered. Quality is good enough for construction. Delivery distance from the pit to the head of Km159+500 is around 50.5 km (3km through aggregate road, 47.5 km through NR20).

- ❖ **Sand pit No. 6:**

Location: Sand pit Tan Phu 2, ward Tan Phu 2, Dinh Lac commune, Di Linh dist., Lam Dong province, exploited by Long Thao private enterprise.

Sand exploitation is done along the water-course; the output amount accounts for about 1.500 m^3/month.

Component: Grain size ranged from medium to large in yellow grey, brown yellow.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to the road section is about 5 km. From the pit, the delivery passes through 5-km soil road of 5 - 6m in width before arriving the chainage Km153+650.

- ❖ **Sand pit No. 7:**

Location: Sand pit Phu Hoi, Duc Trong dist., Lam Dong province, exploited by Trieu Khanh Co. Ltd.

Sand exploitation is done at basin along Da Nhim river; the output amount accounts for about 10.000 m^3/month.

Component: Grain size ranged from medium to large in yellow grey, white grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to the head of the road is about 2 km. From the pit, the delivery passes through 2-km asphalt concrete road of 5 - 6m in width before arriving the Km201+800.

❖ **Sand pit No. 8:**

Location: Sand pit Phu Chau Co., ward 2 Dai Lao commune, Bao Loc town, Lam Dong province, exploited by HTM Co. and Phu Chau Co.

The area of sand exploitation is 3 ha and could be expanded to meet growing demand; estimated deposit is 200.000 m^3.

Component: Large grain in brown grey, yellow grey after filtering.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to the head of the road is about 2.5 km. From the pit, the delivery passes through 2,5-km soil road of 3 - 4m in width before arriving the Km112+000.

❖ **Sand pit No. 9:**

Location: along Dong Nai river, near Bien Hoa City; a large volume of sand required by constructions in Ho Chi Minh City, Dong Nai and other neighbouring provinces is acquired from the river.

Exploitation condition: The exploitation is done by Dong Nai Sand Exploitation Factory and sand is stored at Huu Ngan bank of Dong Nai river (near Dong Nai bridge - NR1).

Although the sand volume in Dong Nai river is huge, any exploitation are put under tight management to prevent river flows from negative influence and bank landslide at the area of exploitation. The output amount accounts for about 300.000-500.000 m^3/month.

Component: Grain size ranged from medium to large in yellow grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to the head of the road is about 49 km. The distance runs from the pit along NR1A to the head of road (chainage Km0+000) is about 49 km.

❖ **Sand pit No. 10:**

Location: Sand pit Ben Nom, Phu Cuong commune, Thong Nhat dist., Dong Nai province, exploited by Dong Tan Bien Hoa Co.

Sand exploitation is done at Tri An river; the output amount accounts for about 15.000 m^3/month.

Component: Grain size ranged from medium to large in yellow grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 3,5 km. From the pit, the delivery passes through 3,5-km asphalt concrete road of 6 - 7m in width before arriving the chainage Km18+800.

❖ **Sand pit No. 11:**

Location: Sand pit at La Nga river, ward 5, La Nga commune, Dinh Quan dist., Dong Nai province, exploited by Dong Tan Co.

Sand exploitation is done at Tri An river; the output amount accounts for about 10.000 m^3/month.

Component: Grain size ranged from medium to large in yellow grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 3,7 km. From the pit, the delivery passes through 3,7-km asphalt concrete road of 6 - 7m in width before arriving the chainage Km33+000.

❖ **Sand pit No. 12:**

Location: Sand pit at La Nga river, Gia Canh commune, Dinh Quan dist., Dong Nai province, exploited by Tin Nghia Co.

Sand exploitation is done along the La Nga river in a boundary of 8-9km within Gia Canh commune; the output amount accounts for 10.000 - 15.000 m^3/month.

Component: Grain size ranged from medium to large in brown yellow, white grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 4,5 km. From the pit, the delivery passes through 4,5-km asphalt concrete road of 5 - 7m in width before arriving the chainage Km42+100.

❖ **Sand pit No. 13:**

Location: Sand pit at La Nga river, Phu Thinh commune, Tan Phu dist., Dong Nai province, exploited by Phu Thinh co-operative society.

Sand exploitation is done along the La Nga river; the output amount accounts for 5.000 - 10.000 m^3/month.

Component: Grain size ranged from medium to large in brown yellow, white grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 4,5 km. From the pit, the delivery passes through 4,5-km asphalt concrete road of 5 - 7m in width before arriving the chainage Km48+400.

❖ **Sand pit No. 14:**

Location: Sand pit at La Nga river, ward Phu Hop B, Binh Phu commune, Tan Phu dist., Dong Nai province, exploited by Hai Phi Co. Ltd., and Mien Dong Co. Ltd.

Sand exploitation is done along the La Nga river; the output amount accounts for 5.000 - 10.000 m^3/month.

Component: Grain size ranged from medium to large in brown yellow, white grey.

Quality: in good quality, suitable material for bridge and culvert construction.

Delivery condition: delivered through road, delivery distance from the pit to road section is about 6,7 km. From the pit, the delivery passes through 2,7-km soil concrete road whose width is 4 - 6m and another 4-km asphalt concrete road of 5 - 7m in width before arriving the chainage Km55+100, approximately.

1.5.7.3 Stone material.

12 local quarries have been investigated within the project. During the implementation process, any quarry which is near the sections and enables a comfortable exploitation would be under priority; further quarries are also under consideration in case of material insufficiency.

- **Quarry No. 1:**

Granolithic quarry 1646 (Lam Vien Co.), locates at Km238+200 (NR20), ward 11, Da Lat city, Lam Dong province, 250 m from the road centerline to the right. The quarry is featured by large exploitation, high deposit, high quality. The delivery distance to the end of Km268 is around 30.5 km (600m through aggregate road, 29.9 km through NR20).

- **Quarry No. 2:**

Granolithic quarry (TNHH-XD 757 Co.), locates at Km236+850 (NR20), ward 11, Da Lat city, Lam Dong province, 250 m from the road centerline to the right. The quarry is featured by large exploitation, high deposit, high quality. The delivery distance to the end of Km268 is around 31.4 km (250m through aggregate road, 31.15 km through NR20).

- **Quarry No. 3:**

Granolithic quarry (Cam Ly), locates at Km232 (NR20), Da Lat city, Lam Dong province, 8 km from the road centerline to the left. The quarry is featured by large exploitation, high deposit, high quality. The average distance of delivery to the sections on both sides of the quarry is around 20 km (delivered through NR20).

- **Quarry No. 4:**

Bazaltic quarry (KTVLXD Duc Trong commune Co.), locates at Km220+700 (Highway), Hiep An commune, Duc Trong dist., Lam Dong province, 150m from the road centerline to the right. The quarry is featured by large exploitation, high deposit, high quality. The average distance of delivery to the sections on both sides of the quarry is around 12 km (delivered through NR20).

- **Quarry No. 5:**

Bazaltic quarry (Thien Chi), locates at Km186+800 (QL20), Ninh Gia commune, Duc Trong dist., Lam Dong province, 4km from the road centerline to the left. The quarry is featured by large exploitation, high deposit, high quality. The average distance of delivery to the sections on both sides of the quarry is around 20 km (4 km through aggregate road, 16 km through NR20).

- **Quarry No. 6:**

Bazaltic quarry (Hung Vuong), locates at Km176+820 (QL20), Di Linh town, Duc Trong dist., Lam Dong province, 2.5km from the road centerline to the left. The quarry is featured by large exploitation, high deposit, high quality. The average distance of delivery to the sections on both sides of the quarry is around 20 km (2.5 km through aggregate road, 17.5 km through NR20).

❖ **Quarry No. 7:**

Bazaltic quarry (Tam Bo), locates at Km177+800 (QL20), Ninh Gia commune, Duc Trong dist., Lam Dong province, 100m from the road centerline to the right. The quarry is featured by large exploitation, high deposit, high quality. The average distance of delivery to the sections on both sides of the quarry is around 15 km (2.5 km through aggregate road, 12.5 km through NR20).

❖ **Quarry No. 8:**

Bazaltic quarry (Loc Chau II), locates at Km106+630 (QL20), Dai Lao commune, Bao Loc City, Lam Dong province, 100m from the road centerline to the left. The quarry is featured by large exploitation, high deposit, high quality (exploitation license and rock experiment criteria are available). The average distance of delivery to the section Km108 - Km154 is around 30 km (delivered through NR20).

❖ **Quarry No. 9:**

Location: locates at ward Nguyen Hue 2, Quang Trung commune, Thong Nhat dist., Dong Nai province, exploited by Bien Hoa Construction Materials Production Co., Ltd.

The exploited area is about 25 ha, featured by huge deposit and high-quality rock. The monthly exploited output is about 20.000 m^3 for construction sites within and beyond the province.

Component: andesite rock in white-grey and blue-grey.

Delivery condition: Delivery by road; 2-km distance from quarry to section. 1-km distance from the quarry along the stone road whose width is 5-6m to asphalt concrete road 762 whose width is 4-6m., 1-km to Km7+000 of NR20.

❖ **Quarry No. 10:**

Location: Quarry Soklu 6 locates at Quang Trung commune, Thong Nhat dist., Dong Nai province, exploited by No. 5 Construction JS. Co.

The exploited area is about 12 ha, featured by huge deposit and high-quality rock. The monthly exploited output is about 10.000 m^3 for construction sites within and beyond the province.

Component: andesite rock in white-grey and blue-grey.

Delivery condition: Delivery by road; 1-km distance from quarry to section, 1-km distance from the quarry along the stone road whose width is 5-6m to asphalt concrete road 762 whose width is 4-6m., 1-km to Km7+000 of NR20.

❖ **Quarry No. 11:**

Location: Quarry Soklu 2 locates at ward Nguyen Hue 2, Quang Trung commune, Thong Nhat dist., Dong Nai province, exploited by Bien Hoa Construction Materials Production Co., Ltd.

The exploited area is about 15 ha, featured by huge deposit and high-quality rock. The monthly exploited output is about 20.000 m^3 for construction sites within and beyond the province.

Component: andesite rock in white-grey and blue-grey.

Delivery condition: Delivery by road; 4-km distance from quarry to section, 1-km distance from the quarry along the stone road whose width is 5-6m to asphalt concrete road 762 whose width is 4-6m., 3-km to Km7+000 of NR20.

❖ **Quarry No. 12:**

Location: Gia Canh quarry locates at ward 8, Gia Canh commune, Dinh Quan dist., Dong Nai province, exploited by Mai Phong Construction Materials Production Co., Ltd.

The currently exploited scope is set to 3 ha out of 9 ha of total area with 50m of maximum depth of exploitation. The quarry is featured by huge deposit and high-quality rock. The annually exploited output is ranged from 100.000 to 150.000 m^3 for construction sites within and beyond the province.

Component: andesite rock in white-grey and blue-grey.

Delivery condition: delivery through asphalt concrete road (Thac Mai road) whose width is 5-7m, distance from quarry to chainage Km33+900 is roughly 7 km.

1.5.7.4 Other materials like iron, steel, cement

+ Bought at Bien Hoa City, Dong Nai province. delivery distance to the head of (Km0+000) is roughly 49 km.

+ Bought at Bao Loc city, Lam Dong province; the average distance of delivery to sections is roughly 40 km.

+ Bought at Di Linh town, Di Linh dist., Lam Dong province; the average distance of delivery to sections is roughly 20 km.

+ Bought at Lien Nghia town, Duc Trong dist., Lam Dong province; the average distance of delivery to sections is roughly 20 km.

+ Bought at Da Lat City, Lam Dong province; the average distance of delivery to sections is roughly 20 km.

+ Bought at Don Duong dist., Lam Dong province; delivery distance to the end of Km268 is roughly 5 km.

1.5.8 DISPOSAL SITE

❖ **Waste site No. 1:**

Located at Km251+900, 25m from the road centerline to the right, waste capacity is roughly 40.000 m^3. The site belongs to Xuan Truong commune, Da Lat city, Lam Dong province. Official working document with local authority is available.

❖ **Waste site No. 2:**

Located at Km263+400, 20m from the road centerline to the right, waste capacity is roughly 40.000 m^3. The site belongs to Xuan Truong commune, Da Lat city, Lam Dong province. Official working document with local authority is available.

❖ **Waste site No. 3:**

Located at Km247+400, 15m from the road centerline to the right, waste capacity is roughly 45.000 m^3. The site belongs to Xuan Tho commune, Da Lat city, Lam Dong province. Official working document with local authority is available.

❖ **Waste site No. 4:**

Located at Km247+100, 25m from the road centerline to the right, waste capacity is roughly 30.000 m^3. The site belongs to Xuan Tho commune, Da Lat city, Lam Dong province. Official working document with local authority is available.

❖ **Waste site No. 5:**

Located at Km178+800, 100m from the road centerline to the left, waste capacity is roughly 10.000 m^3. The site belongs to Ninh Gia commune, Duc Trong dist., Lam Dong province. Official working document with local authority is available.

❖ **Waste site No. 6:**

Located at Km186+520, 3.7km from the road centerline to the right, waste capacity is roughly 50.000 m^3. The site belongs to Ninh Gia commune, Duc Trong dist., Lam Dong province. Official working document with local authority is available.

❖ **Waste site No. 7:**

Located at Km223+870, 12m from the road centerline to the left, waste capacity is roughly 50.000 m^3. The site belongs to Hiep An commune, Duc Trong dist., Lam Dong province. Official working document with local authority is available.

1.5.9 TOTAL INVESTMENT RATE

Table 1.14. Total cost estimate of project

No.	Items	Cost (million VND)
I	**Total amount**	**7.648.508**
1	Construction cost after tax	4.466.694 (including environment protection cost, l96.180,71)
2	Site clearance cost	879.702
3	Project management cost	24.754
4	Construction consulting cost	148.058
5	Other costs	117.763 (including environment protection cost, 3.186,00)
6	Back-up cost	2.011.537
II	**Project component I**	**4.589.588**
1	Construction cost after tax	2.704.402
2	Site clearance cost	513.518
3	Project management cost	14.998
4	Construction consulting cost	85.009

5	Other costs	69.060
6	Back-up cost	1.202.611

1.5.10 PROJECT PROGRESS

Project component I (Km0 - Km123+105) is conducted under the form of BT contract, planned to start from 2012 and to be completed after 36 months from the date of commencement. Project component II (Km123+105 - Km268) is planned to start from 2013 and also to be completed after 36 months from the date of commencement. Details of the work progress could be seen in Table 1.15.

Table 1.15. Construction progress of departments/items in the project

A. Section Km0+000 - Km123+105

No	Work items	First year												Second year												Third year												No. of month
		Month												Month												Month												
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
I	**Road section**																																					
1	Km0 - Km20																																					11
2	Km20 - Km62																																					16
3	Km62 - Km76+700																																					12
4	Km79+800 - Km98																																					10
5	Km108+458 - Km123+105																																					14
II	**Bridge work**																																					
1	Gia Duc, Phuong Lam																																					12
2	La Nga																																					18
3	Darleu, Dai Quay																																					15
4	Damrhe																																					15
III	**NR1 intersection**																																					12

B. Section Km123+105 - Km268

No	Work items	First year												Second year												Third year												No. of month
		Month												Month												Month												
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
I	**Road section**																																					
1	Km123+105 - Km154+400																																					14
2	Km159+500 - Km172																																					12
3	Km176+500 - Km199																																					14
4	Km210+500 - Km234																																					14
5	Km234+500 - Km268																																					20
II	**Bridge Work**																																					
1	Dai Nga																																					15
2	Dinh Trang Hoa, Lien Dam																																					12
3	Darle, Hiep Thuan																																					12
4	Dai Ninh																																					18
5	Xom Trung																																					12
6	Dinh An I																																					12
7	Cau Dat																																					12
8	Cau Xeo																																					12
III	**Intersection**																																					30

1.5.11 CONSTRUCTING ORGANIZATION

1.5.11.1 Division of bid package

The project is intended to break into 2 construction packages: package 1 is drawn to construction items within the area of Dong Nai province and package 1 is drawn to those within the area of Lam Dong province.

1.5.11.2 Arrangement of construction site

A. General regulations on positioning work sites

- Bridge constructions are scattered, not centralized and apart to each other along the road. Therefore, each bridge location should has its own site. Each site is equipped with batch plant; A batch plant may be shared by nearby small bridges within a scope of 10 km. Concrete delivery is made through NR20.

- Simple beams could be made at each bridge site. However, due to a large number of bridge, for the purpose of good quality control and cost-cutting for forms and casting pedestals, it is able to consider the beam production at 2 locations for 2 respective packages. Here are intended locations for beam casting:

+ Area near La Nga bridge, La Nga commune, Dinh Quan dist.: The site is in charge of providing beams for La Nga bridge and put at the center in relation to 2 bridges: Gia Duc and Phuong Lam.

+ Bao Loc town area: The Section from Km86 (Darleu bridge) to Km149 (Lien Dam bridge) could get the beam from the site.

+ Area near Dai Ninh bridge, Ninh Gia commune, Duc Trong dist.: The site is in charge of delivering beams to Dai Ninh bridge and to the Section from Km 180 (Darle bridge) to Km263 (Xeo bridge).

B. Site map of construction area

Based on stated-above regulations, Table 1.16 and 1.3 describe the construction areas mapping along the road.

Table 1.16. Allocation of construction plants along the project road

No	Construction plant	Square (m^2)	Location/ Characteristics
1	Const. plant 1	300	Gia Duc 1 bridge, Km1+880, farming land.
2	Const. plant 2	600	La Nga bridge, Km35+712, farming land and river land.
3	Const. plant 3	300	Phuong Lam bridge, Km65+056, farming land.
4	Const. plant 4	300	Darleu bridge, Km86+700, farming land.
5	Const. plant 5	300	Dai Quay bridge, Km88+850, farming land.
6	Const. plant 6	300	Damrhe bridge, Km97+900, farming land and fruits.
7	Const. plant 7	300	Dai Nga bridge, Km129+500, farming land.
8	Const. plant 8	300	Dinh Trang Hoa bridge, Km139+300, wild plant + coffee

No	Construction plant	Square (m^2)	Location/ Characteristics
9	Const. plant 9	300	Lien Dam bridge, Km149+303, wild plant + coffee.
10	Const. plant 10	300	Darle bridge, Km177+800, farming land.
11	Const. plant 11	300	Hiep Thuan bridge, Km183+376, vegetable, coffee.
12	Const. plant 12	600	Dai Ninh bridge, Km189+200, vegetable, coffee, wild plant.
13	Const. plant 13	300	Xom Trung bridge, Km194+771, farming land.
14	Const. plant 14	400	Dinh An I bridge, Km217+810, farming land.
15	Const. plant 15	400	Dat bridge, Km254+254, farming land.
16	Const. plant 16	500	Xeo bridge, Km263+100, forest land and wild plant.

1.5.11.3 Constructing solution and method statement

A. General regulations on constructing solution

(a). Following regulations are used to properly assign work issues:

- To be in line with the current road system; delivery distance of material is set to optimum.
- To be in line with scheduled construction sub-plans; strengths, experience and capacity of contractors should be fully used.

(b). Pay high attention to priority issues, especially large bridges' locations with special design, intersections and technical issues that have effect on work progress.

(c). Apply typical design (culvert, flat bridge whose deck/span is below 20 m), that is produced in shop-floor (sub-product), transported, installed on-site for the purpose of quality assurance, progress consolidation and construction aesthetics. It is encouraged to buy the product made by the shop-floor itself for typical simple decks/spans whose lengths are above 30m.

B. Work implementation

a. Preparation

Preparation are drawn as following:

- Material source: Scattered backfill soil, sand, stone/rock should be comfortably exploited along the road near construction works; other materials such as iron, steel, cement, v.v... should be available at urban cities along the NR20.
- Material supply: Transportation of materials is followed by the "Just-in-Time" rule to narrow down the rendez-vous area.
- Rendez-vous for materials and equipments: Construction area is main area to store construction materials and work equipments.
- Establishment of batch plant: Batch plants are available at construction area.
- Establishment of operating house, accommodation hut: huts for workers are mainly located within the construction area; operating houses for investors, contractors

and supervision and consulting organizations could be arranged on-site or at private households along the road.

- Power and water supply: is extracted from the available system of electricity and water along the road section.
- Workforce: The number of technical engineers and workers shall be sufficient for any important work item. The unskilled labour at Dong Nai và Lam Dong is fairly abundant to be able to accomplish work items.

b. Implementation of road work

- Each Section work shall be properly planned in terms of time, schedule progress, the availability of equipments/technology and workforce of the contractors without affecting the NR20's traffic.
- Road work is done through successive method: Any next work item is not allowed as long as the previous one is not completed; Scattered works are forbidden to remove traffic obstacles, traffic dangers, unnecessary workloads and to ensure the local aesthetics.
- Cross culvert shall be done before road work, half of the culvert work is priorly done to ensure the traffic issue along the road.
- Vertical culvert in town: Although vertical culvert work has less effect on the road work, it is required to be in line with other cross culverts and road work for the total quality and aesthetics.

c. Implementation of bridge work

- Site clearance: Site clearance is made within the area of bridge work and temporarily borrowed land to make temporary bridge and road; trees are removed within the construction area; its roots and stumps and are also removed.
- Construction of temporary bridge and road:
  + Temporary bridge and road are built at the site of 12 small and medium bridges where centerlines of the old and new bridge share the same point: Gia Duc, Phuong Lam, Darleu, Dai Quay, Damrhe, Dinh Trang Hoa, Darle, Hiep Thuan, Xom Trung, Dinh An I, Cau Dat and Cau Xeo (for 4 remaining bridges: new bridges are put next to old ones which are still used for traffic purpose on NR20).
  + Temporary road: Traffic purpose and bridge work are ensured through road for construction traffic whose $B_{nền}$ = 7m, $B_{mặt}$ = 6m; surface dressing ballast aggregate road; pavement strength is E_{yc} = 1400daN/cm^2; drainage through Pipe culvert Φ1m.
  + Temporary bridge: loading is HL93; bridge width is 2 x 4,0m; two driving lanes without side-walk.
- Redirect the traffic flow to temporary road.
- Removal of old bridge:
  + Remove railing system, bridge deck, bridge beam;
  + Remove support concrete;
  + Remove bridge pile foundation (steel or BTCT).
- Sequence of new bridge work:
  + Substructure work:

  - o Erection of cast-in-situ concrete pile or driven pile (pile joint method shall be used in any area near residential district).
  - o Erection of terrestrial supporting pier is done through cutting method, while that of subaqueous one is made through sheet pile or temporary cofferdam. Covered chamber could be used in deep rivers. The channel cleaning shall be noted after the erection completion.
  - o Erection of foundation, body, pier, abutment, tower of the bridge.

+ Superstructure work:
  - o Based on actual conditions, precasted simple girder structures are made on-site or at factory before being installed by special-purpose equipments such as cranes.
  - o Plate and box beam structures are casted on-site through scaffold or traveler.

CHAPTER 2
ENVIRONMENTAL, NATURAL AND ECONOMIC-SOCIAL CONDITIONS OF PROJECT AREA

2.1. NATURAL ENVIRONMENT CONDITIONS

2.1.1. TOPOGRAPHICAL AND GEOMOPHOLOGICAL CHARACTERISTICS

The line of the project begins at a plain with a height of about 20 meters and ends at a highland with a height of about 1,100 meters (above sea level). The terrain of line area is divided into basic types:

– Plain combined with low know, with the average height of 80 – 150 meters: From Km0 –Km62, it is a kind of even and flat terrain, hardly segmented; there are rarely excavation and backfill. The upper layer is clay, glacial clay at the quasi-plastic and semi-hard state with the thickness of 10 meters. Beneath is bazan creating layer of Xuan Loc and Tuc Trung bed system.

– Hilly terrain: Construction of this terrain includes hills and mountain ranges with average height (from 200 – 800 meters), cross slope changes from 20 – 30^0, the terrain is strongly segmented by flumes and small valleys before mountain. The line through the area of this terrain includes segments Km62-Km108 (Chuoi and Bao Loc mountain pass), Km171 – Km175 (Phu Hiep mountain pass). For these segments, the main line goes along mountain slop; covered on the face of terrain is kinds of soil, rock whose source is vestige hillside, clay, clay loam with semi-hard state to hard state of macadam, grit, crushed decayed rock with the thickness of 1 – 10 meters. Lower layer is making wall of La Nga, Dinh Quan, and Bao Loc bed system.

– Highland terrain: from Km108 to Km 210, the line goes through knobs and mountains at the height of 600 – 900 meters. From Km210 to Km260 (the end of the line), the line goes through high mountainous areas with the height of about 900 – 1500 meters. This is characterized by the terrain of Midland highland with low hills with feature of round top, working man hillside in series like a upturned bowl. Nowadays, on this terrain, there are rice – fields on which industrial crops are planted such as tea, coffee, rubber trees. Covered on this terrain are kinds of red basaltic soil originating from magmatic rock eruption with the thickness from 5 – 20 meters, somewhere is rolling carved stone. At some knobs, there are original rocks right on the surface.

2.1.2. GEOLOGICAL CHARACTERISTICS

2.1.2.1. Stratum structure

Based on the results of field investigation and reference in geological map of Viet Nam: Gia Ray – Ba Ria, B'Lao, Da Lat – Cam Ranh at the rate of 1:200,000, it indicates that the national highway 20 mainly goes through geological making walls:

- La Nga bed system of midle Jura Age (J_2ln): lithologic component of rocks mainly grey fine sand with white mica like scab form combined with grey powder and black clay which has pyrit crystal with small segment. The width of this bed system is estimated about 600 – 800 meters. The line on this strata occupies a part within the section Km0 – Km20 and the section cross the Bao Loc mountain pass (Km71 – Km98).

- Dinh Quan complex with late Jura Age ($\gamma\delta_3J\text{đ}q_2$): includes diorite creating walls, quart diorite, particle gabrodiorit with medium to small size, blue grey – black grey, or has small particle grannodiorit, granit with black dots, block structure, semi automorphic architecture. This complex connects a part with the section of the line through Bao Loc mountain pass.

- Bao Loc bed system with late Jura Age ($J_3\text{đ}b_l$): includes creating walls which are mainly aldehyde, porphyrite aldelhyde combined with a little precipitated sandy rocks with black grey color. The rock has solid block structure. The width is about 400 – 500 meters. This bed system lies mainly at the section of the line through Bao Loc mountain pass.

- Ca Na complex (γK_2-*cn*): penetrated rocks belong to Ca Na complex, lie widely within Lam Dong – Nha Trang area; typically is Da M'Bri block and other blocks in Bao Loc. Lithologic component is granite biotite penetrated rocks with bright color, alaskite with homogenous block structure, semi automorphic architecture, with big to medium size. In the area containing the line, granite penetrated rock of Ca Na complex appears obviously at Da M' Bri river bed (to the left of the section).

- Dai Nga bed system with late Neogen age (βN_2*đn*): lithologic component is mainly olivin basalt, plagio basalt which has structure like solid form with holes. The width changes from 50 – 250 meters. The line on this bed system is mainly the section from Bao Loc to Di Linh.

- Tuc Trung bed system with late Pliocen and early Pleistocen age (βN_2-Q_I*tt*): lithologic component is mainly olivin basalt with blue grey color. The line through this bed system is mainly the section from Km 20 – Km40 and Km140 – Km150.

- Xuan Loc bed system with average Pleistocen age (βQ_{II}*xl*): component is mainly olivin basalt with blue grey color. The line through this bed system is mainly the section from Km0 – Km20 and Km150 – Km180.

- Quarter bed system ($Q_{IV}^{1\text{-}2}$): aluvi (aQ), deluvi (dQ), proluvi (pQ) Deposits are allocated under narrow long forms creating thin layers (clay loam, clay sand) and sand spits, thin gravels at the sides along the river and big springs in the area; its components are sands, gravels, clay loam with grits, the width changes from 5 – 7 meters.

2.1.2.2. Stucture of soil, rock layer

The main line goes through along hilside and hill across peaks therefore the layers of hillside waste, vestiges, and sometimes prouvium, alluvium mainly exist; beneath these layers are layers of original rock with different decomposition levels. In general, the basic strata of the area from the above down includes the following layers of rock, soil:

- Layer 1 – soil like prouvium, hillside waste, alluvium: spits, blocks, gravels lie on very plastic, high dust layer. Dispersive soil with spongy to medium tight state, cohesive soil with medium hard to hard state, the width changes from 0.5 – 5.0 meters. In general, this layer has medium load strength but its components are little homogenous and influenced drastically by the weather.

- Layer 2 – residual soil: its components include very plastic dust, very plastic sandy dust, lean clay, plastic clay ... with red brown, yellow brown, grey brown color at hard – very hard to solic state. Within its component exists weathered rocks like blocks, pieces with the width changing from 2 – 5 m. Load strength of this layer is quite high.

- Layer 3 – original rock: the main line goes through the are with dug bed therefore the scale of the line contains a few kinds of rocks (mainly at the line over mountain pass like Chuoi, Bao Loc mountain pass); original rocks seeable can include:

Black, blue grey basaltic rock has changes in decomposition level from soft decompostion, cracked decomposition to solid decomposition. This rock layer has changes in resistance strength, from tens (50 kG/ cm^2) to hundreds (800-900 kG/cm^2)

Sandstone, grey thinly bedded clay stone of La Nga bed system which is cracked, crushed cover which is quite strongly folded is often decomposited at medium to high level above. This rock layer has low strength of press resistance and changes a lot, from some (9-10 kG/cm^2) to hundreds (200 – 300 kG/cm^2).

Diorite rock, diorite crystal, gabrodiorite, particle granite with medium to small size, has blue grey to black grey color, or has gradiorite, granite biotite which is small, white grey, black dotted, has block structure as that of Dinh Quan complex. This rock layer has the high strength of press resistance, chaning from 400 – 1000 kG/cm^2 .

Anderit, anderit porphyrit stone intermix little thin stone tuffaceous structure with dark gray, opaque or dacit, ryodacit and their tuf of gray, light gray. Stone's structure is solid of Bao Loc Pass bed system.

In addition to rock layers above, sections through ponds, lakes, wetlands contain layers:

- Layer 1A: brown grey or black grey facial mud, this soil layer is mainly allocated locally in rice fiel cultivated by people with the width of 0.3 – 1.0 m, load strength is low, however it is simple to process because of narrow allocation and small thickness.

- Layer 1B: soil on the hillside, vestiges: are allocated right beneath facial mud layer which has yellow brown, grey clay at quasi plastic to semi hard state, the width is 4 – 5 meters. This layer has the ability to endure

2.1.2.3. The geological phenomenas, work motive power

- Corrosive phenomenon: on the line, some sites cross flumes (building sites of bridges, big drains), in rainy season, level of raised stream water, flush of water cause erosion of blanket, prouvium beneath the bed and along two banks of stream, developing along corrosion with horizontal corrosion. Corrosive phenomena have strong influence on abutments and pillars of the bridge together with bent slope along sections of river and stream.

- Rock, mud spate: Due to sloping terrain of the area, plentiful rainfall in which rainy season centralize from may to november (while it rains very little in other months) therefore in rainy season, huge flood happens making stream of rock, mud spate occur which has very huge kinetic energy which may destruct construction.

- Corrosion makes slope roof unstable: hillside layer, vestiges in the region which has quite big covered bed, big void ratio (average = 1.3), small natural density (average = 1.7) are weathered products of eruptive rocks (basaltic rocks) which have big dust content, flowing limited humidity is quite high therefore it is sensitive to water. On the other hand, most of surveyed line goes along hillsides with average rainfall of 1,750 – 3,150 mm/year, average relative humidity of year is 85 -87% therefore corrosion, unstability of slope roof always bear the risk. Specially, it is neccessary to pay attention to deep slip happening on the the surface of original rock when all slope roofs are wetted, increasing load, reducing strength. In addition, it is neccessary to pay attention to erosion of slope roof due to strong flow.

2.1.3. HYDROMETEOROLOGICAL CONDITIONS

2.1.3.1. GEOLOGIC CONDITIONS

(1) TEMPERATURE

– Temperature of Dong Nai is quite stable. Monthly average temperature changes within 24 - 29^{0}C therefore on average, yearly temperature is 26.5^{0}C and standard deviation σ = 1,2^{0}C. In months 1, 2 and 12, it is less hot. Yearly average temperature is about 25 - 26^{0}C; in months 3 -6, it is hotter, average temperature is about 27 – 28.5^{0}C.

– Temperature of Lam Dong changes in respect to the height and is quite stable in each subarea. For Bao Loc, monthly average temperature changes within 19.5 – 24.1 ^{0}C; the average value in recent years is about 19 - 21 ^{0}C; in months, it is warmer; the average temperature is about 22.5 - 23.5 ^{0}C.

– For Duc Trong, monthly temperature changes within 19.4 – 22.9^{0}C; the average value in recent years is 21.5^{0}C. In months 1, 2 and 12 it is coldest; the yearly average temperature is about 19 - 21 ^{0}C; in months 3 -6, it is warmer, the average temperature is about 22 - 23 ^{0}C.

Table 2.1. Average temperature of months in year (^{0}C)

Month / Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Long Khanh	24,6	25,4	26,8	27,9	26,6	26,4	26,1	26,1	25,8	25,8	25,4	25,0
Bao Loc	20,2	21,5	22,4	23,6	23,3	23,3	22,5	22,5	22,2	22,2	21,4	20,8
Lien Khuong	19,4	20,8	21,8	22,9	22,8	22,5	22,0	21,7	21,6	21,2	20,7	20,1

Source: Lam Dong and Dong Nai Department of Statictics, 2010

(2) Sunlight and irradiation

– Average hour of sunlight in recent years in Dong Nai is within 2,200 – 2,400 hours, taking up about 26% of year time. Monthly average hour of sunlight in year changes for a wide range, from 100 – 270 hours. Months which has a lot of hours of sunlight are months 2 to 6, the average value in years is 200 – 2400 hours; on the contrary, months 9 – 12 has less hour of sunlight, change within 145 – 175 hours.

– Average hour of sunlight in recent years of Lam Dong is within 1,960 – 2,070 hours, taking up 23% year time. Monthly average hour of sunlight of year changes for wide range, from 70 – 250 hours; but if considering average number in years, this value changes less, from 100 -200 hours. Months which have a lot of hours of sunlight are from 12 to month 4 of next year with average value of about 190 – 210 hours; on the contrary, months 8 – 11 have less hours of sunlight, changing within 100 – 130 hours.

Table 2.2. Average hours of sunlight of months in year (hour)

Month / Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Long Khanh	200	213	233	213	196	206	190	182	141	161	172	207
Bao Loc	195	212	212	191	175	159	137	135	101	133	140	195
Lien Khuong	216	239	239	225	200	198	149	134	124	154	176	208

Source: Lam Dong and Dong Nai Department of Statictics, 2010

(3) Rainfall

– Average rainfall in years at Long Khanh station – the center of Dong Nai province is 2,100 mm. The allocation of yearly rainfall is not regularly but is affected by 2 seasons, rainy season and dry season. During dry season, from december of the previous year to april of the following year, rainfall of month during this period of years changes within 3 – 60 mm. During rainy season, from may to october, rainfall of month is quite high, usually within 160 – 450 mm. Average rainfall of month during this period of years change within 250 – 350 mm.

– Rainfall in Lam Dong is not regularly allocated and depends on the height. The average rainfall of years in Lien Khuong is 1,600 mm and in Bao Loc the rainfall is 3,000. The rainfall is allocated regularly in year, centralized in 7 months of rainy season from may to october. The highest rainfall of month in Lien Khuong is measured at 485 mm and in Bao Loc is 1,073 mm. During dry season, from december of the previous year to april of the following year, rainfall of month only reaches millimeters to tens of millimeters, even it does not rain in one month. The average rainfall of months during this period in year changes within 8 – 170 mm.

Table 2.3. Average rainfall of months in year (unit: mm)

moth / Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Long Khanh	4	33	64	88	301	216	323	326	456	246	136	16
Bao Loc	36	68	133	214	265	294	420	507	405	359	168	96
Lien Khuong	6	18	65	137	210	192	181	181	270	211	93	40

Source: Lam Dong and Dong Nai Department of Statictics, 2010

(4) Humidity

– Yearly average humidity of Dong Nai is about 81%; month average humidity of year changes within 70 – 88%. The period of humidity coincides with rainy season, lasting from may to november in which average humidity is about 83%-88%. Month with the highest humidity is september, average humidity of years changes 86 – 88%. Dry period coincides with season when it rains little. Exception for december when the weather is quite wet, average humidity ranges around 80%, the 4 remaining months from January to april, average humidity of years ranges 70 -75%. The driest period is usually february – march, average humidity is about 71%.

– Yearly average humidity of Lam Dong is around 86%; monthly average humidity of year changes within 76 – 94%. The period of humidity coincides with rainy season, lasting from may to november in which average humidity is about 88% - 94%. Month with the highest humidity is from may to november, average humidity of years changes 89 – 94%. Dry period coincides with season when it rains little. average humidity of years ranges 76 -85%. The driest period is usually february – march, average humidity is about 80%%.

Table 2.4. Average Humidity of months in year (unit: %)

month / Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Long Khanh	74	71	74	76	85	86	87	87	88	88	83	79
Bao Loc	81	79	83	85	90	90	91	91	93	90	87	82
Lien Khuong	83	79	82	84	89	87	89	91	91	89	86	82

Source: Lam Dong and Dong Nai Department of Statictics, 2010

(5) <u>Wind</u>

a) Dong Nai region

– In general, the weather of the whole Dong Nai province is moderate, changes of year's time, daytime is not considerable, hardly affected directly by flood.

– Main wind direction of the region from month VII – X is West – South west direction, in compliance with wind speed of 3.0 – 3.6 m/s, and 3.3 m/s on average; from XI – II, the wind prevails at North – south north direction, in compliance with wind speed of from 3.4 – 3.6 m/s, reaching 4.2 m/s on average.

b) Lam Dong region

– Every year, Average wind speed changes from 2.8 – 6.2 m/s, reaching the highest in november, lowest in january. During these time, wind speed can reach 10 m/s or more.

Table 2.5. Average and the heighest Wind speed (m/s).

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average wind speed	2,8	4,7	4,8	3,0	3,2	3,3	3,9	3,6	3,4	3,3	6,2	4,4

Maximum wind speed	10,5	17,0	21,0	13,0	16,5	12,5	12,5	16,0	12,0	10,0	21,0	14,0

– Lam Dong region is far from the sea, is not directly affected by the storm. However, avearage wind speed is quite higher than that of some deltas. Average wind speed in dry season is higher than that in rainy season.

– Wind direction as well as its strength change in compliance with tim and these changes lead characteristics of the weather in every season, period.

– East – North wind field is typical in dry season. But during half dry season, when this wind field becomes stronger, it is cloudy, small rain appears, temperature reduces and strong wind lasts for days. During last half dry season, when the strength as well as frequency of the wind of East – North reduces, it is less cloudy, it is sunny and dry in daytime.

– In May, West wind field begins its operation, indicating a long warm season. Months 6, 7, 8 westerly wind is in strong operation and prevails combining with temperate interference, which makes Lam Dong region gloomy, lasting rain continues, medium rain to heavy rain appear.

(6) <u>Steadiness of atmosphere</u>

To define whether atmospheric conditions are steady, neutralized or unsteady, it is necessary to survey and analyze phenomena of the weather happening every day. In general, levels of atmospheric steadiness mentioned above may occur at the same location at different periods of day. Usually, reduction in temperature at heights happens at the half end of the following at noon, when the sun provides sufficient energy to warm up the air near the ground which the air is cooled and the ground too at the previous night.

Under mentioned weather condition, if radiated power becomes high the ground may be heated. Then, the ground heats the adjacent air layer, in its turn this air layer heats adjacent air layer above, and finally super adiabatic atmosphere appears that is unsteady air.

After the sun sets, at night due to no radiation from the sung, in addion the ground is ideally black object which emits irrfrared ray into the air therefore the ground is cooled rapidly. This makes air layers adjacent to the ground cooled alternatively, that is forming quite steady heat flow from the air to the ground by means of heat exchange: heat conduction, light convection and radiation. As a result, at the following early morning it is observed that at the near ground, the temperature increases gradually at heights, up to the height of 300 m. This is inversion layer of atmosphere and it is called radiative inversion.

When the sun goes up, the ground and every thin air layer is heated gradually to form nearly adiabatic air layer at the near ground. The air in this adiabatic layer can not integrated into remaining inversion layer above it at the previous night due to high steadiness. However, at the adjacent border there is still mixture between air in newly formed adiabatic layer and the air of inversion layer, in addition radiation of the sun becomes stronger and stronger, making warm adiabatic air layer increase gradually and finally removing absolutely inversion layer at noo. At mid afternoon, it can be seen that adiabatic picture spreads up to the height of 2000 meters; at that time, from the near ground up to some hundreds meters there may be super adiabatic layer – unsteady air layer.

Horizontal and vertical Diffusion coefficient of the air (σ_y), (σ_z) significantly depends on steadiness of the atmosphere. With experiment, Pasquill and Gifford sets up relationship between coefficients σ_y, σ_z and distance (x) in accordance with the wind direction corresponding to levels of steadiness of the atmosphere. Levels of steadiness of the atmosphere relates strictly to air temperature variation at the heights. Depending direction and levels of temperature change at heights, we have isotherm, adiabatic, super adiabatic or inversion (Figure 2.1). Temperature variation at the heights depends on factors of weather such as radiation, the sun at daytime, quatity of cloud at night, wind speed ….

Pasquill suggests 7 levels of steadiness of the atmosphere, with symbols such as A, B, C, D, E, F and G as follow:

A: Unsteadiness	E: Light steadiness
B: Medium Unsteadiness	F: Medium steadiness
C: light Unsteadiness	G: Strong steadiness
D: neutralization	

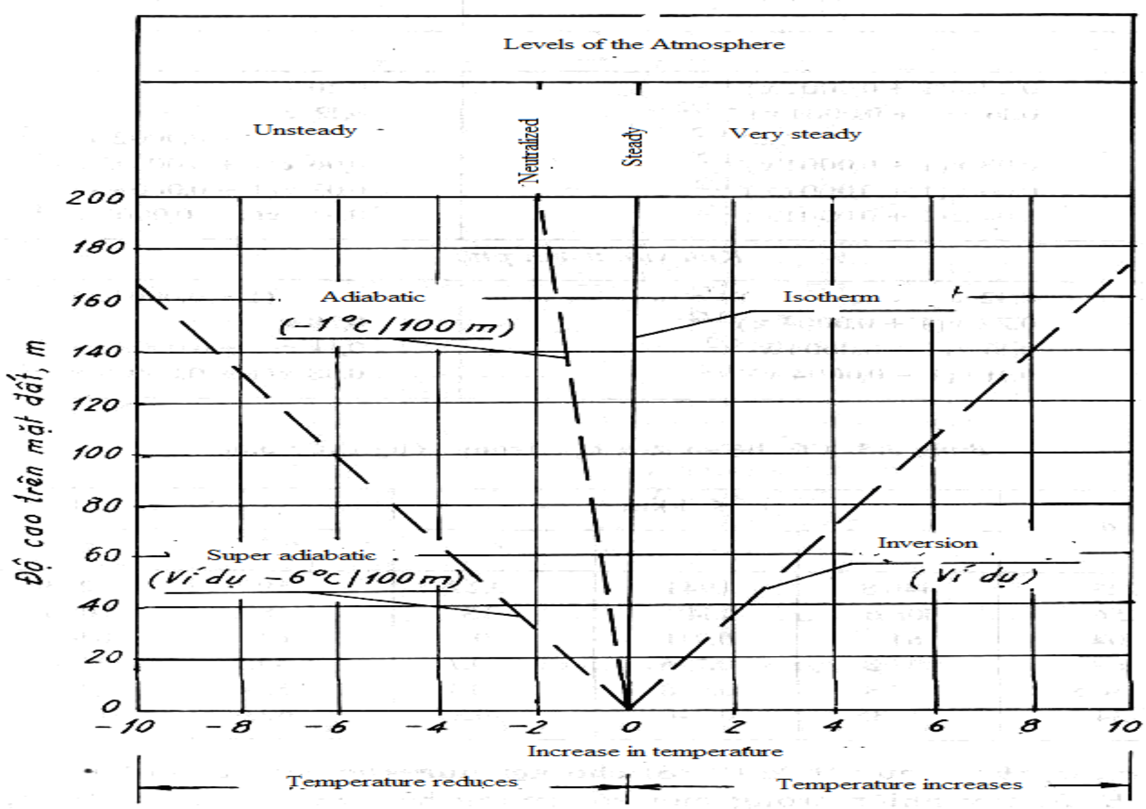


Figure 2.1. Air Temperature variation at the heights on the ground

With classification as mentioned and local meteoric condition, for Lam Dong, the steadiness of the atmosphere on sunny days, A-B weak wind speed; on cloudy days wind speed are C-D. At night, the steadiness of the atmosphere is E type. For Dong Nai, the steadiness of the atmosphere on sunny days, B weak wind speed; on cloudy days wind speed is C. At night, the steadiness of the atmosphere is E type.

2.1.3.2. Hydrology

a) Dong Nai Region

In the project's region, hydrology system is controlled by the following rivers:

– Dong Nai river: Dong Nai river flows across Dong Nai at the third terrain step and is the middle zone of the river. The section from the border of Dong Nai – Lam Dong to the opening of Be Tan Uyen river which flows at North West – south East. The terrain of valley at the middle zone is 100 – 300 m in height, at the section from Ta lai to Tri An there are waterfalls. At the section after Tri An, the river flows gently, the river bed is widened and deep. The big affluents of Dong Nai river include La Nga, Be river.

– La Nga river: the section of La Nga river which flows across Dong Nai provine is 55 km long, sinuos. At this section, La Nga river is narrow, has branches, typically Gia Huynh and Tam Bung stream. Gia Huynh stream has a 125 km^2 valley, flow module is 9 1/s km^2 in dry season and 47.41 1/s km^2 in rainy season, coming from national highway 1, the border of Dong Nai – Binh Thuan. Tam Bung stream has the valley area of 155 km^2, coming from the North of Xuan Loc highland, flow module is 10 1/s km^2 in dry season and 65 l/s km^2 in rainy season. La Nga river flows into Tri An lake with amount of water of $4.5x10^9$ m^3/year, taking up 1/3 total water of the lake, yearly flow module is 35 l/s km^2.

– Hydrologic parameters such as average level of water, the highest level of water and the lowest on Dong Nai river and La Nga river during surveying period 1978 – 1995 at stations Dong Nai region is presented in Table 2.6 to Table 2.8.

b) Lam Dong Region

Lam Dong is a province belongin to Dong Nai river system, has abundant water resource, stream network is interlacing, the potential of hydroelectricity is hight, including 73 reservoirs, 92 rolling weir. Streams, rivers of Lam Dong province are allocated quite regularly, average density is 0.6 km/km^2 , the bottom slope is less than 1%. Most of streams, rivers flow from norht east to south west direction. Due to mountainous and seperated terrain, most of rivers, streams have small valleys and have waterfall at the headwater.

Huge rivers flow across the project's region in Lam Dong province which belongs to Dong Nai river system (including 3 main rivers: Da Dang, Da Nhim, Da Huoai river) and La Nga river.

– Da Dang river: Da Dang river originates from high mountainous region of La Duong district, flowing across Dan Kia lake to Lam Ha district, having stream entry with 2 main branches of stream of Da Dang river: they are Cam Ly stream and Da K'Nang stream. Cam Ly branch is 73 km long, originating from the North East of Da Lat city with the valley area of 215 km^2, flowing across Da Lat city, Lam Ha district, Duc Trong district. Da K'nang branch is 35 km long, it valley area is 167 km^2. Da Dang, the main river is 90 km long, its valley area is 1,225 km^2.

– Da Nhim river: Da Nhim flows across districts La Duong, Don Duong, Duc Trong and has stream entry with Da Dang river at the neighbouring region between Dan Phuong commune (Lam Ha) and Ninh Gia commune (Duc Trong)

– Da Huoai river: inflowing stream flows into Dong Nai river, its valley area is 968 km^2 with 2 main branhes: Dambri and Da Quay stream. Dambri branch has valley area of 345 km^2, the length is 70 km, flowing from Bao Loc city across Da Teh district and Da Huoai district. Da Quay branch has valley area of 259 km^2, the length is 35 km, originating from high mountainous region bordering between Binh Thuan province and Da Huoai district of Lam Dong province.

– La Nga river: is one of 2 main branches of Dong Nai River, originating from the mountain chain with the height of 1,400 – 1,500 m on Bao Loc – Di Linh highland. The above section of the river is formed from two rivers Dai Nga and Draiam. Draiam river originates from the moutainous region in the south of Di Linh district at the height of 1,400 – 1,500 m, flowing at south North direction to Di Linh with the height of 900 m, after that continuing flowing at South West direction and having confluence with Dai Nga river at the height of about 700 m. After having confluence, the river flows at South – north direction to the moutainous region in the south of Bao Loc. Due to moutainous terrain, the river has a lot of waterfalls.

At Ta Pao, La Nga flows at South – West and is downward from 550 m to 130 m. After 36 km from Ta Pao to Vo Xu and 40 km from Vo Xu to Vo Dat, the La Nga river flows downward to the delta. Due to drastical reduction in slope, at this region flood often takes place in rainy season. Stream flow of La Nga river changes significantly between dry season and rainy season. At Ta Pao station, stream flow Q_{min} = 4 - 7 m^3/s and Q_{max} = 400 - 1000 m^3/s.

Hydrologic parameters such as average level of water, the highest level of water and the lowest on Dong Nai river, Da Nhim and La Nga river during surveying period 1978 – 1995 at stations Lam Dong region is presented in Table 2.6 to Table 2.8.

Table 2.6. Average water level at surveying period (cm)

Ordinal number	Station	River	Surveying period	Average water level												
				Month												Year
				I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1	Tri An	Dong Nai	78 – 95	3725	3699	3680	3687	3729	3811	3884	3983	3979	3976	3857	3776	3816
2	Thanh Binh	Cam Ly	78 – 95	977	968	967	982	992	1016	1030	1060	1074	1141	1044	994	1021
3	Dai Nga	La Nga	78 – 95	771	760	756	767	788	836	868	908	904	901	839	796	825
4	Ta Pao	La Nga	77 – 95	526	503	487	494	522	599	656	750	752	745	640	567	665

Source: National hydro – metoorological service of Viet Nam
Note: The height of water level at stations is calculated by special height of each station

Table 2.7. The heighest water level at surveying period (cm)

Ordinal number	Station	River	Surveying period	Characteristic	The heighest water level **and time**											
					month											
					I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	Tri An	Dong Nai	78 - 95	Medium	3742	3715	3702	3726	3776	3918	3971	4114	4096	4069	3919	3820
				highest	4139	4119	4116	4198	4217	4339	4281	4399	4392	4444	4298	4232

				Time	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985
				lowest	3662	3634	3621	3624	3656	3775	3846	3962	3960	3927	3824	3734
				Time	1978	1978	1978	1983	1983	1978	1980	1982	1983	1982	1982	1978
2	Thanh Binh	Cam Ly	78 - 95	medium	984	977	1017	1122	1132	1201	1198	1240	1278	1400	1175	1011
				highest	999	1018	1059	1332	1277	1272	1314	1328	1365	1449	1357	1041
				Time	1981	1981	1979	1985	1978	1976	1978	1984	1983	1979	1979	1980
				Lowest	964	955	972	999	999	1050	1014	1082	1072	1334	1052	986
				Time	1983	1983	1983	1983	1981	1985	1981	1985	1985	1982	1984	1982
3	Dai Nga	La Nga	78 - 95	Medium	798	779	777	812	830	932	924	990	972	973	882	821
				highest	841	825	800	846	869	1008	1032	1110	1034	1002	929	843
				Time	1981	1981	1982	1985	1979	1981	1979	1978	1982	1981	1980	1985
				lowest	777	765	755	763	786	814	868	920	905	931	845	805
				Time	1978	1984	1984	1978	1978	1978	1983	1985	1985	1984	1984	1979
4	Ta Pao	La Nga	76 - 95	medium	544	518	519	540	612	761	807	931	938	920	756	615
				highest	563	565	673	633	782	970	1018	1043	1040	1029	822	671
				Time	1981	1981	1982	1985	1985	1981	1979	1984	1982	1983	1980	1980
				lowest	521	501	485	498	518	560	693	762	843	700	661	571
				Time	1978	1978	1977	1977	1983	1977	1980	1977	1983	1977	1984	1977

Source: National hydro – metoorological service of Viet Nam

Note: The height of water level at stations is calculated by special height of each station

Table 2.8. The lowest water level at surveying period (cm)

Or	**Station**	**River**	surve	**Characte**	The lowest water level **and time**

di na l nu m be r			ying perio d	**ristic**	**month**											
					I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	Tri An	Dong Nai	78 - 95	Medium	3711	3686	3667	3667	3693	3735	3824	3872	3900	3894	3804	3746
				highest	4118	4094	4075	4082	4141	4148	4215	4222	4286	4286	4212	4155
				Time	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985
				Lowest	3635	3606	3601	3593	3596	3638	3721	3766	3796	3795	3721	3680
				Time	1978	1978	1978	1978	1983	1983	1983	1980	1979	1982	1984	1978
2	Thanh Binh	Cam Ly	78 - 95	Medium	972	963	958	958	965	970	988	998	1008	1048	1006	983
				highest	984	974	972	975	977	985	1029	1039	1040	1099	1032	1005
				Time	1981	1979	1979	1982	1978	1980	1979	1979	1980	1983	1979	1979
				Lowest	955	947	943	940	942	949	958	973	982	997	984	966
				Time	1983	1983	1983	1983	1983	1983	1983	1982	1983	1982	1982	1982
3	Dai Nga	La Nga	78 - 95	Medium	763	752	745	745	762	786	838	846	866	857	811	781
				highest	766	759	749	756	788	819	888	890	893	876	829	791
				Time	1981	1981	1978	1982	1985	1980	1979	1979	1980	1980	1982	1985
				Lowest	759	747	740	716	738	760	803	819	838	840	797	777
				Time	1979	1978	1984	1978	1978	1983	1978	1980	1981	1982	1984	1983
4	Ta Pao	La Nga	76 - 95	Medium	513	492	475	475	486	518	589	624	660	659	590	539
				highest	527	507	483	503	528	578	693	723	722	710	622	558
				Time	1981	1981	1981	1982	1985	1976	1979	1984	1980	1980	1980	1980

				Lowest	499	480	470	463	460	479	522	562	616	580	559	522
				Time	1978	1978	1977	1977	1983	1983	1977	1977	1981	1977	1976	1977

Source: National hydro – metoorological service of Viet Nam

Note: The height of water level at stations is calculated by special height of each station

2.1.4. NATURAL RESOURCES

2.1.4.1. Soil resoures

a) Dong Nai region

Soil of Dong Nai province has 10 main groups. However, based on origin and quality, soil can be divided into 3 main groups:

- Soils formed on basaltic rock: include pumice stony ground, muck soil, rich red earth, taking up 39.1% of natural square 229,416 hectares, allocated in ther north and north east of the province. These soils are suitable to low-time and long term industrial trees such as: rubber, coffee…

- Soil formed on Old alluvium and clay slate such as: grey soil, grey brown, spotted taking up 41.9% of natural square (246,380 hectares), allocated in the south, south east of the province (Vinh Cuu, Thong Nhat, Bien Hoa, Long Thanh, Nhon Trach district). These soil are less rich, suitable to low time trees such as: bean tree… and a few fruit trees, long term industrial trees such cashew….

- Soils formed on newly alluvium: rich soil, sandy soil, allocated mainly a long rivers such as Dong Nai, La Nga rivers. The quality of soil is high, suitable to types of trees such as food crop, farm produce, vegetables…

Up to 2010, Dong Nai has 48.96% of soil areas used for agricultural production such as low time and long term trees. In addition, soils used in forestry (production forestry, protection forestry and special forestry) take up 30.47%. Dong Nai has used 18.86% of the whole areas of soil as housing area and special-purpose soil for headquarter, security, national defence, earth for public activities and production, non agricultural business.

b) Lam Dong Region

Soil of Lam Dong is classified into 8 groups with 45 different types, most important of which is soil growing on basaltic rock, with the area of 212,309 hectares, centralized on Bao Loc – Di Linh highland, which has quite plain terrain, rich soil, are suitable for developing long term industrial trees. According to Report on Soil planning for 2010 of Lam Dong province, structure of groups is as follow: Group of rich soil takes up 2.96%; glay soil taking up 4.59%; newly changed soil takes up 1.67%; red earth takes up 21.74%; grey earth takes up 67.55%; muddy soil takes up 0.09%; leachy oil takes up 0.01%; black earth takes up 0.31%.

The main drawback of the land in the province of Lam Dong is a steep slope, susceptible to erosion and runoff during the rainy season, potentially degraded land gradually if not used appropriately. The structure of land slope as follows: Land with a slope <80 account for 14.41% slope 8-200 accounting for 15.6% and slope> 200 accounts for 69.99%

2.1.4.2. Water resource

a) Dong Nai Region

– Dong Nai thereby has tremendous total water of 16.82 x 10^9 m^3/year, in which rainy season takes up 80%, dry season takes up 20%. Rivers of Dong Nai has decisive significance for hydrologic regime and ecological balance in the region, the highest flow reaches 880 m^3/s. Nowadays, there are more than 23 reservoirs, of which Tri An lake is the biggest one with the area of more than 32,300 hectares, the capacity is around 2.8 billion m^3. Ground water resource can meet the need for water in production and life in the province and can supply to Ba Ria – Vung Tau province and Ho Chi Minh city.

– In Dong Nai, there are interlacing river networks. There are more than rivers, small and huge streams, concentration of rivers, streams is around 0.5 km/Km^2, howerver they are non-homogeneously allocated. Most of streams, rivers centralize in the North and a long Dong Nai river to the south – West direction.

– Potential of underground water in Dong Nai is quite huge: Water reserve of the whole province is 793.379 m^3/day. Of which capacity reserve is 789.689 m^3/day and yielding reserve is 3691 m^3/day. Moving reserve is about 4,714,847 m^3/day including ground flows during dry season and is limitation of underground water reserve. Therefore, total of underground water reserve of Dong Nai is around 5,505,226 m^3/day.

– Although underground water reserve of Dong Nai province is abundant, allocation is not regular, in months of dry season it does not rain, the need for exploitation is high, therefore exploitaion of underground water must comply planning on reasonable exploitation

– Because of qualified water, underground water resource is considered as reservoir water and can serve production, building, and life activities at moderate and small scope.

b) Lam Dong Region

– For ground water, Lam Dong has an abundant river network. There are about 60 rivers, streams with more 10 km in length. Some big rivers, streams are Dong Nai, Da Nhim, Da Dang, Da The; Da Tam, Dai Nga…Density of river net changes around 0.18 – 1.1 km /km^2. Rivers, streams in Lam Dong narrow landing step, back fall, waterfalls, strong flow and allocated unregularly in year. In addition, Lam Dong has system of abundant reservoir, huge water reserve serving livelihood of people, irrigation, aquaculture and traveling including: Chien Thang, Tuyen Lam, Dankia, Suoi Vang, Da The, Daklo, Da Boa, Da Ham, Nam Phuong, Tay Di Linh, Tan Rai, Loc Thang, Kalam Cam Ly Thuong, Phuc Tho, Da Ron, Pro.

– For underground water, the region can use it for irrigation mainly in places with low, plain terrein; in high mountainous regions, underground water can hardly be supplied. The results of Group of water resource planning and investigating show:

+ The Bao Loc has promising reserve for exploitation of 3000 m^3/day; potential reserve for exploitation is about 355,000 m^3/day.

+ Di Linh has promising reserve for exploitation of 3700 m^3/day; potential reserve for exploitation is about 118,000 m^3/day.

+ Duc Trong has promising reserve for exploitation of 6900 m^3/day; potential reserve for exploitation is about 355,000 m^3/day.

In general, water resource of the region has a wide rewater, huge flow module, good quality of water can meet the need for irrigation in agricultural production and life activities. In addition, due to the advantage in terrain makes good for building reservoirs and rolling weir right in the areas of agricultural production; at the same time, it is able to combine exploiting potential of hydroelectricity with tourism activities.

2.1.4.3. Forest resource

a) Dong Nai Region

Forest of Dong Nai is characterized by tropical forest, which has abundant resources of animals and plants. In 1976, cover ratio of forest is 47% of the natural area, in 1981 reduces 21.5%. In 2006, forest cover is 26.05% of total natural area. Nam Cat Tien national garden with rare, precious animals, plants is typical for ecosystem of forest in the region. Based on forest growing programm and planning of the province, it can be foreseable that cover ratio (including long term industrial trees) will increase up to 45 - 50% during periods of 2015.

it can be classified into 3 kinds for 2009:

- Special use forest: 947.4 hectares, taking up 52.8%
- Protection forest: 404.09 hectares, taking up 22.5%
- Production forest: 444.02, taking up 24.7%

b) Lam Dong region

Total area of forestry soil of the whole province is 602.142 hectares, of which: natural forest is 547,813 hectares; planted forest is 54,329 hectares, forestry soil is 33,512 hectares.

It can be classified into 3 kinds for 2009:

- Special use forest: 83.813 hectares, taking up 13.91%
- Protection forest: 172,800 hectares, taking up 28.73%
- Production forest: 345,003 hectares, taking up 57.36%

Total forestry product reserve: wood is 56,182,789 m^3 (natural forest 55.172.965 m^3, taking up 95.04%; planted is 1.009.824 m^3, taking up 4.96%) and 518 million baamboos. In addition, forest in Lam Dong also possesses precious drug growing on seams of tree of natural forest.

2.1.4.4. Mineral resource

a) Dong Nai region

(1) <u>Metal:</u>

– Gold: by now 17 mines, ore sites and mineralization sites have been discovered; centralizing mainly in the northern province. There are 2 small mines in Hieu Lam and Vinh An which are promising; the remaining ore sites are evaluated sufficiently such as: Suoi Ty, Suoi Nho, Tam Bung, Suoi Sa Mach, Vinh An, La Nga, Hieu Liem.

– Aluminum (bauxite ore): 2 mines have newly been discovered in Datapol (Ma Da) and La Nga, have the area of about 1,120 hectares, but are of restricted areas (Nam Cat Tien forest) with over 2/3 areas. The reserve estimated reaches about 450 million m^3.

– Tin: only seen at rims. These rims are wide but their content is low and is not worth finding; centralized in Chua Chan mountain, Suoi Ret, Suoi Sao, and Gia Ray river.

– Lead, Zinc, multi metal: are discovered in Chua Chan mountain

(2) Non Metal

– Kaolin: 10 mines have been discovered, they are mainly small ones and ore sites; centralized mainly in Phuong Thien, Hang Nai, Phuoc Tho, Tam Hoa, Tan Phong, Binh Y, Thanh Phu.

– Colored clay: 9 ore sites have been discovered by no in Long Binh Tan, Xuan Khanh and Xuan Loc.

– Limestone: only 2 sites have been discovered in Tan Phu and Suoi Cat.

– Circuited quartz: allocated scatteredly, only one site has been discovered in Xuan Tam (Xuan Loc district). Circuited quartz is used in mettalurgical industry.

– Building rock and devitrified stone: building rocks are being exploited in 24 mines, centralized in Bien Hoa, Thong Nhat, Trảng Bom, Long Thành, Vĩnh Cửu, Định Quán, Nhơn Trạch, Xuân Lộc.

– Building sand: centralized mainly in Dong Nai river from the intersection Tan Uyen to the intersection, which has been probed and evaluated on reserve. Besides, among small rivers, streams there are the same sands as in Dinh Quan region, Tan Phu especially in Tri An Lake.

– Leveling sand: Phuoc An (Dong Mu Rua, Go Sim), Nha Be river, Dong Tranh.

– Building unit clay: quite abundant, allocated mainly in Thien Tan, Thanh Phu (Vinh Cuu district), Long an, Long Phuoc (Long Thanh district)

– Haydite: allocated in Dai An and Tri An with the estimated reserve of about 8 million.

– Puzzolan: abundant, mainly in Dinh Quan, Long Thanh and a few in Cay Giao, Gia Kiem, (Thong Nhat) and Vinh Tan (Vinh Cuu)

– Laterite: quite abundant; mainly in Vinh Cuu, Bien Hoa, Long Thanh and Nhon Trach.

– Semi and previous rocks: allocated at small scope, not promising for industrial exploitation.

– Ziricon: Gia Kiem, Nui La, Tan Phong

– Saphia: La Nga bridge, the north of Tan Phong, Gia Kiem.

– Pyrop-ziricon.

– Opan-canxedoan: Chứa Chan mountain.

– Tecfic: the north of Tai Lai.

(3) Mineral water, hot water resource

– Mineral water – hot water: in Phu Loc and Kay

– Magie – bicarbonat mineral water: in Nho stream

– Super light – salted mineral water: in Tam Phuoc and Son Trach

– Ironic mineral water: in the south of Nam Thanh Tuy Ha

– Chloride **-** sodium saline water: in Nam Tuy Ha

b) Lam Dong region

According to the Report of "Investigation, evaluation of potential, planning of probe, exploitation, using mineral resource in Lam Dong province by 2010, oriented for 2020" project, in Lam Dong 2283 mineral sites have been discovered and registered, the presence of mineral, metal, non metal, precious rocks – semi precious and mineral water – hot water. Of 283 sites, there are 31 huge minerals, 22 medium minerals, 48 small minerals, 149 presences of minerals and 42 mineralized sites. Minerals are centralized mainly in the North of the provinces (Lac Duong, Da Lat, Dam Rong, Lam Ha, Don Duong) and in Duc Trong, Di Linh, Bao Loc. The districts which are poor in minerals are Da Te, Cat Tien, Da Huoai.

Types of minerals in Lam Dong have been discovered and evaluated at different techical level such as:

– Brown coal in Dai Lao – Bao Loc with deposit of 1 million tons.

– Ore Bauxite in Tan Rai (Bao Lam) has deposite of 59.8 million tons pure ore; Tan Phat mine (Bao Loc) has deposit of 3 million tons, 3.87 tons in Dambri. In general, quality of ore is quite high, conditions for exploiting and transporting is easy, there is potential for combination development: hydroelectricity – bauxite exploiting industry – Alumium processing and alumium treating.

– Tin exists in Ward 8,9 – Da Lat, in Da Sar – Lac Duong, Di Linh with deposit of about 13 0 14 thousands tons.

– Gold exists in Ta Nang – Duc Trong, Da Don – Lam Ha with deposit of about 1,700 kg.

– Kaolin in Lam Dong has deposit of over 100 million tons, the quality is high, suitable for producing anti – fire materials. Kaolin is allocated anywhere in the province, but centralized at two main mines with potential for industrial exploitation including kaolin of Trai Mat with deposit of 33 million tons, Prenn kaolin mine with deposit of 49 million tons.

– Bentonite has 4 mines, of which Tam Bo – Di Linh mine has deposit of 4 million tons, its quality is high, it can be used for producing drilling oil solution, detergent in lubricant industry, food industry and addition in composition fertilizer….

– Clay resource in Lam Dong is very abundant and allocated widely. As forecast, the need for building unit in Lam Dong is very huge, about 100 million balls/year. At present time, only 36 – 40 million tuynen balls/year are produced all over the province.

Table 2.9: *Minerals Statistics of Lam Dong province*

Ordinal number	**Type**	**Quantity (point)**	**Deposit (Million tons)**	**Predited resourses (Thousand tons)**
I	***Fuel minerals***			
1	Lignite	11	1,008	96,35
II	***Metal minerals***			
2	Iron	2		

Ordinal number	Type	Quantity (point)	Deposit (Million tons)	Predited resourses (Thousand tons)
3	Antimony	1		
4	Copper (molybden)	1		
5	Lead-Zinc	3		Pb=1,06; Zn=0,192
6	Arsenic	5		1,93
7	Tin (pure and deposit)	29	1,112	81
8	Tin –Wolfram	2		
9	Aluminium (bauxite)	9	583,4	35000
10	Pure gold and deposit	52	1,399	5,85
III	***Non metal minerals***			
11	Pyrite	3		
12	Muddy coal	7	3,01	735
13	Fire clay	2		110,3 million m^3
14	Argilla	25	61,14	63679,4
15	Diatomite	5	8,9	10.000
16	Bentoníte	5	846 million m^3	97 million m^3
17	Chalky clay	3		2 million m^3
18	Cement clay	1		150 million m^3
19	Building unit clay	31	1,4 million m^3	160,4 million m^3
20	Building sand	17		6 million m^3
21	Puzlan	4		3 million m^3
22	Building stone	3	10 million m^3	719 million m^3
23	Devitrified stone	3	3,3 million m^3	81,5 million m^3
24	Backfill material	3		61,2 million m^3
25	Hot mineral water	8		
26	Sapphire	1		
27	Opal	5		
	Total	283		

Source: Planning for investigation, exploitation and mineral proccesing of Lam Dong province to 2020

2.1.4.5. Biological Resources

2.1.4.5.1. Biological resources in the project area

a. Diverse ecosystems

The project line goes across the geographical, climatic region, land using present condition is quite diverse and clearly different, leading to the diversity of ecosystems in the project area. It represents on the diversity of terrestrial ecosystems and the wetland ecosystem.

a1. The terrestrial ecosystem

Terrestrial ecosystems, including forest ecosystems, agricultural ecosystems and urban ecosystems. Agricultural ecosystems and urban ecosystems are availably scattered along the project route, alternated by forest ecosystems, which occupied the largest area. Forest ecosystems account for a significant proportion in the last 10 km of road sections on the territory of Dong Nai province (Km60 - Km70) and the first 50 km of road sections of Lam Dong province (Km71 - Km120).

Because of distribution at different height, many different forest vegetations have been formed, especially the special-use forests show the typical forest ecosystems such as broad-leaved mixed forest species , broad-leaved and coniferous mixed forest and, broadleaf forest, mixed evergreen forests of bamboo, etc. ..

a2. The wetland ecosystem

- ***The fast- flow ecosystems:*** This type is mainly zone- hydro like rivers, streams, occupying by 2% of the natural area in the region, including major rivers such as Dong Nai, Sere Pok, La Nga, Da Nhim, etc. ..

- ***The slow- flow and wetlands ecosystems:*** Consisting of lowlands and flood prone areas, upstream of lakes, rivers, accounting for more than 2% of natural area of the project area.

- ***Very slow- flow or no- flow ecosystems:*** This type includes water reservoirs for hydro power purposes, irrigation or tourism, which are typical of the Tri An, Damri, Da Nhim, Dai Ninh , Da Teh, Di Linh, etc. ..

- ***The other wetland ecosystems:*** These wetlands occur during the rainy season or around the year. It is typical of the wetlands of Tan Phu district in Dong Nai and Cat Tien district of Lam Dong such as bau Dia, Bau Sau, Bau Chim and Bau Sen in Cat Loc region of Cat Tien National Park. This is the flooding grassland, one of some types where one-horned rhino (Rhinoceros sondaicus) was also found in Vietnam.

a3. The important ecosystem areas in the project area

- Wetlands Tri An and Bau Sau Lake, with an area of 13,759 ha, located about 5km far from the line

- Cat Tien National Park, with an area of 70,548 ha, located about 4 km far from the line.

b. Diverse flora and fauna system

b1. Diverse flora

b1-1. Diversity of vegetation

The following vegetation was found in the area of the project:

1. Evergreen dense forest with the broadleaf trees in a tropical monsoon in low topography (elevation <600 m);
2. Secondary forests of evergreen broadleaf trees;
3. Secondary forest mixed with bamboo;
4. Secondary forests of bamboo;
5. Secondary scrub of falling leaf.
6. Grassland;
7. Evergreen dense forest of broadleaf trees in the tropical monsoon in low mountain belt (600 - 1200m);
8. Evergreen forest mixed with bamboo;
9. Evergreen secondary forests of broadleaf trees in the tropical monsoon in the low mountains belt at upper layer (1200 - 1600m);
10. Secondary scrub on the low mountain belt at upper layer (600 - 1200m);
11. Secondary scrub on the lower mountain belt at upper layer (1200 - 1600m);
12. Secondary grassland on the lower mountain belt (600 - 1200m);
13. Pine forest growing on different rocks in the low terrain belt (<600m);
14. Pine forest growing on different rocks in the lower layer belt of terrain (600-1200m);
15. Pine forest growing on different rocks, good drainage on the upper layer belt of terrain (1200 - 1600m);
16. Paddy;
17. Annual crops and cultivation;
18. Pine plantation, glue;
19. Plant communities in the village and town development area
20. Lakes, swamps, rivers and streams.

b1-2. Diversity of species

1.5.11.3.1According to survey data, which has identified 3490 species of forest flora and 393 species of mushroom in the project area, most of which, 131 species were listed in Vietnam Red Book 2007, 45 species listed in IUCN Red List 2006 and 43 species listed in Decree 32/2006/ND-CP such as red pine (*Taxus wallichiana*), The two flat-leaf pine (*Pinus krempfii*), The Da Lat pine (*Pinus dalatensis*), Fokienia (*Fokienia hodginsii*), Green Cypress (*Calocedrus* *macrolepis*), Ba Ria Barian kingwood (*Dalbergia bariaensis*), Rosewood (*Dalbergia cochinchinensis*), dalbergia odorifera (*Pterocarpus macrocarpus*), Lan lamé (*Anoectochilus setaceus*), Dalat (*Paphiopedilum dalatensis*), etc. ..

1.5.11.3.2b2. Diverse fauna

1.5.11.3.3Animals in the project area are diverse in species, mainly in Tan Phu district (southern Cat Tien National Park) - Dong Nai and Lam Dong province. According to research, survey data, which has acknowledged the presence of 86 species of mammals, 686 species of insects, 301 species of birds, 102 species of reptiles - amphibians, most of which are mentioned in the IUCN Red List 2006 , 2007 and Decree 32/2006/ND-CP SDVN such as one-horned rhinoceros (*Rhinoceros sondaicus*), *Pygathrix nigripes, Nomascus gabriellae, Ursus malayanus, Ursus thibetanus, Bos gaurus, Neofelis nebulosa, Peacock Pheasant Polyplectron germaini,Lophura nycthemera, Arborophila davidi, Rheinartia ocellata, Buceros bicornis), Ophiophagus hannah, etc. ..*

1.5.11.3.4For aquatic animals, although the number of freshwater fish and other aquatic species has not been studied and fully statistic for the entire project area, but only Ca Tien National Park, they have identified 111 species of 20 families in 8-foot (including 5 threatened species listed in Red Book at national level), 257 species of plankton, 125 species of plankton fauna and 63 species of plankton benthos.

1.5.11.3.52.1.4.5.2. Biological resources along the project rout.

Biological resources along the project are reviewed within scope of 500 m width of corridor route from middle-rout. Characteristics of biological resources have quite different features in each sections.

The section Km0 - Km76 +700 and from Km108 - Km268:

a. Flora

1.5.11.3.6

1.5.11.3.7- Most of the natural forest vegetation does not exist; they are replaced by plants created by humans. Natural plant in this region is secondary scrub growing on degraded land and grassland growing on erosion soils or wet soils along streams, valley.

1.5.11.3.8- Perennial plant communities including Rubber (*Hevea brassiliensis*), Coffee Rubusta (*Coffia canephora robusta*), Coffee Arabica (*C. arabica L.),* Dormoy Tea (*Camellia dormoyana (Pierre.) Sealy*), gold Tea (Camellia flava (Pit.) Sealey), Pepper (*Piper nigrum*), Article (*Anacardium occidentale*), Casuarina (*Casuarina equisetifolia*), Eucalyptus (*Eucalyptus spp),* Acacia auriculiformis (*Acacia auriculaeformis*), Acacia mangium (*A . Oraria*), the fruit trees such as Jackfruit (*Artocarpus heterophyllus*), Mango (*Mangifera indica*), durian (*Durio zibethinus*), breast milk (*Chrysophyllum cainito*), Papaya (*Caria papaya*), Lemon, Orange (*Citrus spp*), Grapefruit (*Citrus grandis Osbeck*), rambutan (*Nephelium lappaceum*), banana

(*Musa spp*), Guava (*Psidium guyava L.*), etc... In which, the most common plant in this section are rubber, cashew, pepper, coffee and tea.

1.5.11.3.9- The annual plant communities including water rice (*Oryza sativa*), cassava (*Manihot esculenta*), maize (*Zea mays*), sugarcane, bananas and legumes which are planted in one area

b. Fauna

1.5.11.3.10- **Insects:** In the forest regions, insects have a small number of species, mainly a few species of butterflies belonging to the spot butterfly (*Danaidae*), some species of grasshoppers (*Acrididae*) and some species of leaf eating wing (*Chrysomelidae*) on shrubs, trees and grass; ornamental wetland plants often meet wetland species of aquatic life or semi-static hydrophobic as some members of the two wings (*Diptera*), the dragonfly (*Odonata*), their braces braces (*Dystiscidae*), their hard wing glass (*Hydrophilidae*), the wing straight (*Orthoptera*), the wing scales (*Lepidoptera*), some species eat their hard wing leaves (*Chrysomilidae*), ladybirds (*Coccinellidae*), (*Carabidae*). In the agricultural lands and residential areas, the dominant agricultural pests are coffee pests, pepper, rice pests, corn, vegetables, etc. ... and the closely related species such as flies, mosquitoes, etc ... There are also natural enemies of pests (such as ladybugs, parasitic wasp, flies etc ...), some species of butterflies phoenix (*Papilionnidae*), Butterfly wealth (*Pieridae*) etc. ... No rare species are recorded in Vietnam Red Book.

- Birds: In the forest, we just look at some species such as *Dicrudrus paradiseus*, *Dicaeum chrysorrheum*, *Pycnonotus joconus Pattani*, *Enicurus schistaceus*. In river areas we look at insect killing birds or small shrimps such as White Stork (*Egretta Gazzetta*), (*Amanrornis Phoenicurus, Charadrius dubius*, *Halcyon smyrnensis*. In agricultural areas, we look at White Stork (*Egretta Gazzetta*), Ardeola sp., (*Streptopelia chinensis tigrina*). No rare species recorded in Vietnam Red Book.

- Animal: In the forest ecosystems, agricultural ecosystems, the animal is rare. Apart from some small mammals such as seedlings (Viverra zibetha), Civet (Viverricula indica), we commonly look at Mice family such as (Suncus murinus), house mice (Mus musculus), house mouse (Rattus flavipectus), mouse mice (Rattus exulans). There are no rare species recorded in Vietnam Red Book.

- Reptiles and amphibians: In the study area including the floor gecko (Hemidactylus frenatus), (Calotes mystaceus), flowers skinks (M. multifasciata), water snakes (Xrnochrophis piscator), spots dry Snake (Boiga multimacula), the toad (B. melanosticus), lumpy water toad (Ooeidozyga lima), (Rana guentheri), (Rana Limnocharis), the frog (R. rugolosa), Counterfeit cassava (Philautus asperum), bullfrog (

Kaloula pulchra), (Microhyla annamensis), (M. ornata). No rare species are recorded in Vietnam Red Book.

c. Aquatic

c1. Phytoplankton

Flow in the study area was dominated by La Nga River. Through surveys in the basin within survey scope at 2 sides of project rout and the samples taken in rivers and streams flowing through the line, 138 species of Algae have been found, including species listed in £ 2.10.

Table 2.10. Numbers of algas in hydrologic zones along section Km0 – Km76 and Tri An lake

No.	**species**	**Along section**		**Tri An lake**	
		Quantity	**Ratio (%)**	**Quantity**	**Ration (%)**
1	Green alga	46	33,33	50	22,22
2	Diatom	61	44,20	122	54,22
3	Blue-green algae	23	16,66	40	17,78
4	Euglenophyta	6	4,35	8	3,56
5	Chrysophyta	1	0,72	1	0,44
6	Yellow alga	1	0,72	2	0,89
7	Pyrrhophyta	-	-	2	0,89
Total		**138**	**100**	**225**	**100**

Most of this type of Algae lives on the land, trees, concrete, metal submerged in water. The Algae is easily adapted to ecological conditions formed by water flowing upstream river.

Algae in La Nga River Basin is composed of algae which is not as diverse as the area inundated by the reservoir, such as Tri An. When compared to the Tri An reservoir, the study area has fewer than 87 species of Algae and Algae Armor is absent. The density of Algae in the study area ranges from 6,200 to 10,800 individuals per liter, much lower than in wetlands survey of the Tri An reservoirs (66 667 individuals / liter). Like in Tri An reservoir, Tao silicon in the study area are dominated in number, about 62% of the algae; green Algae is very diverse, about 22% of the total number of algae, while blue algae has low density, only around 860 individuals / liter (12%).

c2. Zooplankton

The composition of zooplankton identified 38 species and specie groups of Zooplankton belonging to protozoan, Copepoda, Cladocera, Rotatoria and insect larvae in the study area. Compared to the Tri An reservoir floodplain, the composition of zooplankton in the study area are inferior in some species, especially for protozoa (Table 2.11).

Table 2.11. Species of Phytoplankton in main hydrozone alongsection Km0-Km76 and Tri An lake.

No.	Phytoplankton's Group	Along section		Trị An lake	
		Quantity	Ratio(%)	Quantity	Ratio(%)
1	*Protozoa*	15	39,5	36	60,0
2	*Rotatoria*	12	31,6	7	11,7
3	*Cladocera*	8	21,1	9	15,0
4	*Copepoda*	3	7,9	7	11,7
5	*Insecta Larvae*	-	-	1	1,7
Total		**38**	**100**	**60**	**100**

Average density of Phytoplankton in the study area is 486 animals/m3. The highest density of Phytoplankton belong to *Copepoda* (55%), then *Cladocera* (21%), other occupy by 24%.

c3. Benthic

In the study area, apart from aquatic insects, zooplankton, in the group includes 12 species, has identified 24 species of *Mollusca Gastropoda* and *Mollusca Bivalvia*), groups of shrimp, crab (*Crustacea*). Group of insects belonging to the ephemeral - *Ephemeroptera*; Dragonflies - *Odonata*; *Hemiptera*; *Lepidotera*; hard wing - *Coleoptera*; feather wing - *Trichoptera*; two wings - *Diptera*. Compared to Tri An lake, study area has less animals than the bottom.

Table 2.12. Species of Benthic in main hydrozone alongsection Km0-Km76 and Tri An

No.	Benthic	Along section		Trị An lake	
		Quantity	Ratio (%)	Quantity	Ratio (%)
1	*Mollusca – Bivalvia*	11	30,6	11	25,0
2	*Mollusca – Gastropoda*	7	19,4	10	22,7
3	*Crustacean*	6	16,7	7	15,9
4	*Oligochaeta*	0	-	2	4,5
5	*Insecta Larvae*	12	33,3	14	31,8
Total		**36**	**100**	**44**	**100**

c4. Fish fauna

Through documents and surveys, in the La Nga River Basin, there are 59 species of fish and 18 families of five sectors in which carp family is the most abundant with 29 species, accounting for 49.15% of total species of fish, Fasteners includes six species of fish with 10.17% and *Anabas testudineus*, *Clarias spp*, each family has 3 species with 5,8%.

All the fish are freshwater fish, and can be divided into 2 groups. Static hydrophilic group includes species such as mullet (*Ophoocephlus triatus*), tilapia (*Anabas testudineus*), catfish (*Clarias spp*.) The rest is flowing hydrophilic groups of fish rice (*Clupeichthys gpniognathus*) and *Notopterus notopterus*). The composition of fish species found in the study area is less than about 95 species of fish found in Tri An lake. No rare fish species recorded in Vietnam Red Book in the study area.

- **Section from Km76 +700 - KM98:**

The line began to enter this region of Lam Dong province, passing Chuoi and Bao Loc mountain Pass, about 20 km on the roadside slopes which are forests.

a. Flora

- Natural forest vegetation including broad-leaved evergreen forest in tropical season, secondary forest of evergreen broadleaf trees, secondary forest mixed with bamboo, secondary scrub, grasslands. Besides there are other vegetation glowed by human such as annual plants and perennial industrial plants.

- Primary forest: Most areas of this forest has been destroyed. Along this line has about 20 km on the slopes, roadside strip of land is cleared by resident and followed by the forest -road is about 500 - 1000m. Dense forest of evergreen monsoon is characterized by the of primary forest growing on low terrain areas and on lower mountain belt. Many plant species grow in this forest type because it exists appropriate link between temperature, humidity and soil conditions, at the same time in this dry season, it is not too severe, land is not erosed because it is formed from many rocks such as basalt, granite, granite and sandy siltstone Diorit. These soils can hold water better. The trees belong to the Oil (dipoterocarpaceae), (Meliaceae), (anna cardiaceae) andLauraceae families) grew popularly in primary forest on the lower mountain belt. In the undestroyed forest area, the density of trees with a diameter from 12 cm to 120 cm is 300 trees/1ha. In the forest area exploiting plant density of 400 to 500 trees / ha, but the diameter of the trees of this forest type ranges between 12 and 20cm. Calculated according to height, the tree can be classified into 5 types here, including 3 types of trees for timber. The first plant has a height of about 30m, while the second tree is from 15 to 20m high. The third plant covers young timber, is as high as 15 to 20 meters, as the 2nd crop. The fourth is the shrub, usually less than 1 m high. Finally, The fifth was kind of grass, about 0.7 to 1.5 m high. The majority of timber trees in the floor is evergreen kind. Bamboo also grows in this forest, the height varied from 3 to 5 m.

- Secondary forests include broad-leaved trees, growing on soil derived from granite stone, powder sand or Granite Diorit. This forest has been exploited with very few trees left. In secondary forest, the tree for timber, with a height of 15 to 20m ,diameter from 15 to 50cm, Besides the bush is less than 8m high, and a variety of grassland. Secondary forests are found in the boundary region between the two districts Da Huoai and Da Te.Most secondaryforests are recovered including small trees, the most dominant is Long ......

- Mixed secondary forests including broadleaf trees and bamboos, growing on granite rocks, sand and stone powder different except Bazan. This type of forest grow in the lowlands, valleys scattered over the mountain pass in Chuoi and Bao Loc Pass. The trees grow in this belonging to drought resistant trees and poor soil winstanding trees. In the forest, some trees for timber are from 15 to 20 meters high, including Dilleneia pentagyna, Dipterocarpus Obtusifollius, Neonauclear sessiliforlia, Dipterocarpus tuberculatus and Lagestroemia tomentosa and mixed bamboo are from 3 to 5 meters high, including species of Le Oxynanthera and Schizostachium spp.

- Perennial plant communities including coffee (*Coffea spp*), tea (*Camellia sinensis*), Pepper (*Piper nigrum*), Article (*Anacardium occidentale*), Mulberry (*Morus alba L.)*, Acacia auriculiformis (*Acacia auriculaeformis*), Acacia mangium (*A. Oraria*), the fruit trees such as Jackfruit (*Artocarpus heterophyllus*), durian (*Durio zibethinus*), Papaya (*Caria papaya*), Lemon, Orange (*Citrus spp*), Grapefruit (*Citrus grandis Osbeck*), Guava (*Psidium guyava L.*), etc. .. In that group, the most common crops in this phase include coffee, tea, pepper.

b. Fauna

- Insects: Although insects in the study area are less than the Cat Tien National Park, it is much more diverse than the forest area. According to data from research and surveys, in natural forests including the following insects: Mantis (*Mantidae*) has *Hierodula patellifera, Mantis religiosa Lin, Statilia nemoralis*.Corn dragonfly (*Libellulidae*) has *Crocothemis servilla Drury, Drury Orrthetrum sabinum*. Grasshoppers family (*Acrididae*) has *Dirch Acrida Willemse*, Atrractomorpha lata (*Motschulsky*), Carrianda diminuta (*Walker*). *Gryllidae* includes (*Brachytrupes partentosus*). (*Cicadidae*) includes (*Platylomia sp*). (*Coreidae*) - *Grypocephalus pallipectus Hsiao, Homoeocerus striicornis Scott, Marcius rubiner mis Blute*; (*Plataspidae*) - *Mont Coptosoma denticeps*; (*Arididae*) - *Brachyrlynchus feanus Berg* ; (*Chrysomelidae*) - *Abirus fortaneu Baly, Altica cynea Nebes, Hoplasoma unicolor, Hoplasomoides flara*; (*Coccinellidae*) - H*armonia sedecimnota, Menochilus sexmaculata; (Elateridae) - Campsosternum auratus, Shirozulus bifoveolatus ; (Scarabaeidae) - anomala viridula, Apogonia Amida*. (*hymenoptera*) include: their honeybees (*Apidae*) - *Apis dorsata, Apis cerana; (Anthophoridae) - Xylocopa aestuans; (Mutillidae) - Olive Mutilla interrupta; (Sphecidae) - Sceliphron javanum Lepel*. (*Diptera*) include: (*Calliphoridae*) - *Chrysomyia rufigacias Aubertin; Mosquitoes (Culicidae) - Anopheles aconitus Dönitz, Anopheles dirus Peyton (Muscidae) – Atherigona atripalris Mall, Atherigona falcata Thoms*; they fly gray (*scarcophagidae*) have *Boettcherisca peregrina*; they fly buffalo (*tabanidae*) and *Mahadeva* frequently *Chilasa Parides* varuna; they swallow him (*uraniidae*) have *Nyctalaemom patrolus Hampson*; they Plead night (*Noctuidae*) has *Anomis flava (Fabr.)* and *Agrotis spilon (Rortt.).*

- Animal: The line is about 20 km away through the forest but is surrounded by residential areas or farmland. Animal was hunted in this area frequently, so there are only about 20% compared to the animals in Lam Dong. In the study area, we see a number of individual species, but few such as long-tailed macaques (*M. fascicularis*), Otter (*Lutra Lutra*), seedlings (*Viverra zibetha*), Civet (*Viverricula indica*), pigs Forest (*Sus scrofa*), diagonal cross Capricorn (*Tragulus javanicus*), (*Muntiacus muntjak*), black Soc (*Black Giant Squirrel*), (*Dremomys rufigenis*), (*B. savilei*), (*Chiropodomys gliroides*), (*R. Koratensis*), (*Rattus sabanus*), (*Hystrix brachyura*), (*Lepus peguensis*).

- Birds: (*Megalaima lagrandieri*), (*M. faiostricta*); (*Alcedo hercules*), the Brown Kingfisher (*Halcyon smyrnensis*), (*Ceryle lugubris*) (*Centropus sinensis intermedius*), (tou*lou C. bengalensis)*; (*Streptopelia chinensis tigrina*); (*Egretta Gazzetta*), Having (*Ardeola sp.)* (*Enicurus schistaceus*), (*Saxicola furrea harringtoni*) (*Sturnus nigricollis*), Yeng, (*Gracula regiliosa),* (*Pycnonotus joconus Pattani*), (*P. aurigaster germaini*), *(P. flavescens sordidus),* (*Prinia atrogularis superciliaris*), (*Orthotonus attrogularis*), cotton *(O. coronatus*); (*Dicaeum chrysorrheum*), (*D. ignipectus*); (*Aethopyga gouldiae annamensis*) (*Arachonothera nongiristris*); (*Dicrudrus paradiseus*), (*D. aeneus eanea*).

- Reptiles and amphibians: In the study area including (*Cyrtodactylus irregularis*), (*gecko Geckks*), (*Hemidactylus frenatus Schlegel*). (*Agamidae*) with checkered scales O (*Acanthosaura lepidogaster*), (*Calotes microlepis*), (*C.mystaceus*), (*C.versicolor*). (*Mabuya longicaudata*), (*M. macularis*), (*M. multifasciata (Sphenomorphus stellatus*). (*Varanidae*) (*Varanus salvator)* (*Typlopidae*) (*Typhlos diardi*). (*Boidae*) (*Python molurus*). (*Colubridae*) (*Dendrelaphis subocularis*), (*Dryocalamus davisoni*), (*Elaphe radiata*), (*Xrnochrophis piscator*), (*Boiga multimacula*), (*Chrysopelea ornata*). (*Elapidae*) (*Bungaris caudidus*), snake kraits (*B. fasciatus*), (*Calliophis macclellandi*), (*Naja Naja*). (*Crotalidae*) (*Trimeresurus albolabris*), (*T. monticola*), (*T. popeorum*). (*Bufonidae*) (*Bufo galeatus)* (*B.melanosticus*). (*Ranidae*) (*Ooeidozyga lima*), (*Phrynogiossus laevis*), (*Rana andersoni*), (*R. guentheri*), (*R. Limnocharis) (R. livida*), Mile He (R. *milleti*), (*R. montivaga*), the frog (*R. rugolosa*), Hiu hiu (*R. sauteri*), (*Rhacophoridae*) has Counterfeit cassava (*Philautus asperum*), (*P. Gryllus*), (P. laevis (*P. palpebralis*). (*Microphylidae*) (*Kaloula pulchra*), (*Microhyla annamensis*), (*M. ornata*), (*M. picta*).

- The rare species: Most rare or endangered animals live in Cat Tien National Park. A few species have been seen near the study area, but when interviewing the commune authorities and residents in this region, some large mammals and endangered species such as Asian Elephant Elephas maximus, Tiger Panthera tigris no longer appears near the project area for 20 years. And, we rarely look at the rare animals such as some animals (*Trangulus javanicus, Lutra Lutra),* Birds (kingfisher *Alcedo hecules* , kingfisher *Ceryle lugubris guttulata* large cavity type), some reptiles (*Gecko Gecko*, But O ro *Acanthosaura Lepidogaster* scales, *Varanus salvator* marble States, *Ptyas korros* drain snake).

c. Aquatic

c1. Phytoplankton

Flow in the study area was dominated by the Dong Nai river and a small part of La Nga River Basin. Through surveys in the basin in the scope of survey in 2 sides of project and the samples taken in rivers and streams flowing through the line, 184 species of algae have been found, including species listed in Table 2.13.

Table.13. Numbers of algae at hydrologic zone along section Km76 – Km98 and Tri An Lake

No.	Species	Along section		Tri An Lake	
		Quantity	Ratio (%)	Quantity	Ratio (%)
1	Green alga	43	23,37	50	22,22
2	Diatom	114	61,96	122	54,22
3	Blue-green algae	20	10,87	40	17,78

4	Euglenophyta	5	2,72	8	3,56
5	Chrysophyta	1	0,54	1	0,44
6	Yellow alga	1	0,54	2	0,89
7	Pyrrhophyta	-	-	2	0,89
Total		**Total**	**100**	**225**	**100**

Most of this species of algae lives on the land, trees, concrete, metal submerged in water. The algae are easily adapted to ecological conditions formed by water flowing upstream river.

When compared to the Tri An reservoir, the study area with fewer than 41 species of algae and algae Armor is absent. However, structural components of the dominant algae in two areas are very close together. The density of algae in the study area ranges from 6,700 to 11,200 individuals per liter, much lowerthan figures of algae in wetlands survey of the Tri An lake(66 667 individuals / liter). As in Tri An, Tao silicon in the study area are dominated in number, about 65% of the algae; green algae is very rich, about 21% of the total number of algae, while Algae has low density, only about 850 individuals / liter (11%).

c2. Zooplankton

The composition of zooplankton identified 40 species and species groups of Protozoa; Copepoda, Cladocera Rotatoria and insect larvae in the study area. Compared to the Tri An reservoir floodplain, the composition of zooplankton in the study area are inferior in some species, especially for protozoa (Table 2.14).

Table 2.14. VND species in the waters along the route Km76 - KM98 and Tri An

No.	Zooplankton	**Along section**		**Trị An lake**	
		Quantity	**Ratio (%)**	**Quantity**	**Ratio (%)**
1	*Protozoa*	24	60,0	36	60,0
2	*Rotatoria*	5	12,5	7	11,7
3	*Cladocera*	8	20,0	9	15,0
4	*Copepoda*	3	7,5	7	11,7
5	*Insecta Larvae*	-	-	1	1,7
Total		**40**	**100**	**60**	**100**

Average density of Zooplankton in the study area is 472 individuals/m^3. The highest density of Zooplankton belongs to *Copepoda* (52%), then *Cladocera* (23%), other group of 25%.

c3. Bottom animal

In the study area, in addition to aquatic insects, Zooplankton has identified 13 different species of the group of (*Mollusca Bivalvia*), groups of shrimp, crab (*Crustacea*). Group of insects belonging to the ephemeral - *Ephemeroptera*; Dragonflies - *Odonata*; wing half - *Hemiptera*; wing scales - *Lepidotera*; wing hard - *Coleoptera*; wing feathers -

Trichoptera; two wings - *Diptera*. Compared to the Tri An floodplain, study area has less bottom animals clearly.

Table 2.15. Components of Bottom animal at main hydrologic zones a long the section Km76 – Km98 and Tri An lake

Ordinal number	Groups of bottom animals	A long the section		Tri An Lake	
		Quality	Ration (%)	Quality	Ration (%)
1	*Mollusca – Bivalvia*	11	52,38	11	25,0
2	shellfish - *Mollusca – Gastropoda*	0	0	10	22,7
3	*Crustacean*	2	9,52	7	15,9
4	Less silk worm - *Oligochaeta*	0	0	2	4,5
5	*Insecta Larvae*	8	38,10	14	31,8
Total		**21**	**100**	**44**	**100**

c4. The region of fish system

Documents and survey show that fishes with two faces at hydrologic zone of the studied region are quite similar to those of other section mentioned above. In the surveying region of this section, there are 56 kinds of fish of 5 branches and 18 tontines, of which the carp tontine is the most abundant with 29 species, taking up 51.8 % of total species. The anabas and loach tontine each has 3 species, taking up 5.3%.

All the fish are freshwater fish, and can be divided into 2 groups. Static hydrophilic group includes species such as mullet (*Ophoocephlus triatus*), tilapia (*Anabas testudineus*), catfish (*Clarias spp*.) The rest is flowing hydrophilic group include anchovy (*Clupeichthys gpniognathus*) and the fish is sliced (*Notopterus notopterus*). The composition of fish species found in the study area is less than about 98 species of fish found in Tri An reservoir.

In the studied region, there are 33 kinds of fish which are commercial, of which kinds of fish are highly appreciated on the market and can be caught with huge quantity, including oily fish, seahorse (in Tri An lake, fishes with economic valuable can reach up to 40 species). In general, economic fish are live bait fish or carnivorous fish. A small number of fish uses of plankton and organic residues available. No rare fish species recorded in Vietnam Red Book in the study area.

2.1.5. REAL STATUS OF NATURAL ENVIRONMENTAL COMPONENTS

To evaluate current situation on quality of regional environmental of project, Centrer for studying environment – Institue of nuclear has carried on investigating, measuaring, and sampling to analyze at zones along the line of the project during the period from 04/11/2010 to 29/11/2010. Position for sampling air, ground water, underground water, soil sample and surveying noise are presented on Figure 2.2.

2.1.5.1. Real status for quality of air enviroment

To evaluate current situation on quality of regional environmental of project, 25 positions have been chosen for surveying and sampling to analyze – they are positions where there are residential area and sensitive establishments a long two sides of the 20 highway. (Table 2.16)

Table 2.16. Surveying and sampling positions for analysing air quality

Symbol	Postion	Location	Coordinates
A1	Dau Giay intersection (national High way 1A intersection)	Km00	X = 733898; Y = 1210467
A2	Gia Kiem residential area	Km9	X = 737746; Y = 1218366
A3	Phu Cuong, Dinh Quan residential area (Phu Cuong market)	Km19	X = 738442; Y = 1226648
A4	Center of Phu Cuong commune	Km21+500	X = 740931; Y = 1226750
A5	La Nga residential area	Km 34+600	X = 747097; Y = 1240093
A6	Dinh Quan town	Km48+150	X = 758436; Y = 1240456
A7	Tan Phu town	Km58	X = 765741; Y = 1246955
A8	Phuong Lam residential area (near Phuong Lam market and Phuong Lam)	Km65+500	X = 772248; Y = 1249196
A9	Madagui residential area (Da Huoai, Lam Dong)	Km76	X = 775943; Y = 1258487
A10	Damri town, Lam Dong	Km94	X = 790342; Y = 1262796
A11	Loc Chau residential area (near Hai Ba Trung Primary school, Loc Chau market)	Km117	X = 804277; Y = 1276849
A12	Loc Son residential area (near Loc Son Primary school, Hoa Lu kindergarten)	Km123	X = 807861; Y = 1276626
A13	Loc An residential area (near Loc An B primary school, Loc An high school)	Km131+600	X = 816979; Y = 1278256
A14	Hoa Ninh residential area (Near Le Hong Phong high school, Hoa Ninh market)	Km137+400	X = 820972; Y = 1277254
A15	Di Linh residential area (near Vo Thi Sau primary school)	Km 154	X = 835274; Y = 1281450
A16	Tan Nghia Town (near Tan Nghia II primary school, Phuoc Lac pagoda)	Km160+400	X = 838550; Y = 1285124
A17	Phu Hiep residential area (near Phu Hiep primary school, Gia Hiep secondary)	Km170+500	X = 846967; Y = 1287333
A18	Hiep Thuan residential area (near Hiep Thuan secondary school)	Km184	X = 858989; Y = 1287529
A19	City block 10, Liên Nghĩa town	Km199	X = 866619; Y = 1297686
A20	Hiep Thanh residential area (Hiep An business, Hiep An food proccessing factory)	Km211	X = 873930; Y = 1306180

Symbol	Postion	Location	Coordinates
A21	Dinh An residential area (Dinh An secondary school)	Km218	X = 876810; Y = 1312324
A22	residential area of distict 9, Da Lat (Tran Phu high school)	Km235	X = 877449; Y = 1322971
A23	Da Loc residential area, Xuan Tho (Xuan Tho high school)	Km245	X = 884835; Y = 1321518
A24	Cau Dat residential area, Xuan Truong (Xuan Truong secondary school)	Km254	X = 887021; Y = 1315705
A25	Don Duong residential area (across national High way 27)	Km268	X = 892143; Y = 1311747

Sampling equipment includes: High volume air sampler – Aspiro 1200 and Air sampler – DESAGA 212 (German). Sampling is carried out at the height of 1.5 m and 5 m from the edge of wall. Targets are surveyed 12 times during 24 continuous hours (with cycle of every 2 hours). The results of surveying and analyzing are presented in Appendix 2. Measured Average value of targets during surveying are presented in Table 2.17.

Table 2.17. Daily Average value of surveying targets at 25 positions of the line

Position	surveying targets								
	Temperature (^{0}C)	Pressure (mBar)	Wind speed TB (m/s)	Humidity (%)	TSP (mg/m^3)	CO (mg/m^3)	SO_2 (mg/m^3)	NO_2 (mg/m^3)	HC (mg/m^3)
A1	26,3	988	0,8	58,6	0,063	1,14	0,056	0,078	0,06
A2	28,6	1004	0,7	60,5	0,034	1,08	0,055	0,040	0,02
A3	26,3	988	0,9	76,2	0,035	0,21	0,049	0,069	0,02
A4	30,7	995	0,7	64,7	0,027	0,79	0,051	0,068	0,02
A5	29,3	992	0,8	81,9	0,016	0,07	0,031	0,035	0,02
A6	30,3	990	0,7	85,8	0,020	0,21	0,052	0,064	0,03
A7	28,6	990	1,1	65,0	0,030	0,12	0,037	0,041	0,02
A8	28,8	987	0,9	90,7	0,033	0,08	0,048	0,049	0,02
A9	25,3	986	0,8	75,5	0,028	0,09	0,046	0,046	0,01
A10	24,9	987	0,9	68,8	0,059	0,30	0,049	0,065	0,02
A11	25,4	988	0,7	87,7	0,043	0,06	0,042	0,045	0,01
A12	24,1	978	0,7	85,3	0,015	0,12	0,043	0,044	0,03
A13	24,0	978	1,0	83,6	0,016	0,22	0,054	0,070	0,03
A14	23,8	953	0,8	66,6	0,043	0,06	0,041	0,041	0,02
A15	21,9	930	0,9	63,6	0,013	0,20	0,041	0,041	0,02
A16	22,0	930	0,8	60,0	0,022	0,38	0,051	0,050	0,02
A17	21,3	906	0,9	82,7	0,044	0,13	0,045	0,048	0,02
A18	21,3	906	1,1	60,5	0,032	0,31	0,063	0,061	0,01

Position	surveying targets								
	Temperature (^{0}C)	Pressure (mBar)	Wind speed TB (m/s)	Humidity (%)	TSP (mg/m^3)	CO (mg/m^3)	SO_2 (mg/m^3)	NO_2 (mg/m^3)	HC (mg/m^3)
A19	21,0	901	1,4	80,0	0,036	0,07	0,040	0,042	0,08
A20	20,8	902	2,4	64,1	0,012	0,12	0,044	0,050	0,02
A21	20,9	896	3,0	58,6	0,016	0,10	0,044	0,043	0,02
A22	20,0	842	2,8	58,3	0,075	1,26	0,030	0,025	0,02
A23	19,8	842	2,5	58,3	0,055	1,93	0,057	0,050	0,02
A24	20,0	845	2,7	58,7	0,074	1,61	0,028	0,038	0,02
A25	21,0	902	2,1	63,8	0,106	2,42	0,050	0,033	0,02
QCVN 05:2009	-	-	-	-	0,200	5	0,125	0,100	-

Assessment on results of observation:

- Concentration of total dust TSP, CO, NO_2 and SO_2 in the air at all surveying position is lower than allowed limited value of Viet Nam Standard QCVN 05:2009/BTNMT. Background level of concentration of dust has the amplitude ranging 3% - 25% of limited value; CO concentration changes within the range of 1% - 19% of limited value; SO_2 concentration changes within the range of 25% - 43% of limited value; NO_2 concentration changes within the range of 37% - 68% of limited value.

- In general, Background level of dust and exhaust a long the line of the project is low, loading capacity of waste arising during the process of carrying out the project is quite moderate.

2.1.5.2. Real status of noise and vibration

1.5.11.4 *Current situation on noise and vibration of the project's region before building are surveyed at 25 positions conincidingwith surveying positions for air quality mentioned above; measuring point is 5 m from the road and at the height of 1.5 m over noise, near the face of the road over the vibration; measuring time is within 04/11/2010 to 29/11/2010.*

The detailed results of measuring noise and vibration are presented in Applendix 3. Noise strength at times on surveying day at 25 positions is presented in Figure 2.3. Timely Average value is as in Table 2.18.

Table 2.18. Average noise value, vibrating at 25 measuring positions a long the line

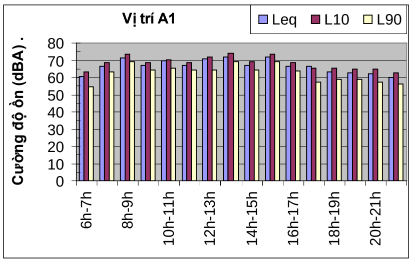
Surveying position	Average time	Noise (dBA)	Vibration	Displacement
			Acceleration (EQ PEAK)	

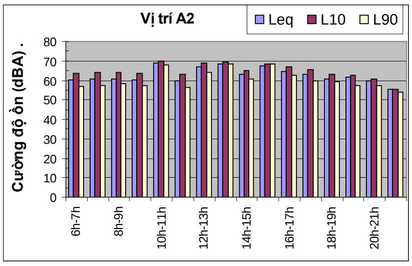
		L_{eq}	L_{10}	L_{90}	3Hz-5kHz (m/s^2)	3Hz-20kHz (m/s^2)	RMS (mm)
A1	6 h - 21 h	64,5	66,1	62,0	0,010	0,012	0,0010
	21 h - 22 h	59,8	60,8	58,0	0,003	0,003	0,0002
A2	6 h - 21 h	67,0	68,8	63,0	0,002	0,003	0,0003
	21 h - 22 h	60,0	62,9	56,3	0,001	0,001	0,0001
A3	6 h - 21 h	63,1	65,3	60,8	0,005	0,008	0,0004
	21 h - 22 h	55,2	55,6	54,1	0,002	0,005	0,0001
A4	6 h - 21 h	64,3	66,0	61,9	0,008	0,011	0,0010
	21 h - 22 h	59,6	60,7	57,9	0,001	0,002	0,0002
A5	6 h - 21 h	61,1	62,2	50,3	0,005	0,007	0,0004
	21 h - 22 h	50,3	49,9	41,1	0,001	0,005	0,0001
A6	6 h - 21 h	65,4	67,1	62,5	0,014	0,017	0,0023
	21 h - 22 h	60,3	61,1	57,6	0,005	0,005	0,0005
A7	6 h - 21 h	65,7	67,5	62,7	0,004	0,004	0,0003
	21 h - 22 h	54,2	54,6	52,4	0,001	0,001	0,0001
A8	6 h - 21 h	66,1	68,0	63,2	0,006	0,007	0,0006
	21 h - 22 h	56,5	57,3	55,1	0,001	0,002	0,0001
A9	6 h - 21 h	65,7	67,6	62,8	0,005	0,008	0,0008
	21 h - 22 h	59,9	62,9	53,5	0,001	0,002	0,0001
A10	6 h - 21 h	66,7	68,7	63,8	0,010	0,014	0,0014
	21 h - 22 h	61,3	64,4	56,2	0,002	0,003	0,0003
A11	6 h - 21 h	65,0	66,7	62,3	0,004	0,005	0,0008
	21 h - 22 h	53,8	54,1	52,7	0,001	0,001	0,0001
A12	6 h - 21 h	65,1	67,1	61,6	0,005	0,006	0,0007
	21 h - 22 h	57,6	58,1	55,0	0,001	0,001	0,0002
A13	6 h - 21 h	65,9	68,3	61,8	0,008	0,011	0,0011
	21 h - 22 h	59,1	61,5	55,8	0,001	0,002	0,0002
A14	6 h - 21 h	63,5	64,0	59,7	0,003	0,003	0,0004
	21 h - 22 h	54,2	55,6	51,7	0,001	0,002	0,0002
A15	6 h - 21 h	64,6	66,4	60,4	0,006	0,007	0,0008
	21 h - 22 h	55,2	55,6	54,1	0,001	0,001	0,0002
A16	6 h - 21 h	65,8	68,2	61,9	0,009	0,012	0,0012
	21 h - 22 h	61,9	64,9	57,4	0,002	0,003	0,0005
A17	6 h - 21 h	64,2	66,3	60,9	0,007	0,009	0,0008
	21 h - 22 h	56,8	57,1	54,7	0,001	0,002	0,0002
A18	6 h - 21 h	65,1	67,1	62,1	0,009	0,011	0,0012
	21 h - 22 h	61,5	64,5	56,7	0,001	0,001	0,0003
A19	6 h - 21 h	64,4	66,7	60,2	0,003	0,003	0,0004
	21 h - 22 h	53,8	54,2	52,9	0,001	0,001	0,0002
A20	6 h - 21 h	64,5	66,7	61,4	0,012	0,014	0,0016
	21 h - 22 h	61,8	64,5	56,8	0,001	0,002	0,0003
A21	6 h - 21 h	65,3	67,3	61,8	0,014	0,017	0,0018
	21 h - 22 h	59,5	62,6	53,3	0,001	0,002	0,0003
A22	6 h - 21 h	65,9	67,9	63,1	0,006	0,007	0,0006
	21 h - 22 h	56,3	57,2	55,0	0,001	0,002	0,0001

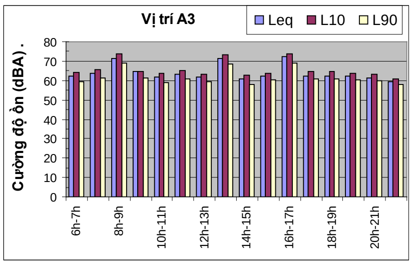
Surveying position	Average time	Noise (dBA)			Vibration Acceleration (EQ PEAK)		Displacement
		L_{eq}	L_{10}	L_{90}	3Hz-5kHz (m/s^2)	3Hz-20kHz (m/s^2)	RMS (mm)
A23	6 h - 21 h	65,8	68,2	61,7	0,008	0,011	0,0011
	21 h - 22 h	59,0	61,4	55,7	0,001	0,002	0,0002
A24	6 h - 21 h	64,1	66,2	60,8	0,007	0,009	0,0008
	21 h - 22 h	56,7	57,0	54,6	0,001	0,002	0,0002
A25	6 h - 21 h	64,3	66,5	61,2	0,012	0,014	0,0016
	21 h - 22 h	61,6	64,3	56,6	0,001	0,002	0,0003
QCVN 26:2010 (Noise)		(*) 6h - 21h: 70; 21h - 6h: 55 (**) 6h - 21h: 55; 21h - 6h: 45					
QCVN 27:2010 (Vibration Accelation)		(*) 6h - 21h: 0,03; 21h - 6h: 0,01 (**) 6h - 21h: 0,01; 21 - 6h: 0,006					-

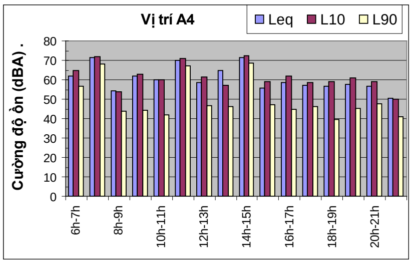
(*) Applied to tenement house, house/ attached house, hotel, agencies.

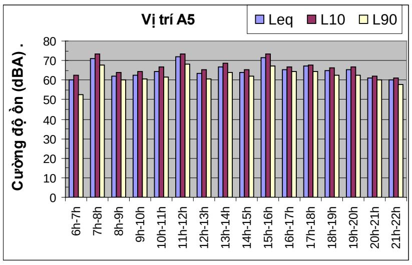
(**)Applied to medical establishments, library, kindergarten, churche, communal house, pagoda.

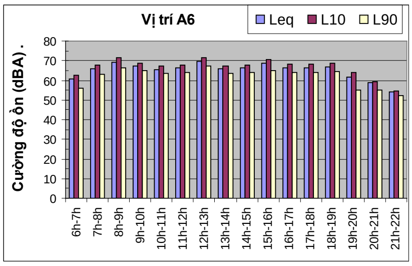


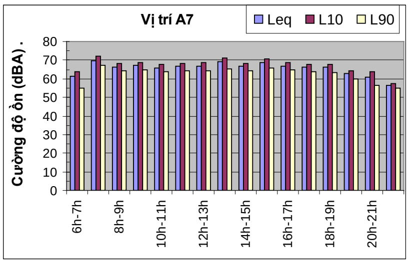


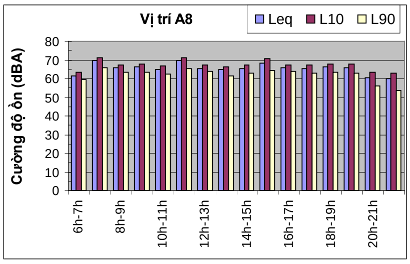


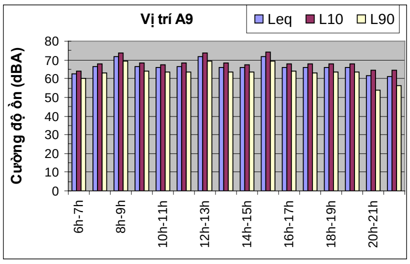


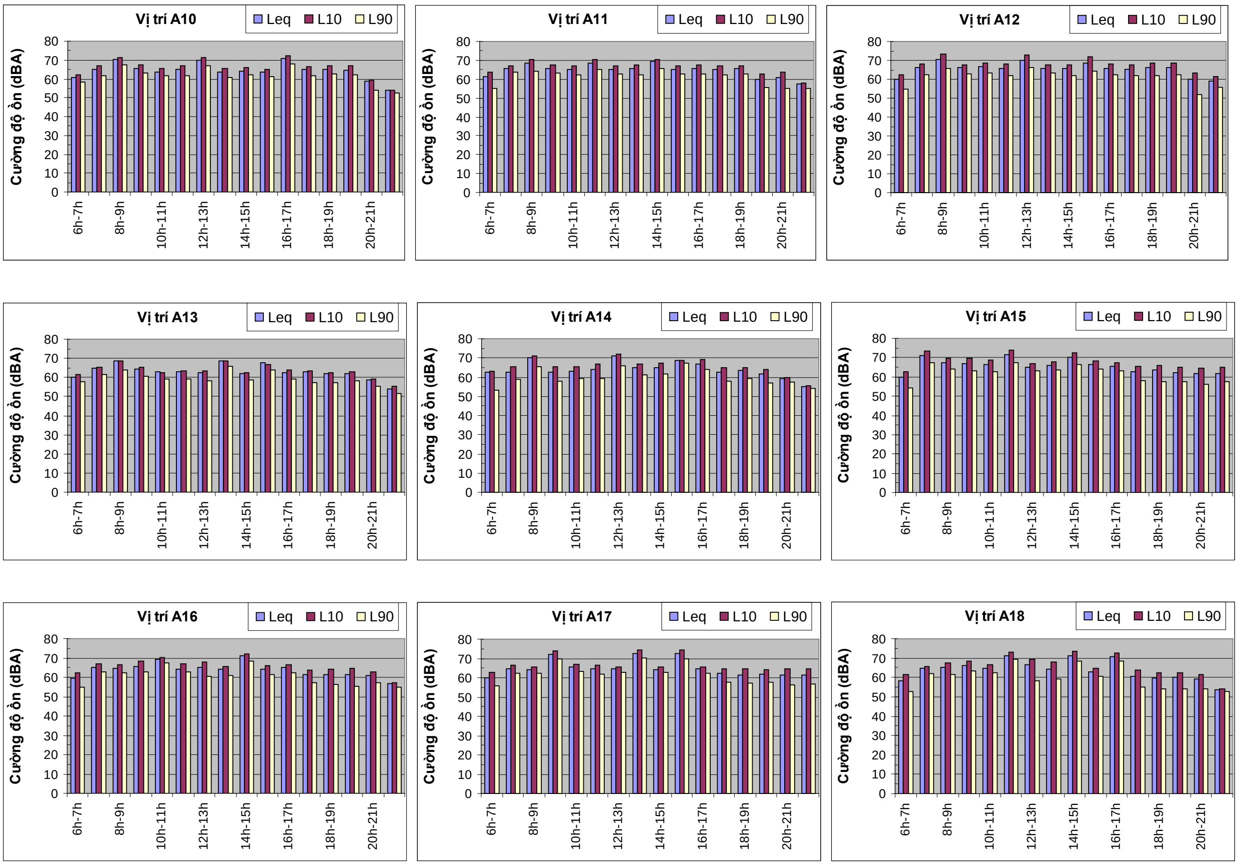












Hình 2.3. Figure 2.3. Intensity at times at surveying position.

Assessment on results of surveying:

- Considered on average value of day, measured noise during surveying time for all positions does not exceed permitted limitation as in the standard of QCVN 26:2010 applied to conventional region (residential area, seperated/attached house, hotel, administrative organs).
- Considered on average value of surveying time, most of positions with less noise over permitted value as in the standard of QCVN 26:2010 applied to conventional regions.
- Measured vibration during surveying time does not exceed permitted limitation as in the Vietnamese Standard QCVN 27:2010 applied to conventional region (residential area, seperated/attached house, hotel, administrative organs).

2.1.5.3. Real status for quality of water environment

A. Quality of ground water

Current condition on quality of ground water in the project's region is evaluated at 15 streams, rivers across the line, where bridges over flow will be built (Table 2.9). For 14 small and medium flows, sample is taken on one section at bridge building position; for La Nga river, sample is taken on 2 sections on the 2 sides of back river and downstream. At each section, 2 samples are gathered in day and night at 2 water layers (near ground and near bottom) to analyze needed quality target.

Table 2.19. Sampling Places for anlyzing quality of ground water.

Symbol	Name of bridge	Location	Coordinates	Sampling frequency
W1	Gia Duc	Km1+540	X = 733895; Y = 1212012	twice a day/ 2 water layers/01 section
W2	La Nga	Km35+712	X = 748226; Y = 1234404	twice a day/ 2 water layers/02 section
W3	Phuong Lam bridge	Km65+056	X = 771893; Y = 1248882	twice a day/ 2 water layers/01 section
W4	Da Huoai river	Km87+350	X = 783853; Y = 1262590	twice a day/ 2 water layers/01 section
W5	Tien stream	Km96+200	X = 792270; Y = 1263841	twice a day/ 2 water layers/01 section
W6	Dai Nga bridge	Km129+500	X = 813964; Y = 1276636	twice a day/ 2 water layers/01 section
W7	Dinh Trang Hoa bridge	Km139+300	X = 822833; Y = 1277218	twice a day/ 2 water layers/01 section
W8	Lien Dam bridge	Km149+303	X = 829910; Y = 1280894	twice a day/ 2 water layers/01 section
W9	Darle bridge	Km177+800	X = 853257; Y = 1286387	twice a day/ 2 water layers/01 section
W10	Hiep Thuan bridge	Km183+376	X = 858034; Y = 1287394	twice a day/ 2 water layers/01 section
W11	Dai Ninh bridge	Km189+200	X = 861288; Y = 1290238	twice a day/ 2 water layers/01 section
W12	Xom Trung bridge	Km194+771	X = 864524; Y = 1294394	twice a day/ 2 water layers/01 section
W13	Dinh An I bridge	Km217+810	X = 876821; Y = 1312146	twice a day/ 2 water layers/01 section
W14	Dat bridge	Km254+254	X = 886925; Y = 1315470	twice a day/ 2 water layers/01 section
W15	Xeo bridge	Km263+100	X = 890603; Y = 1312159	twice a day/ 2 water layers/01 section

Indicators to be assessed include: Temperature, pH, Turbidity, conductivity, DO, COD, BOD_5, suspending sediment - TSS, NH_3, NO_2^-, PO_4^{3-}, NO_3^-, Cu, Cd, Pb, Zn, Hg, As, Fe, grease, Coliform. The result of analysing water quality indicators is given in Index 4. The avarage content of analysing indicators at water sources is given in Table 2.20.

Comment about the observational result:

❖ When compared to the National technical regulations on surface water quality – QCVN 08:2008/BTNMT, the following conclusions can be drawn:

- The content of poisonous heavy metals (As, Cd, Cu, Hg, Pb, Zn) in surface water sources flowing across the line is many times smaller than the allowed limit value for surface water type A2;

- All the sampled water sources have pH value satisfying QCVN 08:2008/BTNMT for type A2;

- Targets of dissolved oxygen (DO) in surface water sources in the project area is quite low at the time of survey, only 5 of 15 satisfy the requirements for the type B1.

- The majority of locations surveyed are indicators COD, $BOD_{5,}$ TSS does not satisfy the requirements of surface water type A2 but only B1 type.

- The concentration of Coliform in surface water in project area is quite high; only 6 in total 15 investigated water sources have the concentration of Coliform lower allowed value of surface water type A2. Some water sources are seriously Coliform contaminated.

Table **2.20**. Avarage content of analysing indicators at water sources flowing across the line

Position	Temperature	pH	Turbidity	Conductivity	DO	COD	BOD_5	TSS	NH_3	NO_2^-	NO_3^-	PO_4^{3-}	Grease	As	Cd	Cu	Fe	Hg	Pb	Zn	Coliform
	^oC		NTU	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	MPN/ 100ml
W1	28.6	6.40	11.8	144.7	2.62	14.63	13.9	42.4	0.63	0.022	6.66	0.038	2.0	1.17	0.14	5.0	144	< 0.05	0.46	8.8	8,975
W2	29.1	6.37	106.5	104.5	2.35	21.48	12.1	37.3	0.20	< 0.01	1.39	< 0.01	1.1	5.23	0.13	14.0	1235	< 0.05	0.70	10.7	11,300
W3	29.8	6.59	45.5	145.4	1.60	28.23	13.2	40.0	0.16	< 0.01	1.36	< 0.01	< 0.3	1.94	0.20	4.1	400	< 0.05	0.19	6.4	10,925
W4	26.2	6.52	59.1	91.4	4.32	19.83	10.3	44.5	0.15	< 0.01	1.99	< 0.01	< 0.3	41.03	0.30	5.7	252	< 0.05	1.38	5.6	3,650
W5	22.5	6.88	11.8	25.9	3.99	12.88	7.6	30.0	0.14	< 0.01	0.96	< 0.01	1.1	1.51	0.17	3.9	179	< 0.05	2.78	9.0	11,175
W6	22.5	6.81	22.6	42.1	5.42	14.80	8.8	28.8	0.22	0.031	3.34	0.026	1.3	0.68	0.16	7.5	685	< 0.05	0.28	18.8	7,077
W7	22.8	6.62	15.4	91.8	3.74	14.80	11.5	35.7	0.38	0.023	4.01	< 0.01	1.5	0.99	0.16	6.4	403	< 0.05	0.38	14.4	3,590
W8	22.6	6.90	23.1	76.5	4.58	15.98	9.8	30.4	0.14	< 0.01	7.40	< 0.01	1.2	1.31	0.17	6.3	607	< 0.05	0.31	20.7	2,495
W9	22.6	6.88	23.8	76.6	3.61	16.13	9.8	30.8	0.16	0.033	7.74	0.025	1.1	1.32	0.17	6.4	606	< 0.05	0.32	21.1	4,150
W10	22.7	6.96	27.2	114.0	2.35	16.93	10.5	31.6	0.34	0.023	13.45	0.052	1.3	1.80	0.17	4.7	552	< 0.05	0.31	21.3	11,350
W11	24.4	6.78	220.1	119.5	1.67	17.20	11.8	29.1	0.45	< 0.01	4.29	< 0.01	1.4	11.13	0.33	11.7	4078	< 0.05	1.12	29.6	7,875
W12	22.4	6.83	18.8	39.0	4.66	14.95	9.0	28.9	0.17	< 0.01	1.35	0.019	1.0	0.81	0.17	7.8	662	< 0.05	0.30	20.0	2,475
W13	22.7	5.85	12.0	44.5	3.25	15.23	9.1	24.9	0.24	0.020	4.59	< 0.01	1.3	0.29	0.14	9.3	249	< 0.05	0.30	8.0	1,225
W14	23.1	6.99	12.1	36.0	2.74	13.18	7.3	41.5	0.16	< 0.01	1.26	< 0.01	< 0.3	1.18	0.13	8.0	250	< 0.05	0.31	12.8	5,552
W15	22.6	6.74	34.0	51.4	5.43	14.20	7.9	28.4	0.12	0.017	9.30	0.014	2.1	0.25	0.12	6.3	751	< 0.05	0.20	14.8	11,175

Position		Temperature	pH	Turbidity	Conductivity	DO	COD	BOD_5	TSS	NH_3	NO_2^-	NO_3^-	PO_4^{3-}	Grease	As	Cd	Cu	Fe	Hg	Pb	Zn	Coliform
		^oC		NTU	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	MPN/ 100ml
QCVN 08:2008	A2		6-8.5	-	-	≥ 5	15	6	30	0.2	0.02	5	0.02	20	20	5	200	1000	1	20	1000	5,000
	B1		5.5-9	-	-	≥ 4	30	15	50	0.5	0.04	10	0.03	100	50	10	500	1500	1	50	1500	7,500

B. Ground water quality

Status quo of ground water quality in project area is assessed at 32 positions of bridge constructing area in the project (Table 2.21). At each position 1 sample is taken to analyse quality indicators, including: Temperature, pH, Turbidity, hardness ($CaCO_3$), total solids, NH_3, NO_2^-, SO_4^{2-}, NO_3^-, PO_4^{3-}, Fe, Cu, Cd, Pb, Zn, Hg, As, E. coli, Coliform.

Table 2.21. Sampling sites for analysing ground water quality in project area

Sign	Sampling site	Depth (m)	Coordinate
GW1	Bau Ham 2 commune, Thong Nhat district	90	X = 733978; Y = 1212878
GW2	Quang Trung commune, Thong Nhat district	80	X = 735385; Y = 1216065
GW3	Gia Tan 3 commune, Thong Nhat district	90	X = 737127; Y = 1222879
GW4	Gia Tan 1 commune, Thong Nhat district	90	X = 736762; Y = 1224528
GW5	Phu Cuong commune, Dinh Quan district	80	X = 740931; Y = 1226750
GW6	Tuc Trung commune, Dinh Quan district	110	X = 743264; Y = 1230041
GW7	Phu Ngoc commune, Dinh Quan district	110	X = 750350; Y = 1235162
GW8	La Nga commune, Dinh Quan district	90	X = 744215; Y = 1233467
GW9	Dinh Quan Town, Dinh Quan district	110	X = 758436; Y = 1240456
GW10	Tan Phu Town, Tan Phu district	80	X = 765741; Y = 1246955
GW11	Phu Thanh commune, Tan Phu district	90	X = 768299; Y = 1247502
GW12	Phu Trung commune, Tan Phu district	90	X = 773653; Y = 1251191
GW13	Ma Da Gui Town, Da Huoai district	110	X = 775943; Y = 1258487
GW14	Hectares Lam commune, Da Huoai district	90	X = 784966; Y = 1262587
GW15	DaM'ri Town, Da Huoai district	90	X = 790342; Y = 1262796
GW16	Dai Lao commune, TP. Bảo Lộc	110	X = 799411; Y = 1271487
GW17	Loc Chau commune, TP. Bảo Lộc	110	X = 804277; Y =

Sign	Sampling site	Depth (m)	Coordinate
			1276849
GW18	Loc Son commune, TP. Bảo Lộc	110	X = 807861; Y = 1276626
GW19	Loc An commune, Bao Lam district	90	X = 816979; Y = 1278256
GW20	Lien Dam commune, Di Linh district	110	X = 827728; Y = 1281165
GW21	Di Linh Town, Di Linh district	90	X = 835274; Y = 1281450
GW22	Dinh Lac commune, Di Linh district	90	X = 841944; Y = 1286795
GW23	Tam Bo commune, Di Linh district	110	X = 850882; Y = 1286231
GW24	Ninh Gia commune, Duc Trong district	90	X = 860790; Y = 1288621
GW25	Phu Hoi commune, Duc Trong district	90	X = 863007; Y = 1293582
GW26	Lien Nghia Town, Duc Trong district	110	X = 867810; Y = 1299286
GW27	Hiep An commune, Duc Trong district	110	X = 876276; Y = 1309734
GW28	Hiep Thanh commune, Duc Trong district	90	X = 871688; Y = 1304712
GW29	Ward 4, Da Lat	80	X = 875685; Y = 1318498
GW30	Ward 11, Da Lat	90	X = 884835; Y = 1321518
GW31	Xuan Tho commune, Da Lat	80	X = 887021; Y = 1315705
GW32	Xuan Truong commune, Da Lat	90	X = 892143; Y = 1311747

The result of analysing water quality indicators is given in Index 5. The content of analysing indicators in ground water samples is synthesized and given in Table 2.22.

Comment about observational result:

❖ When comparing the analysing result with National technical regulationss about ground water quality - QCVN 09:2008/BTNMT we see that:

- All the sampled wells have pH, hardness, total solids satisfying QCVN 09:2008/BTNMT.

- Content of poisonous heavy metals (As, Cd, Fe, Hg, Mn, Pb, Znin ground water samples is many times smaller than the allowed limit value.

- NH_3 exceeds the alloed value at 5 sampled wells (Bau Ham 2 commune, Phu Ngoc, La Nga, Phu Thanh, Dai Lao).

- NO_3^- indicator exceeds the allowed value at 18 over total 32 investigating sampling wells (including: Quang Trung, Gia Tan 3, Gia Tan 1, Phu Cuong, Phu Trung, Dai Lao, Loc Chau, Lien Dam, Di Linh Town, Ninh Gia, Phu Hoi, Lien Nghia, Hiep An, Hiep Thanh, Ward 4, Ward 11, Xuan Tho, Xuan Truong).

- Ground water in bacteria contaminated is quite common, of which 8 in total 32 investigated wells are E. Coli contaminated and 30 wells are Coliform contaminated. The reason for contamination mainly is because of position of drilled wells is so near animals feeding barns or of wasted water sources family living.

Table **2. 22**. Content of indicators analysing ground water quality in project area

Sampling site		Temperature	pH	Turbidity	Hardness ($CaCO_3$)	Total solids	NH_3	NO_2^-	NO_3^-	PO_4^{3-}	Cl^-	SO_4^{2-}	Cu	Fe	As	Cd	Hg	Pb	Zn	E. coli	Coliform
		°C		NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	MPN/ 100ml	MPN/ 100ml
GW1	Bau Ham 2	30.1	5.69	0.69	84.0	574	0.260	<0.01	10.8	0.04	9.9	0.91	4.6	8	0.74	0.11	< 0.05	0.2	19.2	KPHT	23
GW2	Quang Trung	30.0	6.11	0.23	82.0	574	0.030	0.01	101	< 0.01	12.4	2.51	8.2	14	1.57	0.17	< 0.05	0.29	9.3	11	5650
GW3	Gia Tan 3	29.3	6.18	0.16	84.0	574	0.020	0.01	67.4	0.03	20.3	3.6	1.1	2	3.24	0.19	< 0.05	1.22	7.8	KPHT	4600
GW4	Gia Tan 1	29.3	6.36	0.12	127.0	886	0.040	<0.01	153	0.035	14.5	4.01	5.8	12	1.49	0.21	< 0.05	0.21	2.7	KPHT	43
GW5	Phu Cuong	29.8	5.86	1.06	68.5	325	0.030	0.02	74.5	0.042	12.1	4.51	8.6	161	1.92	0.17	< 0.05	0.27	33.1	KPHT	460
GW6	Tuc Trung	29.2	6.60	4.45	50.5	313	0.060	0.02	5.80	0.025	25.5	4.3	5.7	155	3.59	0.28	< 0.05	0.36	17.7	KPHT	420
GW7	Phu Ngoc	29.6	5.97	0.52	40.3	194	0.100	<0.01	1.37	0.015	5.6	1.57	3.8	10	0.9	0.24	< 0.05	0.16	12.6	KPHT	460
GW8	La Nga commune	29.8	5.89	0.45	23.5	139	0.290	<0.01	1.55	0.028	12.9	2.43	5.4	11	0.48	0.31	< 0.05	0.16	13.4	9	8550
GW9	Dinh Quan Town	29.1	5.88	15.79	35.5	268	0.050	0.09	3.10	0.037	7.7	0.48	2.6	157	1.77	0.33	< 0.05	0.26	18.8	11	9650
GW10	Tan Phu Town	27.8	5.62	2.01	58.0	302	0.050	0.14	0.61	0.045	8.8	0.27	8.9	12.5	0.74	0.18	< 0.05	0.16	44.9	KPHT	23
GW11	Phu Thanh	28.8	6.13	0.63	133.0	659	0.100	<0.01	0.75	0.022	12.4	4.33	7.2	11	1.19	0.11	< 0.05	0.31	9.8	11	2650
GW12	Phu Trung	27.4	5.21	0.46	24.1	186	0.030	<0.01	41.3	0.035	6.2	0.73	5.6	11.6	0.45	0.17	< 0.05	0.18	20.7	KPHT	120
GW13	Madagui Town	29.1	5.96	31.20	64.0	452	0.030	<0.01	1.62	0.025	6.5	3.1	10.4	302	3.48	0.24	0.07	0.36	22.8	11	9650
GW14	Hectares	22.7	5.6	0.44	24.5	166	0.010	0.02	3.85	0.06	8.9	5.1	12.3	16	0.11	0.37	<	0.11	16.2	KPHT	2400

Sampling site		Temperature	pH	Turbidity	Hardness (CaCO$_3$)	Total solids	NH_3	NO_2^-	NO_3^-	PO_4^{3-}	Cl^-	SO_4^{2-}	Cu	Fe	As	Cd	Hg	Pb	Zn	E. coli	Coliform
		^oC		NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	MPN/100ml	MPN/100ml
	Lam		6														0.05				
GW15	DaM'ri Town	22.6	5.97	0.52	40.6	194	0.050	0.01	0.067	0.04	4.1	1.64	8.2	10	0.9	0.16	< 0.05	0.16	12.3	KPHT	93
GW16	Dai Lao	22.3	5.52	0.50	43.0	247	0.350	0.08	18.6	0.045	2.7	1.65	12.4	20	0.15	0.21	< 0.05	0.06	17.7	KPHT	290
GW17	Loc Chau	22.1	6.13	0.67	74.0	304	0.050	0.016	45.7	0.065	5.6	2.1	12.5	8	1.74	0.13	< 0.05	0.16	9.3	KPHT	460
GW18	Loc Son	22.9	7.23	1.70	37.0	174	0.050	0.019	11.7	0.025	4.7	0.71	5.2	8	3.7	0.31	0.009	0.35	12.6	KPHT	420
GW19	Loc An	23.0	5.80	0.37	6.0	84	0.014	<0.01	2.10	<0.01	4.4	3.53	1.4	12	0.06	< 0.10	< 0.05	0.15	14.7	9	8550
GW20	Lien Dam	23.2	6.52	1.04	22.0	129	0.047	0.05	69.4	0.052	5.2	3.16	1.7	10	1.88	0.27	< 0.05	0.25	13.7	11	320
GW21	Di Linh Town	22.5	5.76	0.91	73.0	197	0.080	<0.01	23.800	0.029	9.1	4.1	6.3	19	0.35	0.1	< 0.05	0.17	43.3	KPHT	460
GW22	Dinh Lac	22.7	5.24	2.07	3.0	87	0.041	0.043	1.00	0.041	6.2	0.59	2.7	2	0.33	0.11	< 0.05	0.14	12	KPHT	2400
GW23	Tam Bo	22.5	6.68	1.19	55.5	239	0.021	<0.01	1.26	0.034	5.6	2.24	1.9	8	2.72	0.22	< 0.05	0.26	11	KPHT	5
GW24	Ninh Gia	22.6	6.38	1.10	40.0	211	0.060	0.031	27.80	0.024	6.6	4.3	5.5	14	1.93	0.26	< 0.05	0.21	15.2	KPHT	KPHT
GW25	Phu Hoi	22.4	6.26	2.85	3.0	91	0.050	0.026	105.30	0.031	31.5	14.7	1.4	33	0.26	0.15	< 0.05	0.29	575	KPHT	93
GW26	Lien Nghia	22.5	4.90	0.42	5.2	124	0.013	0.019	72.60	0.014	22.5	8.5	1.8	3.2	0.74	0.12	< 0.05	0.3	23.7	KPHT	120
GW27	Hiep An	22.3	5.71	3.51	73.0	357	0.027	0.042	22.50	0.027	9.6	2.2	8.8	5	1.33	0.14	< 0.05	0.25	72	KPHT	23
GW28	Hiep Thanh	22.4	5.3	1.97	39.1	241	0.012	0.056	39.80	0.022	23.4	13.6	5.4	4.1	1.04	0.13	<	0.28	47.9	12	260

Sampling site	Temperature	pH	Turbidity	Hardness ($CaCO_3$)	Total solids	NH_3	NO_2^-	NO_3^-	PO_4^{3-}	Cl^-	SO_4^{2-}	Cu	Fe	As	Cd	Hg	Pb	Zn	E. coli	Coliform
	^oC		NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	MPN/100ml	MPN/100ml
		1														0.05				
GW29 Ward 4	21.6	5.75	2.46	3.4	89	0.016	0.039	35.50	0.016	20.4	11.3	5.8	17.5	0.33	0.18	< 0.05	0.22	82.5	KPHT	30
GW30 Ward 11	21.5	6.01	1.88	38.5	144	0.021	0.072	27.40	0.024	7.8	3.4	6.9	26	0.31	0.33	< 0.05	0.23	97.7	KPHT	KPHT
GW31 Xuan Tho	21.4	5.61	2.17	9.8	211	0.042	0.016	31.20	0.014	21.4	7.8	10.2	14.1	1.24	0.16	< 0.05	0.32	67.2	KPHT	15
GW32 Xuan Truong	21.6	5.72	2.76	5.6	129	0.026	0.031	30.50	0.035	20.6	6.2	14.2	19.5	1.31	0.12	< 0.05	0.29	89.5	KPHT	KPHT
QCVN 09:2008/BTNMT	**-**	**5.5 □ 8.5**	**-**	**500**	**1500**	**0.1**	**1**	**15**	**-**	**250**	**400**	**1000**	**5000**	**50**	**5**	**1**	**10**	**3000**	**KPHT**	**3**

2.1.5.4. Real status for quality of soil

To assess land environment polluting ability in the project executing process, the background level of some basic indicators in land at 25 communes along line and 7 positions planned to overflow waste. Sampling site is about 30 – 50 m far from project edge of road (Table 2.23). Analysing criteris include: pH, total organic substances, acidity, total N (T-N), total P (T-P), Cl^-, SO_4^{2-}, poisonous heavy metals (As, Cu, Cd, Hg, Pb, Zn). Content of analysing indicators in land sample are given in Table 2.24 and detailed listed in index 6.

Table 2. 23. Sampling site analyse land quality in project area

Sign	Sampling site	Station	Coordinate
Sol-1	Bau Ham 2 commune	Km2+400	X = 733978; Y = 1212878
Sol-2	Quang Trung commune	Km6+200	X = 735385; Y = 1216065
Sol-3	Phu Cuong commune	Km14+300	X = 740931; Y = 1226750
Sol-4	Tuc Trung commune	Km26+500	X = 743264; Y = 1230041
Sol-5	La Nga commune	Km35+100	X = 744215; Y = 1233467
Sol-6	Phu Ngoc commune	Km38+300	X = 750350; Y = 1235162
Sol-7	Dinh Quan Town	Km45+400	X = 758436; Y = 1240456
Sol-8	Phu Vinh commune	Km49+400	X = 758988; Y = 1241152
Sol-9	Phu Loi commune	Km53+150	X = 761396; Y = 1243769
Sol-10	Tan Phu Town	Km58+200	X = 765741; Y = 1246955
Sol-11	Phu Thanh commune	Km61+800	X = 768299; Y = 1247502
Sol-12	Madagui Town	Km77+500	X = 776618; Y = 1259760
Sol-13	DaM’ri Town	Km94+300	X = 790342; Y = 1262796
Sol-14	Dai Lao commune	Km109+200	X = 799411; Y = 1271487
Sol-15	Loc Son commune	Km117+300	X = 807861; Y = 1276626
Sol-16	Loc An commune	Km131+400	X = 816979; Y = 1278256

Sign	Sampling site	Station	Coordinate
Sol-17	Lien Dam commune	Km145+500	X = 827728; Y = 1281165
Sol-18	Gia Hiep commune	Km170+100	X = 846967; Y = 1287333
Sol-19	Ninh Gia commune	Km189+200	X = 861288; Y = 1290238
Sol-20	Phu Hoi commune	KM193	X = 863007; Y = 1293582
Sol-21	Hiep Thanh commune	KM208	X = 871688; Y = 1304712
Sol-22	Hiep An commune	Km215	X = 876276; Y = 1309734
Sol-23	Ward 11, Da Lat	Km238+500	X = 880031; Y = 1322761
Sol-24	Xuan Tho commune	Km245	X = 884835; Y = 1321518
Sol-25	Xuan Truong commune	Km254	X = 887021; Y = 1315705
Sol-26	Dump 1	Km178+800	X = 851573; Y = 1286537
Sol-27	Dump 2	Km186+500	X = 860297; Y = 1287906
Sol-28	Dump 3	Km223+870	X = 878287; Y = 1315632
Sol-29	Dump 4	Km247+100	X = 884840; Y = 1259196
Sol-30	Dump 5	Km247+400	X = 884072; Y = 1319812
Sol-31	Dump 6	Km251+900	X = 886079; Y = 1317054
Sol-32	Dump 7	Km263+400	X = 890600; Y = 1312192

Table 2. 24. Content of interested indicators in land sample at 32 positions along project road line

Position		pH (H_2O)	Total Organic	Acidity	T-N	T-P	Cl^-	SO_4^{2-}	As	Cd	Cu	Hg	Pb	Zn
			%	meq/100 g	%	%	mg/100g	mg/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sol-1	Bau Ham 2 commune	6.6	3.42	4.8	0.06	0.019	8.1	2.7	0.42	0.63	2.4	0.48	6.5	26.4
Sol-2	Quang Trung commune	7.1	3.11	4.5	0.08	0.021	9.6	12.2	0.63	0.58	2.9	0.57	9.4	75
Sol-3	Phu Cuong commune	6.5	2.78	5.4	0.07	0.023	8.5	1.7	0.73	0.71	3.7	0.46	3.6	61.5
Sol-4	Tuc Trung commune	5.9	2.44	5.7	0.071	0.019	14.2	21.3	0.87	0.27	2.2	0.53	2.3	23.4
Sol-5	La Nga commune	6.2	2.6	5.2	0.065	0.021	16.5	18.7	0.56	0.62	2.9	0.56	3.6	16.1
Sol-6	Phu Ngoc commune	5.7	2.53	5.5	0.078	0.024	12.6	8.4	0.43	0.47	3.4	0.42	3.1	25.5
Sol-7	Dinh Quan Town	6.3	2.72	5.4	0.064	0.019	11.1	5.03	0.76	0.46	3.1	0.52	11.3	18.4
Sol-8	Phu Vinh commune	6.5	3.54	5.1	0.072	0.021	17.1	2.3	0.68	0.64	4.4	0.46	9.6	25.6
Sol-9	Phu Loi commune	6.1	2.95	4.5	0.059	0.015	26.6	3.53	0.46	0.89	2.6	0.49	5.7	12.3
Sol-10	Tan Phu Town	6.7	3.21	4.9	0.15	0.014	6.1	72.4	1.15	0.52	11.7	0.18	14.8	41.8
Sol-11	Phu Thanh commune	6.7	2.97	4.1	0.14	0.028	6.2	46.3	0.68	0.73	17.4	0.46	15.5	66.4
Sol-12	Madagui Town	6.8	3.16	5.3	0.17	0.012	7	101.9	2.64	0.71	15	0.09	19.2	53.7
Sol-13	DaM'ri Town	6.7	3.24	4.9	0.08	0.045	6.3	86.5	3.14	0.56	11.5	0.52	16.4	47.3
Sol-14	Dai Lao commune	6.9	3.46	5.1	0.07	0.073	5.5	63.8	0.86	0.45	21.1	0.71	23.6	37.8
Sol-15	Loc Son commune	6.9	2.98	5.4	0.068	0.062	7	95.6	1.25	0.28	14.4	0.39	19.4	45.3
Sol-16	Loc An commune	6.3	1.72	5.4	0.064	0.019	14.5	11.9	0.76	0.46	3.1	0.52	11.3	18.4
Sol-17	Lien Dam commune	6.5	1.54	5.1	0.072	0.021	19.6	27.1	0.68	0.64	4.4	0.46	9.6	25.6
Sol-18	Gia Hiep commune	6.1	0.95	4.5	0.059	0.015	25.4	9.6	0.46	0.89	2.6	0.49	5.7	12.3
Sol-19	Ninh Gia commune	6.3	0.88	4.2	0.08	0.025	11.1	5.03	1.12	0.38	5.7	0.51	8.8	48
Sol-20	Phu Hoi commune	6.6	0.96	4.9	0.06	0.015	17.1	16.3	0.41	0.76	3.4	0.52	5.4	67

Position		pH (H_2O)	Total Organic	Acidity	T-N	T-P	Cl^-	SO_4^{2-}	As	Cd	Cu	Hg	Pb	Zn
			%	meq/100 g	%	%	mg/100g	mg/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sol-21	Hiep Thanh commune	6.8	1.48	5	0.08	0.023	26.6	3.53	0.62	0.57	2.9	0.59	11.6	24.6
Sol-22	Hiep An commune	6.7	0.82	4.9	0.06	0.019	14.2	22.3	0.32	0.83	2.4	0.48	6.5	26.4
Sol-23	Ward 11, DL	7.2	1.61	4.5	0.08	0.021	16.5	16.7	0.93	0.56	2.9	0.57	9.4	75
Sol-24	Xuan Tho commune	6.8	1.73	5.3	0.07	0.023	12.6	9.4	0.72	0.74	3.7	0.46	3.6	61.5
Sol-25	Xuan Truong commune	6.1	1.32	4.7	0.07	0.019	8.1	6.7	0.84	0.33	3.8	0.5	4.6	8
Sol-26	Dump 1	6.5	1.32	5.5	0.065	0.022	9.6	11.2	0.94	0.52	4.4	0.56	7.1	15.6
Sol-27	Dump 2	5.8	1.32	5.6	0.071	0.019	8.5	9.7	0.87	0.27	2.2	0.53	2.3	3.4
Sol-28	Dump 3	5.9	1.44	5.7	0.071	0.019	8.5	7.7	0.87	0.27	2.2	0.53	2.3	3.4
Sol-29	Dump 4	6.2	1.6	5.2	0.065	0.021	9.7	8.6	0.56	0.62	2.9	0.56	3.6	6.1
Sol-30	Dump 5	5.7	1.53	5.5	0.078	0.024	18.4	14.3	0.43	0.47	3.4	0.42	3.1	5.5
Sol-31	Dump 6	6.9	0.84	4.4	0.06	0.017	9.9	1.84	1.11	0.76	4.1	0.52	15.1	107
Sol-32	Dump 7	7.1	1.76	5.3	0.07	0.026	17.6	2.9	0.62	0.94	3.1	0.44	13.6	92
QCVN03:2008		-	-	-	-	-	-	-	12	2	50	-	70	200
CCME97												6.6		

Note: (*) CCME97 – Canadian standard with soil

Comment about analysing result:

- In general, indicators about land chemical properties as pH, total phosphorus, total nitrogen and total organic substances in land in project area thuộc loại trung bình đến khá;

- Poisonous heavy metals in all the land samples are lower limit value Vietnamese theo specifications - QCVN 03:2008/BTNMT and Canada standard CCME97. Compared to limit value of standard, content changes about 3,5% - 26%; Cd changes about 13% - 44%; Cu changes about 4% - 52%; Hg changes about 1,4% - 11%; Pb changes about 3% - 42% and Zn changes about 6% - 37%.

2.2. ECONOMIC – SOCIAL CONDITIONS IN PROJECT AREA

2.2.1. ECONOMIC – SOCIAL CONDITIONS IN THE AREA OF DONG NAI

2.2.1.1. Econimic – social general description of Dong Nai province

A. Human resources

In the period 1996 - 2000, population of the whole province avarage increases 2.05%/year and till 2009 the speed of population increase is 1.93%, reflecting effort in decreasing natural growth rate and controlling immigration. In 2009, population of the whole province is 2,491,262 people, in which 828,011 people in urban, accounting for 33.24%.

Because of the geographic position favorable about traffic, being the gateway with South Eastern provinces, especially Ho Chi Minh City, human resources of the province is also added and applied scientific - technological achievements; and combine local and national cultural tradition, human resources of the province are step by step raised.

In 2009, Dong Nai had 1,337,670 people in the working age. In the economy development condition, especially when industry and service quickly increased, it attracted many new jobs (solved the employment for 85 thousand labors in 2000). In this period, to satisfy the need of proceeding industrialization, modernization nationwide, the duty of investing for developing human resources, carrying out training and retraining play a very significant role and the province will active ly carrying out, considering it one of the important measures to ensure the province's socio-economic developing targets in the future.

B. Infrastructure

B1. Power supply system

Dong Nai focused on developing National grid serving producing and and lighting on the whole area, especially satisfied the need of electricity for industrial parks. Since 2001, it brought electricity to the centre of all the commune, wards, towns and so far, over 98,5% of the households in the whole province can use electricity. Now it continues bringing electricity to agglomerations in distant areas.

B2. Water supply system

Urban water supply sector invested in constructing and rehabilitating for water supply power 19,1 million m^3 in 2000. Water supply ability attained 325.000m^3/day and night, adequate for supplying the residents of Bien Hoa city, Xuan Loc Town and industrial projects in industrial parks. 94% of the households used domestic water hygienically.

B3. Transport and traffic

Located on an important traffic hub area of the southern key economic section, Dong Nai has many advantageous conditions about roadway, waterway and air routes to attract investment, develop economy-society. Transport traffic sector has gradually improved transportation system, timely serves the need of socio-economic development of the local society and of the region.

Transport traffic made rapid progress in investing upgrading traffic, especially road traffic. Together with National Highway system with the total length of 244.5 km was upgraded and expanded into a standard of grade I, II delta (Highway 1, Highway 5), grade III such as Highway 20 (across the province 75 km), Highway 56. Particularly Highway 1A in Dong Nai, the province has complete upgrading the entire 102 km, the road width from 12.5 - 24 m, has put into effective operation. Highway 51 has completed the entire 45 km in the province. The road system in the province has length 3,339 km, of which nearly 700 km of asphalt. The province road has 22 routes with the length of 336 km (243 km asphalt), 139 district, city road routes with the length 688 km (146 km asphalt roads). In addition, the road system managed by wards and communes, the roads in agricultural - forestry, industrial zones form a continuous network to the base, 100% of communes, wards whose center car can go.

To further link Dong Nai with the region, the province will focus on developing traffic directly connecting the Ho Chi Minh City via District 9 (high-tech zone) with Nhon Trach new urban area and connecting with Highway 51, Highway 20... This road transportation system will help raise the profile of Long Thanh international airport - with design capacity 80-100 million passengers/ year, further strengthening the connect of the Southern key economic area.

The system of seaports, river ports were planned and built relatively quickly, including the system of Long Binh Tan port, Go Dau A Port and Go Dau B Port, capable of receiving ships of upto 15,000 tons. The output of goods through the ports reached 700,000 tons/year, expected to increase by 25-30 million tons/year. However, the progress of investing constructing the system of seaports, warehouses... is still slow compared to the development need in accordance with the approved plan. National railway passing through the province is 87 km long with 8 stations were maintenanced ensuring straight-through flow.

B4. Communication

Post and Telecommunication industry rapidly develope and are modernized to the level of the countries in the region. Phone level increased from 5 phones/100 people in 2000 to 87 phones/100 people in 2009, internet subscribers reached 23 subscribers/100 inhabitants; meet the communication needs, especially in urban areas and centralized industrial parks. Currently, 100% of wards, communes and towns have had telephones, daily letter and papers.

B5. Tourism potential

Dong Nai is the land of ancient civilizations with many valueable cultural and historical relics, typically Tran Bien temple of literature, Nguyen Huu Canh church, D War zone cultural relics. Many tourist destinations have been established as tourist route Dong Nai River - Pho Isle - Buu Long, tourist route May river – Tri An, tourist route Mai falls – Mo spring, Nam Cat Tien primeval forest, tourist route Long Thanh - He isle, Dong Nai tourism is mainly towards cultural, historical, ecological, picnic potential...

C. Economic indicator

By 2009, GDP of Dong Nai is 31,883 trillion dong, growing 9.3% over 2008. Per capita GDP reached 24.95 million dong.

The economic structure: the construction industry accounted for 57.3%, service 32.8%; agriculture, forestry and fisheries accounted for 9.9%.

Mobilizing investment capital for wholly social development was about 28,037 billion dong, accounting for 46.4% of GDP.

Attracting foreign direct investment capital FDI attained over $3 billion. The total budget revenue over the province area exceeded 4% of the budget delivered by the Centre.

D. Social indicator

– Reduce crude birth rate 0.3‰; reduce the rate of natural population growth down to 1.14%.
– The rate of wards, communes, towns getting standard of secondary education universalization attain 85%.
– 72% of clinics have stably serving doctors, 95% of communes, wards, towns getting national standard on health care; 4 doctor/ ten thousand people, 17 patient beds / ten thousand people.
– Reduce the proportion of children under age 5 are malnourished to 15%, children under age 2 to 9%.
– Create new jobs for 85 thousand workers, newly recruit and vocationally train for 55,500 people. Raise the rate of trained workers to 51%.
– Reduce 11,000 poor households, the poverty rate at the end of year dropped to 6.39%.
– The whole province has 85% of hamlets, streets and 93% of households attain the titles cultural hamlets, streets, cultural families.

E. Environmental indicator

– By 2009, the percentage of households using electricity attained 100% in the urban, 97.5% in the rural; the percentage of households using hygienic water is 98% in the urban and 85.34% in the rural.
– The coverage rate reaches 28.16%.
– Collecting and processing domestic waste reach 77%; collecting and treating medical waste reach 90%; collecting and treating hazardous waste reach 45%.

– Estimated 90% of industrial parks in the area have centralized sewage treatment system attaining environmental standard.

2.2.1.2. Economic – social status of localities located along the project route

A. Thong Nhat district

– Location: Thong Nhat is a midland district, administrative boundaries are identified: adjacent with Dinh Quan district in the North, adjacent with Long Khanh Town in the East, adjacent with Long Thanh district and Cam My district in the South, adjacent with Trang Bom district in the West.

– Total natural area: 247.21 km^2, accounting for 4.2% of the whole province.natural area.

– Avarage population in 2009: 148,273 people, population density 599,786 people/km^2.

– The district has 10 administrative units including communes of: Xuan Thien, Xuan Thanh, Bau Ham II, Gia Tan I, Gia Tan II, Gia Tan III, Gia Kiem, Quang Trung, commune road 25, and Hung Loc.

– The economic structure in 2009: Industry - Construction accounted for 12.23%; Agriculture - Forestry - Fishery accounted for 47.92%; Service accounted for 39.85%.

– Advantages of the district:

  + The climate and land are advantageous for developing fruit trees, short-term and long-term industrial crops such as soybeans, tobacco, coffee, rubber...

  + In the future there will be highway Saigon - Da Lat highway and Dau Giay - Long Thanh - Dist. Ho Chi Minh went through (the arteries on the trunk roads North - South and Central Highlands key economic areas in the region).

  + There are conditions for developing technical infrastructure: electricity, water, traffic... (especially about traffic, has Highway 1, Highway 20 and railway line running through), which attract investment from outside. In the future there will be highway Sai Gon – Da Lat and highway Dau Giay – Long Thanh – Ho Chi Minh City running through (the artery of the traffic axis North - South, Tay Nguyen and key economic regions in the area).

  + There are conditions to develop stronger in all the 3 fields: agriculture, industry - handicraft and services.

Traffic: The district’s main transportation system is roadway and railway. About Highways, there are 2 main routes: Highway 1 and Highway 20 passing through a length of 25.5 km, the structure of asphaltic concrete. The two Highways intersect at Dau Giay intersection. About Provincial road, there are 3 routes with a total length of 29.1 km of road lines have been upgraded to asphaltic road. District managed road system consists of nine routes with a total length of 54,1 km, building line 19 metres.

Power supply system: The district’s grid system is now supplied from 3 electricity branches: Thong Nhat Electricity, Long Khanh Electricity and Dinh Quan Electricity. Currently, 10 communes have low-voltage electricity and medium voltage to the commune centres, the percent of households with electricity use is about 93%.

Water supply and drainage: Almost in the district there hasn't been a water supply station for domestic activities and production. Mainly households, production facilities use groundwater from dug wells, drilled wells. The percentage of households using hygienic water reaches relatively high, reaching 93%. Drainage: drainage ditch system is mainly placed in densely populated areas, along two sides of some sections which national Highway pass through. But these ditch lines only serve rain-water drainage, and domestic waste water is still treated by self-absorbing or overflowing rivers and streams... On the other hand, these ditch sections are uncompleted so are still fulfilled by soil, rubbish causing inundating the road every heavy rain.

A1. <u>Bau Ham 2 commune</u>

Bau Ham 2 is located in the southwest of the center of Thong Nhat district and 1km from the district center. The commune has the natural land area of 2019.5 hectares, accounting for 0.8% of the total land area of the district.

The use of the communal land is as follows: The area of agricultural land (rambutan, durian, cashew, coffee, rubber...) is 1813.2 hectares (accounting for 91.1%) The area of forestry land which is mainly production forest, orientating to grow fruit trees is 0.47 hectares (accounting for 0.02%); The area of specially used land is 84.3 hectares (accounting for 4.12%); The housing land area is 102.3 hectares (accounting for 4.03%).

By 01/04/2009, Bau Ham has 17,109 people, including 7,122 people in working age. The total social labor of the whole commune accounts for 50.1%. In particular, agricultural labor accounts for 30% (corresponding to 2,136 people) and the rest is 70% of non-agricultural labor (corresponding to 4,986 people).

Bau Ham 2 has 3 Highways running through: National Highway 1A 1km long, National Highway 769 5km long and National Highway 20 1km long. The commune currently has 54km roads of other types. Earth road accounts for mainly with 30km, the rest is asphalted road 18km, gravel road 6km.

A2. <u>Quang Trung commune</u>

Quang Trung commune with 20,726 people, located in the north of Thong Nhat district center and 10km from the district center; the communal area of natural land is 3,648.28 hectares, accounting for 16.58% of the district land. In particular, the commune has 3,204.12 hectares of agricultural land, 3.6 hectares of aquaculture land, 330 hectares of non-agricultural land, 110.28 hectares of unused land. The communal forest area is 0.32 hectares.

The weather and climate conditions are quite advantageous for crops, especially the perennial crops, bringing high economic efficiency, increasing GDP avarage 21.28%/year, 2.19 times higher than the average speed of economic development of the district. The commune hass hilly terrain causing difficulty for industrial development. Apart from land and forest resources, the commune also has mineral resource that are quarries located at the Nguyen Hue 2 hamlet and Quang Trung commune.

A3. <u>Gia Kiem commune</u>

Gia Kiem has 20,975 inhabitants living in 3,326.36 hectares of natural land. The use of land in the commune by 01.01.2010 is as follows: Agricultural land accounts for 3,017.26 hectares, of which agricultural land 2,954.76 hectares (annual crop land: 409.91 hectares; perennial crop land: 2,544.85 hectares) and aquaculture land is 11.21 hectares. Non-agricultural land accounts for 286.29 hectares (housing land: 108.95 hectares; specially used land: 140.18 hectares) and unused land is 22.81 hectares.

A4. Gia Tan 1 commune

The total area of natural land of the commune is 2,066.47 hectares. The use of land in the commune area by 01/01/2010 is as follows: Agricultural land accounting for 1,172.76 hectares, of which agricultural land is 1,038.87 hectares (annual crop land: 52.05 hectares; perennial crop land: 986.82 hectares), forestry land 106.55 and aquaculture land is 17.42 hectares; Non-agricultural land accounts for 893.71 hectares (housing land: 103.41 hectares; specially used land: 53.98 hectares). By 1/4/2009, the whole commune has 14,505 inhabitants.

A5. Gia Tan 2 commune

Gia Tan 2 commune is located in the north of the district centre, 12 km from Thong Nhat district centre and 50 km from Bien Hoa city. The commune has Highway 20 passing through, with the natural land area of 1,451.64 hectares accounting for 17.07% the land area of the whole district. In the total natural land area, agricultural land accounts for 1,293.82 hectares - including 1,210.75 hectares of agricultural land (annual crop land: 508.94 hectares; perennial crop land: 701.81 hectares), 4.67 hectares forestry land and 14.00 hectares aquaculture land. Non-agricultural land account for 157.82 hectares (housing land: 81.92 hectares; specially used land: 51.66 hectares). The whole commune has 13,390 inhabitants.

A6. Gia Tan 3 commune

Located in the south of Thong Nhat district centre, 12 km from district centre and 50 km from Bien Hoa city, the commune has the natural land area of 1,904.47 hectares, accounting for 7.70% the land area of the whole district. The use of land in the area of commune by 01/01/2010 is as follows: Agricultural land accounts for 1,710.41 hectares, of which agricultural production land is 1,650.95 hectares (annual crop land: 470.28 hectares; perennial crop land: 1,180.67 hectares), 1.76 hectares of forestry land and 40,07 hectares of aquaculture land. Non-agricultural land accounts for 194.06 hectares (housing land: 107.48 hectares; specially used land: 52.50 hectares.

There are 19,890 inhabitants in the commune area; the percentage of industrial labors accounts for 27.2%, the percentage of agricultural labors accounts for 46.6%, the percentage of trading labors accounts for 16.3% and the percentage of labors service is 9.9%. Now the economic structure of the commune is: 80.24% agriculture; trading service 15.1% and handicraft 4.53%.

B. Dinh Quan district

– Location: In the East of Dong Nai province, adjacent with Tan Phu district in the North – North East; adjacent with Binh Thuan province in the South East; adjacent with districts Xuan Loc, Long Khanh, Thong Nhat in the South; adjacent with Vinh Cuu district in the West.

- Total natural area: 971.23 km^2, accounting for 16.40% the natural area of the whole province.
- Avarage population 2009: 193,150 people, density of 198.87 people/km^2.
- District has 14 administrative units including Dinh Quan Town and 13 communes: Thanh Son, Phu Tan, Phu Vinh, Phu Loi, Phu Hoa, Ngoc Dinh, Gia Canh, Phu Ngoc, La Nga, Tuc Trung, Phu Tuc, Phu Cuong, Suoi Nho.
- The economic structure: agriculture and forestry account for 49.90%, industry - handicraft account for 16.32% and service accounts for 33.78%.
- Advantages of the district:
  + To the South East of Dinh Quan there are two big rivers flowing through: Dong Nai river 32km long, La Nga river 46.6 km long, advantageous for the development of waterway - roadway traffic and economic exchanges with regions. Dinh Quan is located on Highway 20 between tourist route Ho Chi Minh City - Da Lat so Dinh Quan Town has been shaped over many decades as the tourist destination with famous natural attractions: La Nga river, Ba Chong stone, Ba Giot waterfall, Mai waterfall...
  + The centre town is a region with rather developed service - commerce activities, production facilities, individual households help labors be employed in non-agricultural labor force.
  + Mineral resources of the district include: gold, gems and especially construction stone existing in the most of the district area with large reserves may be industrially exploited.
  + These crops: tobacco, coffee, sugarcane, cashew, beans, crops and planted forest are the main strength of the district

B1. <u>Phu Tuc commune</u>

With the total natural land area of 2,796.05 hectares, of which: the area of agricultural land í 2,555.97 hectares (accounting for 91.4%); the area of forestry land is 1.58 hectares (accounting for 0.06%); the area of aquaculture land is 8.04 hectares (accounting for 0.29%); the area of housing land is 80.94 hectares (accounting for 2.89%); the area of specially used land is 93.60 hectares (accounting for 3.35%). In the area of Phu Tuc commune there are 12,232 people.

B2. <u>Phu Cuong commune</u>

The total area of natural land 5,676.18 hectares, of which: the area of agricultural land is 787.98 hectares (accounting for 13.9%); the area of forestry land is 7.96 hectares (accounting for 0.14%); the area of aquatic production land is 20,67 hectares (accounting for 0.36%); the area of housing land is 82.41 hectares (accounting for 1.45%); the area of specially used land is 48.91 hectares (accounting for 0.86%); the area of specially used river, stream land and water surface is 4,715.87 hectares (accounting for 83.08%). Phu Cuong has totally 2,781 permanent households with 13,778 inhabitants, 278 households with 1,598 inhabitants.

B3. <u>Tuc Trung commune</u>

Tuc Trung is a commune of distant area of Dinh Quan district. Tuc Trung has the total natural land area of of 5.125,41 hectares, accounting for 19% of the total land area of Dinh Quan district, of which: the area of agricultural land is 4,157.42 hectares (accounting for 81.1%); the area of forestry land is 2,79 hectares (accounting for 0.05%); the area of aquatic production land is 12.41 hectares (accounting for 0.24%); the area of housing land is 64.75 hectares (accounting for 1.26%); the area of specially used land is 224.65 hectares (accounting for 4.38%); the area of specially used river, stream land and water surface is 656.09 hectares (accounting for 12.80%). Tuc Trung has the total population of 11,162 people, with 2,165 households.

The trees having strength in Tuc Trung's agriculture include rubber, cashew, mango. The agricultural sector accounts for 83.64% of unemployment rate. Forestry is not the strength so the forestry land area tends to decrease. The main product value is perennial crops such as rubber, cashew and other fruit trees like mango, tangerine. Tuc Trung is a commune in remote areas so it doesn't have industrial parks, it only has some small private business running; a very famous traditional craft is weaving.

B4. <u>La Nga commune</u>

La Nga is a mountainous commune with the area of natural land is 8,242.05 hectares, of which: the area of agricultural land 2,915.46 hectares (accounting for 35.4%); the area of forestry land is 31.46 hectares (accounting for 0.38%); the area of aquatic production land is 212.57 hectares (accounting for 2.58%); the area of housing land 147.74 hectares (accounting for 1.79%); the area of specially used land is 204.08 hectares (accounting for 2.48%); the area of specially used river, stream land and water surface is 4,721.17 hectares (accounting for 57.28%), of which Tri An lake reservoir is 4,720 hectares, accounting for 8.49% the area of natural land of the district. In the commune area forms mountainous industrial park of Dinh Quan district at Phu Quy 1 hamlet - La Nga commune with the total planned area of 163 hectares. La Nga commune has Tri An lake reservoir surface surrounding, has Du Lich hill close to the reservoir and traffic road connecting with Highway 20, convenient and suitable for the development of ecotourism. The whole commune currently has 14,948 inhabitants living. So far electricity grid has supplied electricity for daily life and production for 82% of families over the commune.

B5. <u>Phu Ngoc commune</u>

Phu Ngoc commune has the total natural land area of 7,028.46 hectares, of which: the area of agricultural land is 4,843.52 hectares (accounting for 68.9%); the area of forestry land is 283,40 hectares (accounting for 4.03%); the area of aquatic production land is 132.49 hectares (accounting for 1.89%); the area of housing land is 149.77 hectares (accounting for 2.13%); the area of specially used land is 214.29 hectares (accounting for 3.05%); the area of specially used river, stream land and water surface is 1,328.18 hectares (accounting for 18.90%). The whole commune curently has 17,175 inhabitants.

B6. <u>Ngoc Dinh commune</u>

Ngoc Dinh has the total natural land area of 4,349.47 hectares, of which: the area of agricultural land is 2.624,71 hectares (accounting for 60.3%); the area of forestry land is 926.95 hectares (accounting for 21.31%); the area of aquatic production land is 45.53 hectares (accounting for 1.05%); the area of housing land is 95.16 hectares (accounting for 2.19%); the area of specially used land is 102.02 hectares (accounting for 2.35%); the area of specially used river, stream land and water surface is 542.14 hectares (accounting for 12.46%). The commune curently has 7,831 inhabitants; the percentage of households using electricity is 94.32%, the percentage of households using hygienic water is 98%.

B7. Dinh Quan Town

Dinh Quan Town is the centre of Dinh Quan district; in the area of the town therer is Highway 20 runing through with a length of 4.5km so it is very convenient for economic - cultural exchanges with the outside. The town has the total natural land area of 996.94 hectares, of which: The area of agricultural land is 701.7 hectares (accounting for 70.4%); the area of forestry land is 22.4 hectares (accounting for 2.25%); the area of aquatic production land is 17,5 (accounting for 1.75%); the area of specially used land is 248.9 (accounting for 24.95%); the area of unused land is 6,55 hectares (accounting for 0.65%). Currently, the total population of the entire town is 23,950 people with 4,400 households.

Currently, the town doesn’t have an industrial park, mainly industrial – handicraft production households, including: 312 households with 460 labors. In the area there are 1,547 services commercial business households, accounting for 35%; construction industry 320 households, accounting for 7.2%; transport business 114 households, accounting for 2.5%; agriculture 1,337 households, accounting for 30.3%.

B8. Phu Vinh commune

Phu Vinh is a mountainous commune of Dinh Quan district with the total natural land area of 2,437.00 hectares, of which: the area of agricultural land is 2,199.77 hectares (accounting for 90.3%); the area of forestry land is 6.85 hectares (accounting for 0.28%); the area of aquatic production land is 16.20 hectares (accounting for 0.66%); the area of housing land is 82.11 hectares (accounting for 3.37%); the area of specially used land is 64.95 hectares (accounting for 2.67%); the area of specially used river, stream land and water surface is 59.67 hectares (accounting for 2.45%). The commune has an abundant labor source with the total number of 13,359 inhabitants.

B9. Phu Loi commune

Phu Loi commune has the total natural land area of 2,556.83 hectares, of which: the area of agricultural land 2,345.69 hectares (accounting for 91.7%); the area of forestry land 62.73 hectares (accounting for 2.45%); the area of aquatic production land 4.49 hectares (accounting for 0.18%); the area of housing land 69.86 hectares (accounting for 2.73%); the area of specially used land 67.98 hectares (accounting for 2.66%); the area of specially used river, stream land and water surface is 5.35 hectares (accounting for 0.21%). Currently, the entire commune has about 11,877 inhabitants.

B10. Phu Tan commune

Phu Tan has the total natural land area of 4.488,19 hectares, of which: the area of agricultural land is 4,040.13 hectares (accounting for 90.0%); the area of forestry land is 89.18 hectares (accounting for 1.99%); the area of aquatic production land is 35.60 hectares (accounting for 0.79%); the area of housing land is 106.35 hectares (accounting for 2.37%); the area of specially used land is 138.97 hectares (accounting for 3.10%); the area of specially used river, stream land and water surface is 77.25 hectares (accounting for 1.72%). Currently the entire commune has 2,085 households with 10,290 inhabitants.

C. Tan Phu district

- Location: Is a mountainous district in the north of Dong Nai province, the district centre is 100km from Bien Hoa city, 126 km from Ho Chi Minh City. Adjacent with Lam Dong province in the East and North East; adjacent with province Bình Thuận in the South East; adjacent with province Bình Phước in the North West; adjacent with Dinh Quan district in the South West; adjacent with district Vinh Cuu in the West.
- Total natural area: 775.67 km^2, accounting for 13.13% of the natural area of the province.
- Avarage population 2009: 156,684 people, the density of 201.998 people/km^2.
- The district has 18 administrative units *including*: Tan Phu Town and 17 communes: Phu Thinh, Phu Binh, Phu Xuan, Phu Son, Phu Loc, Dak Lua, Nam Cat Tien and Phu Dien, Tra Co, Phu Trung, Phu Lam, Ta Lai, Phu Thanh, Phu An, Phu Lap, Thanh Son and Nui Tuong.
- Economic structure: Industry - construction 4.91%, agriculture and forestry 59.46% and service 35.63%.
- Advantages of the district:
  + Nam Cat Tien forbidden forest with the area of 35,000 hectares, being invested into the National Park; significant reserve forest with many rare plants and animals, where there are 185 kinds of plants, 62 kinds of animals and 121 bird species, is attracting home and abroad tourists.
  + The land used for agriculture, forestry accounts for 86% of the natural land, which provides raw materials for processing industries.
  + Peat with a large reserve for the production of fertilizer, therer was substantiation applying to the provincial People's Committee for approval to build the production factory.
  + Currently, Tan Phu District has planned Tan Phu industrial park with the area of 50 hectares located on Highway 20, being the area encouraging calling domestic and foreign investment.

C1. Tan Phu Town

The entire town currently has 809.39 hectares of natural land, of which 599.91 hectares of agricultural land (agricultural production land: 506.36 hectares, forestry land: 92.21 hectares) and 209.48 hectares of non-agricultural land. In the area there are 21,050 people. The business development in the area is rather slowly in number, but the production scale is more and more expansing and developing, the output value is more and more raised.

C2. Phu Thanh commune

Currently, Phu Thanh has 2,817.18 hectares of natural land, of which 1,934.48 hectares of agricultural land, there is no forestry land; 418.70 hectares of aquaculture land; 457.71 hectares of non- agricultural land and 6.28 hectares of unused land. The entire commune has 12,332 people, the poverty rate accounts for 19.6%, the percentage of households using electricity is 99.4%, the percentage of households using hygienic water is 87.2%.

C3. Phu Lam commune

Phu Lam currently has 619.6178 hectares of natural area, most of which is agricultural land 459.3468 hectares, 18.1646 hectares of aquaculture land, 139.9049 hectares of non-agricultural land and 2.2015 hectares of unused land. By 2009, the commune has 13,590 inhabitants.

C4. Phu Trung commune

Phu Trung commune, Tan Phu district, has the area of 1,541.49 hectares of natural land, of which 855.15 hectares of agricultural production land; 553.84 hectares of forest land; 21.09 hectares of aquaculture land; 98.63 hectares of non-agricultural land and 12.77 hectares of unused land. Per capita GDP reaches 5.5 million/person/year. The economic structure: 68% of agriculture and forestry, 22% of services trade and 10% of handicraft. The population in 2009: 7,304 people over the total 268 households. The entire commune has 98% of households using electricity and 96% of households using hygienic water, poor households: 11.75%.

C5. Phu Son commune

Phu Son currently has the total of 8,849 people over the total natural area of 1,450.22 hectares. The communal area is mainly forestry land with 921.69 hectares, only 380.54 hectares of agricultural land, 117.19 hectares of non-agricultural land and 2.51 hectares of unused land.

2.2.2. ECONOMIC – SOCIAL CONDITIONS IN THE AREA OF LAM DONG

2.2.2.1. Economic – social general description of Lam Dong province

A. Human resources

According to the census of population and housing 01/04/2009, Lam Dong province's population is 1,186,786 people, after 10 years the province's population increases by 188,759 people, the annual average growth rate during the period 1999 - 2009 is 1.7%/year, down sharply compared to the period 1989-1999 (4.3%/year in 10 years before).

The population in the urban is 449,430 people, with the average annual increase of 1.55%. Meanwhile the population in the rural is 737,356 people, with the average annual increase of 1.9% - higher than the general average increase. Dividing by sex, the male population is 376,010 people, female 361,010 people. The rate of male/female through two surveys is always greater than 1, specifically 101.8 males per 100 females in 1999, and 100.9 males per 100 females in 2009.

In 2009, Lam Dong province has over 30 thousand people are solved jobs, increasing by 2 thousand people compared to 2008, of which foreign labor exports 52 workers, the rest are local jobs.

The income of salaried workers continues being improved, the monthly average income of workers in the local State sector in 2009 reaches 2.29 million, up 30.44%.

B. Infrastructure

B1. Power supply system

The power supply is relatively stable in the province, including Da Nhim hydropower (capacity 160 MW), Suoi Vang hydropower (3.1 MW), Ham Thuan - Da Mi hydropower (475 MW capacity), Dai Ninh hydropower (300 MW) power, diesel plants Bao Loc, Di Linh and Canrang with the total capacity of 4.16 MW. Currently, 100% of communes have electricity to the center.

B2. Water supply system

The water supply system is completed relatively well, there are currently: Da Lat water supply plant, capacity 35,000 m^3/day-night; Bao Loc town water system, capacity of 10,000 m^3/day-night; Duc Trong district water supply system, capacity 2,500 district/day-night; Di Linh district water supply system, capacity 3,500 m^3/day-night; water supply systems Lam Hectares district, capacity 6,000 m^3/day-night. Together with the water supply, the industrial and domestic wastewater treatment system is being completed.

B3. Transport traffic

With the total length of 1,744 km, the roadway traffic system has currently been brought to all communes and residential areas. Highway Routes 20, 27, 28 connecting Lam Dong with the Southeast region, Ho Chi Minh City, the Central Highland provinces, the Southern Central coastal provinces, creating Lam Dong strong socio-economic relations with areas and provinces in the region.

Lien Khuong Airport is 30 km from Da Lat city centre, has been upgraded into an international airport with the runway 3.250 m long which may accommodate medium-range aircraft such as A320, A321 or equivalent. The road from Lien Khuong airport to Da Lat has been upgraded to a 4-lane highway. The road connecting the two cities of Da Lat and Nha Trang with the length of 140 km has shortened the distance and time between the two big tourist centers. The project Highway Da Lat - Dau Giay, railway Da Lat - Thap Cham and Eastern Truong Son road is being constructed.

B4. Communication

The modern communication, post - telecommunication system, satisfying well the requirements of socio-economic development of the local and investors. The number of telephone subscribers in 2009 is 1,834,600 (of which 297,471 home phones and 1,537,129 mobile phones), attained the rate of avarage of 154 subscriber/100 people.

B5. Tourism potential

With the advantage of climate, landscape and forest resource, for long tourism has been a resource and strength of Lam Dong. Lam Dong’s forest is an area for reserving rare animal and plant gen resources, functioning aquatic resource protection watershed of seven large river, stream systems. The biological diversity of this ecosystem plays an important role in the tourism landscape, especially Da Lat pine forests. Together with rivers, streams, lakes, lagoons, waterfall,... Lam Dong forest has created population attractive for home and abroad tourists such as forest landscape surrounding Dalat, Tuyen Lam lake resort, lake resorts Suoi Vang - Dankia, love Valley resort, Datanla waterfall resort, Prenn waterfall, Pongour waterfall, Dam B'ri waterfall, Mount Lang Bian.

The northern tourist center includes Da Lat city and surrounding areas. Da Lat has many wonderful natural landscape famous for lakes, waterfalls and pine forest, beside the buildings of high cultural - artistic value, attractive for tourists. Da La currently has an 18 hole golf attaining the international standard. The rest house, hotel system can accommodate over 30,000 passengers/day, 20 hotels of which attaining international standard from 1 to 5 stars. Da Lat is considered the tourist center of Vietnam and the region.

The south tourist center includes Bao Loc town and vicinity: Bao Loc is situated on Bao Loc - Di Linh plateau with the height of 1,000 m, temperate climate, with beautiful natural scenery. This is the residential locality of ethnic minorities, each people has a separate, unique cultural identity quite well suitable for developing tourism and culture. Here there are valueable sites appropriate for sightseeing, researching such as Phu My - Cat Tien site...

C. Economic indicators

- Gross product in the whole province in 2009 (in accordance with 1994 price) is estimated at 10,543.69 billion dong, up 12.9% over 2008, reaching the plan. Of which the agriculture, forestry and aquatic sector reached 5,450.57 billion dong, up 9.4%; the industry and construction sector reached 2,759.41 billion dong, up 16.4% and the service sector reached 2,333.714 billion dong, up 17.3% over 2008.
- The total state budget revenue in 2009 reached 5,215.65 billion dong, of which the collecting in the province reached 2,687.37 billion dong, the subsidise revenue from the central 1,324.84 billion dong and other revenues reached 1,203.44 billion dong.

D. Social indicators

D1. Education - Training

- Educational outcomes at the and of school year 2008-2009:
  + Preschool education: at the and of year 51,669 half-boarding children; of which kindergartens had 7,439 children, decreasing by 7.1% compared to the previous year; nursery schools had 44,230 children, increasing 3.6% compared to the previous year.
  + The total primary school students at the end of year is 116,654 students, down 3.4% compared to the previous year; secondary schools have 93,963 students, down 1% compared to the previous year; high schools have 47,193 students, down 0.3% compared to the previous school year.
- The situation of the school year 2009 - 2010: At the beginning of year, the education sector put into use 9,030 new classrooms and basically solved the condition 3rd shift studying students. The whole province currently has 306,450 students of all levels, up 0.3% over the previous year.
- The work of secondary education universalization is enhanced and directed and changed well in locals. Up to now, the whole province has had 12/12 districts, towns and cities recognized secondary school education universalization.
- Dropout situation: According to the data of Department of Education - Training of Lam Dong, at the beginning of school year 2009-2010, the number of dropouts at all levels: primary schools with 12 students (0.01% rate), middle schools have 172

students (0.18% rate), high schools have 174 students (0.35% rate), the main reason is due to poor school performance (70%).

D2. The work of ensuring health, food safety and hygiene.

- In 2009, in addition to regular duties, Lam Dong health sector strengthened monitoring of infectious diseases: dengue fever, malaria, respiratory infections caused by influenza virus influenza A (H1N1) and influenza A (H5N1); improved the quality of medical care for people, especially free medical care for the poor, children under 6 years old and over 85.
- The situation of infectious diseases (by 15/12/2009): tuberculosis patients with 352 new cases, no death (the total number of tuberculosis patients currently treated and managed is 440 cases). With leprosy: detected 04 new patients, the province is currently manageing and treating 222 leprosy patients, and taking care of 173 disabled leprosy patients. In the prevention of HIV/AIDS, discovered 97 new cases, the cumulative number of HIV infections so far is 1,413 cases, the cumulative number of AIDS deaths is 236 cases.
- The work of vaccination, the protection of maternal and child health - family planning and prevention of malnutrition continue to be maintained. Held for 19,896 fully immunized children under 1 year, reaching 98.89% of the plan; immuned measles vaccination for 21,115 of children under 6 years of age, immuned tetanus vaccination for 18,759 pregnant women, reaching 91% of the plan and immuned tetanus vaccination for 9,817 women of childbearing age, reaching 78.12% of the plan.
- The work of the medical care at treatment facilities in the province is 2,593,576 times, up 5% over the same period, the number of inpatient was 148,261 times, up 7% over the same period, the number of days of inpatient days was 757,671 times, up 3.1% over the same period in 2008.
- The work of sanitation and food safety: from the beginning of the year till now took place 01 food poisoning case with 38 cases, no death, the cause was identified as E. coli. The number of food production and processing facilities for food safety and hygiene is 836, reaching the rate of 92.6%, the number of business facilities of food and food service reaching hygiene standards of food safety is 9,802, reaching the rate of 91.1%.

D3. Cultural - propaganda activities

- The culture and information sector of Lam Dong maintains and implements various activities, ensuring the political tasks and meet the needs of enjoying culture and art of the strata in the province.
- Museum open regularly and welcome over 3,500 times of tourists to visit and study. The provincial library open for 29,740 times of readers to read and borrow books, newspapers, documents, add 10,652 new books. Mobile projection teams and dance music groups continue to organize film shows and perform 457 concerts for remote areas, ethnic minority areas, attracting over 134 thousand views.
- Inspecting, checking the points of cultural services and tourism with 736 establishments, 102 establishments violated, confiscated 3,979 CD-VCD.

D4. Gymnastics and sports activities

– Public sports movements: Are usually maintained with increasingly rich content, attracting the large masses involved. In the year has held 27 provincial tournaments of 16 subjects (traditional martial arts, table tennis, badminton, soccer, volleyball, chess, tennis, athletics, weightlifting push, tug...) attracting over 2.8 thousand times of athletes to compete.

– High-achievement sports: Joined 38 international, national and regional tournaments, with 16 subjects. The results were 97 medals (26 gold medals, 29 silver medals, 42 bronze medals). Till now, there are 05 masters (there is 01 international masters IM) and 10 national level-I athletes. Are training, coaching 124 talented athletes and team of 10 subjects.

D5. Poor and policy people

– Policies for supporting and helping the policy people, poor households and poor regions are continued to be paid attention for commencement of implementation. Especially, at the moment, the province is commencing the project of sustainable and rapid poverty reduction in Dam Rong district in accordance with the Decree 30a of the Government; simultaneously, use the local budget to invest for 16 communes and 94 hamlets/villages with total investment of over 4,400 billion dong from now to 2015 ; besides, continue to integrate to complement the project of supporting the poor in housing in compliance with the Decision #167/2008/QĐ-TTg of the Government's Prime Minister with the program on deletion of temporary housing of the province, support in production development, provide vocational training and solve the employment, stabilize the life for low-income people; commence the program on investment for socio-economic development such as programs 134, 135 and national target programs with total investment of over 260 billion dongs.

– The current number of disabled ex-servicemen, revolutionary martyr and merit people in the whole of Lam Dong province is 27,897 people, including disabled ex-servicemen: 3,469; revolutionary martyr families: 4,069; sick solders: 1,450; armament hero: 03 people; people having their merit with the revolution: 902 people; people carrying out a war of resistance against the enemy: 16,903; revolutionary veterans: 50 people; cadre rising up in arms: 81; people infected with chemical toxic: 970 people.

– According to data of the Department of Labour, War Invalids and Social Affairs of Lam Dong province, till 2009, the whole province has remaining of 23,402 poor households, accounting for 8.51%, reducing 2.99% with 5,333 households compared to the beginning of the year; among this, poor households of ethnic minorities are 13,320, accounting for 29.6%, reducing 3,930 households, equal to the reducing rate of 3.4%.

– The whole province currently has 7,318 poor households who live in temporary, roof-leakage houses, mainly in remote districts. Vietnam Fatherland Front in Lam Dong province has continued to mobilize more resources to support the poor households in housing and commenced construction of over 1,300 houses.

2.2.2.2. Economic – social status of localities located along the project route

A. Da Huoai district

Da Huoai is the Southwest district of Lam Dong province; total natural area is 495.3 km^2; The population in 2009 was 33,864 people. The average population density is 67.9 people/km^2, ranking 8/11 districts of Lam Dong province. Da Huoai has 8 communes, 2 towns, among these, there are 3 communes which are poor and especially difficult.

Da Huoai has average level of 300m compared to the sea surface. The climate is very different from Dalat, Bao Loc, and its climate is nearly with that of provinces of the South East region. The terrain is gradually low from the northwest to Dong Nai river. This is the terrain with transitional features between highland terrain and plain terrain.

Area of forest and forestry land in the whole district:

+ Da Huoai afforestation yard manages 14,571 hectares of forestry land, 567 hectares of agricultural land and 61 hectares of other land; among this, plan for protection forest: 3,611 hectares, production forest: 11,588 hectares.

+ The Project management unit of Nam Huoai forest manages 19,504 hectares; among this, plan for protection forest: 14,567 hectares, production forest: 4,907 hectares.

Land using structure of Đạ Huoai district is as below: Agricultural land 11,805 hectares (accounting for 23.8% natural area); Forestry land 35,845.4 hectares (accounting for 72.4% natural area); Single-purpose land 1.101,6 hectares (accounting for 2.2% natural area); land which has not yet been used: 778,0 hectares (accounting for 1.6% natural area).

Economy:

Da Huoai is an area with potential in forest with many kinds of precious woods, especially there are plenty of bamboo supplied to the paper industry and many small industries: rattan, tooth-pick, bamboo, incense,...

Da Huoai's land is suitable with industrial trees, fruit trees and grain crops. As there are many rivers and streams with plenty of natural vegetation, and it is in the middle of the road which connects Ho Chi Minh city and Dalat, at the intersection of national road 20 with Đạ Tẻh, Cat Tien by road 721, so Da Huoai has many advantageous conditions to develop the tourist services apart from its main economy of agriculture – forestry – industry.

The output of the grain crops in 2009 was 2,751 tons, per capita 81.8 kg; among this, rice output was 2,337 tons. Total actual production value in the district in 2009 was 843,916 million dongs.

Cashew is the long-day industrial plant with strong development of the district with output in 2009 of 2,066 tons on the area of 5,035 hhectares – and Da Huoai is the district with largest cashew area in Lam Dong province. This type of tree is very suitable with the large area of empty lands and uncovered hills, and Da Huoai supplies cashew for Cashew processing enterprise.

A1. <u>Madagui town</u>

Madagui has area of 2,543.88 hectares, among this, agricultural land accounts for 2,198.38 hhectares; forestry land accounts for 509.29 hhectares; single-purpose land accounts for 232.26 hhectares. The existing population of the town is 8,990 people.

Madagui town has much potential in developing industrial trees, especially processing industry, knitting, manufacture and trading of construction material. The town has 45 businesses with their activities in industry and small handwork industry. The total cultivation area is over 1,199 hhectares. The town has 9.06% poor households.

A2. <u>Ha Lam commune</u>

Ha Lam commune has total area of 4,275.5 hectares; among this is 1,817.16 hectares of agricultural land, 2,410.14 hectares of forestry land. The population in 2010 is 3,634 people, among them are 36 poor households. Till now, the commune has completed to popularize the secondary level; the whole commune with 90% households using clean water, 98% households using electricity and 17% malnutrition children. Total production value is 35.827 billion dong. Per capita income is about 11 million dong/person/year.

A3. <u>Dam Ri Town</u>

Dam Ri town has the natural area of 4,0169 hectares, of which 1,33907 is the agricultural land, 2,59938 hectares are forestry land and 78.4 hectares are unused land. By 2009, the population is 4,751 with the population of 1.141 households, population density of 107 people/km^2. In 2009, cultivated land area for planting powder tuber trees is 5 hectares, of long time industrial trees is 900.5 hectares. For the early 9 months of 2010, the commune's budget was gained over 1 billion Dongs.

B. Bao Loc City

Bao Loc City was established on April 08th, 2010 on the basic of preserving 23,256 ha of the natural area. Bao Loc City is situated in the 20 national road, 110km from Da Lat City, 190km from Ho Chi Minh City and 100km from Phan Thiet (Binh Thuan).

Bao Loc City makes up of 2.38% of Lam Dong Province, in which 17,294ha is for agricultural cultivation and 1,584ha for forestry. Most of whom living in Bao Loc City is Kinh people with 150,428 peple/40,104 households; 745 households are minority people making up of 2.33% Boa Loc population.

Differing from Da Lat, Bao Loc has focused on developing agricultural and industrial sector. Up to now, Bao Loc is continuing to develop tea planting in both cultivation area and productivity. Currently, Bao Loc has 25 tea processing plant and hundreds of small scale tea production plant which can process as much as 150,000 ton of fresh tea per year. Bao Loc has already established the high specialization of centralized production areas, combining material production and processing industry, meeting the demand and tastes of both domestic and oversea customers. Tea nearly plays the exclusive role for southern provinces.

Bao Loc is a locality which got the favorable condition to turn the mulberry cultivation into the large scale and advanced economic-technical sector, closing from mulberry raising to silk processing and production. Bao Loc has been known as a location where silk sector is originated and developed with 9 silk production plant and 18 bases, hundreds of supplier for the market with the amount of 400 tons of automatic silk, 500 tons of mechanical silk, 1,300 tons of cotton fiber silk, and more than 5 million meter of silk and other kinds.

Bao Loc is also suitable with growing some kinds of fruit trees and those kinds of fruit trees also gain high productivity because the province can grow and supply the fruits which are produced in different season in other southern provinces. Those fruits are durian, rambutam, "mit to nu" and avocado… In addition to cash trees, Bao Loc is also considered as a province rich of mineral resource. Bao Loc has attracted the investment of many businesses for construction material production, mining and mineral refinery.

Bao Loc has a large potential to develop mining industry and mineral processing. Bao Loc is preserving a huge storage of bauxite and kaolin in which 378 million tons of bauxite with 209 million tons of C1 (Al_2O_3 = 44,69%; SiO_2 = 6,7%)

Industry of Bao Loc City is accounting for over 40% industrial ratio of the whole Lam Dong province, including tea, coffee, silk and textile and garment processing... Plants, enterprises is concentrated on Loc Son industrial park, Ward 2 and Dao Lao commune. Up to now, 32 projects were certified and the total of invesment registration is 1,240 billion Dong and 25.7 milion USD.

There are so many beautiful waterfalls, lakes, streams such as: Dambri waterfall, Seven floor waterfall, Nam Phuong Lake, Da Ban stream…. Dambri tourist base is famous for imposing waterfalls with the height of 57 m and primary forests, which can serve camping and resting…

B1. Dai Lao Commune

The total natural area of Dai Lao Commune is 5.925,79 ha, in which the residential land is 59, 04 ha; agricultural land is 5.579,93 ha (including agricultural cultivating land: 3.814,61 ha, forestry land: 1, 751, 21; fishery raising land: 14, 11 ha), and other lands: 415, 82 ha. The area has included 3.051 households and 11.562 people, 330 skillful workers and most of those workers are embroidering workers and construction worker…., and 24 enterprises doing business in the locality. Up to now, 100% household uses telephone/ internet or mass media. The total number of poor household in 2010 is 173 household, 18% children under 5 years old is malnourished.

B2. Loc Chau Commune

The total natural area of the commune is 3.620 ha, including 2.897 ha agricultural land (2.162 ha tea, 687 ha coffee, 2, 4 ha mulberry, 2, 4 ha fruits), 139 ha forestry land and 226 ha unused land. The commune has 4.079 households and 16.438 residents. The agricultural production of the commune is quite stable with nearly 10.000 cattle and all kinds of 20.000 poultry. There are 14 businesses situated in the commune and more than 500 household doing business and supplying service.

B3. Ward 01

Ward 01 is the central ward of Bao Loc City, including 431 ha of the natural area with 10 streets and 11.785 people living in, and most of administrative office is located there. The main economic development of the ward is trade-service, terminal market, telecommunication, electric power. More than 1.000 businesses and production bases are doing business there. The ward merely consists of 33 ha agricultural land, therefore, the agricultural output accounts for 3.5%. The handicraft – industrial production value reach 23.1% of total sectors. The trade and service are the spearhead sectors contributing remarkably for the development of the locality, making up of 73.4% the proportion of the economic structure.

B4. B'Lao Ward

With 540 ha of the natural area and as much as 407 ha agricultural land (392 ha tea and coffee and 15 ha subsidiary crops) has owned by the ward. The proportion of economic structure in turn is service – trade, agriculture and industry. There are 3.149 household and 11.377 people living in the ward.

B5. Loc Tien Ward

Loc Tien Ward has owned 1.301 ha of the natural area, including 1.090 ha of agricultural land, having no more forestry cultivation land. The current population of the ward is 13.480 people and 3.370 households. The total revenue in 2010 is around 7.180 million VND. The industry – handicraft, trade and service has being developed significantly, creating favorable condition for developing business and production, and transferring service types.

B6. Loc Son Ward

Loc Son Ward has included 1.236 ha of the natural area with 17.161 population and 4.767 household. Up to the year of 2009, the locality has owned 677 ha of agricultural land, 9 ha unused land, the specialized land, and has not owned any forestry land. The ward is including 46 businesses, factories, and 345 handicraft households, meeting somehow the job requirement of the local people.

B7. Loc Nga Ward

With 1.603 ha area, there are 2.463 household and 9.802 people living in the ward. Most of 1.460ha of the ward area is used for agricultural target and the remaining of 20 ha is unused land.

C. Bao Lam District

Bao Lam District is belonging to Di Linh – Bao Loc highland, located between Bao Loc Town and Di Linh District. With its natural and geographical characteristics, Bao Lam District has advantage and potential in term of developing social- economic sector at a high pace of Lam Dong province. The district is located in the central area of industrial development of the province and plays an important role in the course of social economic development of the province, especially in the heavy industry sector.

With 146.344 ha of the natural area, Bao Lam district is one of the largest area of the province (accounting for 19%). The 20 national road, and the interprovincial road from Bao Loc to Ham Thuan – Da Mi hydropower project help Bao Lam district to access faster to other developed provinces and cities such as Ho Chi Minh city and Eastern provinces, coastal provinces in South and central region.

The geology of Bao Lam district is mountain and plain and relatively flat. The average altitude is 900 m. The annual rainfall is very large, therefore, the reserving water is also abundant (8-10 billion m^3/ year) that is enough to supply for the provincial households, agricultural and industrial production activity in dry season. The district has already built the Tan Lai reservoir at Loc Thang commune and some of the hydro electricity projects helping to supply enough water for people living in Loc Lam commune.

The district has owned the most abundant natural resource of the province, accounting for 10% of the total value of the natural resource in South East Region, and most of those natural resource are Bauxit. At present, Vietnam National Coal and Mineral Industries Group (Vinacomin) has invested to build Alumin factory for Bauxit mining industry with the amount of coal and mineral reserve is as much as 630.000 tons per year.

In addition, the district has some natural landscapes and contains diversified humanities where many different cultures of different people are converged; therefore, the district has a large potential to developing tourism sector and resort services in the future.

Communes: Bao Lam district has 14 administrative units, including Loc Thang commune and 13 other communes.

Demographic structure: Bao Lam district has a large area and a sparse population; the total number of population of the district is 109.994 people and the population density is 75 people/ km^2

Economy:

The current economic structure of the district is Agriculture Forestry – Industry – Service; the identified economic structure in 2015 is Industry – Service – Agriculture Forestry. The strong potential to develop agriculture field of the district is tea, coffee (those are the largest intensive area cultivation cash plants in the province). In addition, a huge reserve of Bauxit aluminum mine is situated in the district, creating favorable conditions to develop the industrial mining of the locality. Some large hydro electricity projects such as Dong Nai 3, Dong Nai 4, DamBri, Dai Nga has been started to construct and expected to produce electricity in 2011.

The land area which can be used for cultivating is 53.000 ha, up to now; the district has grown 43.709,5 ha of long term tree, in which nearly 39.242,6 ha can be harvested.

The district is the largest area supplying tea of the province with the area is 13.187,5 ha, and the annual fresh tea has reached around 98.500 tons, 26.692,2 ha of coffee cultivation and the harvested area is 25.395,2 ha.

The abundant forestry resource and the geology which can be changed a part of protection forest area to production forest area all contribute into the economic development of the district. The forestry land area is 91.825 ha. Bao Lam district is actively implementing the plan to develop the forestry economy, to develop forestry garden which is linked closely with settled agriculture, settlement and to develop society and economy of local people.

Because of the underdevelopment of processing, commerce, service, the total value of revenue of the district still remains low. GDP of the district reaches 11 million VND per year (common level of the province).

C1. <u>Loc An commune</u>

Loc An commune has 4.849 ha of natural area with 17.612 people living in. The current used land area of Loc An commune mainly is used for agricultural target, accounting for 4.182 ha, forestry land is not included.

D. Di Linh District

Di Linh district is not far from the central area of the province and other big cities. The district has a good climate, and abundant mineral and land resource. Di Linh land is fertilizing Banzan and the total area of natural land of the district is 161.463.81 ha, in which 57.561,47 ha of agriculture land, 90.523,38 ha of forestry land and 5.715,15 ha of unused land.

Administrative units of the province include Di Linh district town and 18 communes. The average population of the district in 2009 is 154.786 people, and the population density is 96 people / km^2.

Economy:

The output of cereals in 2009 of the district was 25.845 tons, and the output per capita was 167,0kg, in which the rice output was 12.741 tons.

Di Linh has sub-region weather which is suitable with some kinds of cash tree, especially coffee. The area of long term cash tree of the district in 2009 was 42.248 ha, accounting for 23,1% of the total area of long term cash tea of the province, and the major area is tea and coffee. The area of growing tea is 983 ha and the total output of fresh tea in 2009 was 6.615 tons; the area using to grow coffee is 41.253 ha and the total output of coffee in 2009 reached 95.411 tons (accounting for 31,3% the total output of coffee of the province). The method to grow long term cash tree of the local people is more advanced than that of other localities.

Forestry: In five years (2005 – 2009), the district planted 745 ha of centralized forest, assigned 41.885,52 ha/ 1.331 household to protect the forest, increasing 6.2% per year, took care and grew 2.656 ha, raising the coverage area to 63%. Some models of combined agricultural forestry farm gained positive efficiency in terms of economy – society – environment, creating job for thousands of household in the remote and mountainous area. However, deforestation and forest burning have remained. The wood exploitation output in 2009 reached 20.900 m^3.

Transportation: The rural transportation network has established ad planed following some main national roads such as 20, 28 national roads. Those two roads playing a special role for the district's economy are 20 National Road passing across Duc Trong district and Bao Loc district, 28 National Road starting from Ham Thuan Bac to Dac Nong. The quality of both National Roads is quite good.

Electricity network: National electricity network has finished building and covered all communes in the district. Up to now, 80% population of the district can use electricity supplied from national electricity network. However, because of natural difficulties, some hamlet and village have not installed the electricity line.

Post- office: The communication system of the district is developed, all communes now can use telephone and can access Internet, but the transmit line is quite low. All communes have post-office station; central of those communes have the central post-office and telephone central office.

D1. <u>Dinh Trang Hoa Commune</u>

Most of people living in the commune are Central highland originated minority people and free resettlement people from many other regions. The natural area of Dinh Trang Hoa commune is 5.355,57 ha, in which 167,14 ha is forestry land and 300,89 ha is unused land. Among 4.497,20 ha agricultural land, 139,6 ha is used to grow wet rice field , 150ha to grow tea, and 4.120 ha to grow coffee. Until the end of 2009, the commune has 3.094 household and 14.037 people living in, in which as many as 400 household (13,2%) is poverty household.

D2. <u>Lien Dam Commune</u>

Lien Dam commune has owned 8.477,83 natural land and 10.070 people, the density is 118,28 people per km^2. Agriculture sector accounts for 80% the proposition of the commune's economy and the total area using for production activity is 6.071,19 ha. The commune has 1.947,53 ha forestry land and 131,24 ha unused land. The total amount of local production under the current value is about 252.150 million VND. GDP of the commune in 2009 reached 15 million VND per capita. At present, 90% hamlet and village is able to use clean water, 100% household can use electricity from national electricity network. The commune remains 343 poor household.

D3. <u>Di Linh District Town</u>

Di Linh district town is the center of the province which the natural area is merely 1.826, 33ha, in which 1.422,02 ha agricultural land (98,48 ha land used to grow tea, 1.226,66 ha land used to grow coffee). The district does not have forestry land, and has 3,18 ha unused land, and the rest is specialized land. The district has a cooperative transportation including 29 vehicles. The district has 5.122 household with 18.994 people, the population density is 1.040,20 people per km^2 . GDP is 15 million VND per year. Up to now, the district has remained 172 poor household and 100% household can use clean water.

D4. Tan Nghia Commune

The total natural area of Tan Nghia commune is 3.540,99 ha, in which 3.258,25 ha is agricultural land, 9,87 ha is forestry land and 31,38 ha is unused land. The population of the commune is 6.940 people and the density is 196, 05 people per km^2. The total production in the commune under the current money price in 2009 is 155 billion VND and the GDP under the current money value is 10, 5 million VND per year. 80% of the economic structure of the commune is agriculture, breeding is 15% and other services are 5%. The proposition of poverty household in 2009 is 12% and the malnourished children is 17,9%.

D5. Dinh Lac Commune

Among 3.336,06 natural area, Dinh Lac commune has 2.801,36 ha agriculture land, 110,48 ha forestry land. The economic structure of agriculture – forestry sector accounts for 70%, industry – construction sector is 9%, commerce – service makes up of 21%. GDP in 2009 is 15 million VND per capita per year. The economic growth rate in 2009 reaches 14%; however, the commune remains 6,1% poor household, 16% children under 5 year old is malnourish.

D6. Gia Hiep Commune

The total area of Gia Hiep Commune is 4.777,82 ha, in which the forestry area is 1.037,96 ha, the agriculture production area is 2.850,26 ha, fishery area is 15,47 ha, traffic area is 45,41 ha and other lands are 828,72 ha. The commune has 11 hamlets, in which 3 especially difficult hamlets. At the present, the commune has 10.309 residents and 2.585 household, including 113 poor household (3,65% population of the commune) and 318 household is individual business.

D7. Tam Bo Commune

Tam Bo commune has 27.690,9 ha natural area, including 1.855,35 ha agriculture land, 24.444,77 ha forestry land and as much as 1.143,61 ha unused land. The total number of population is 6.319 people, density is 22,8 people per km^2. The GDP of the commune reaches 11 million VND per capita per year. The permanent worker reaches more than 95%; the poor household proposition is 9,3%.

E. Duc Trong District

Duc Trong district is located in the area included many important route of Lam Dong province such as: 20 National Road (Da Lat – Ho Chi Minh city) 27 interprovincial road (Ninh Thuan – Dak Lak) and Lien Khuong airport creating favorable conditions to develop the district; Duc Trong is becoming one of the district playing important role in the socio – economic development of Lam Dong province.

The natural area of Duc Trong province is 901,8 km^2, population of the district is 166.377 people (in 2009) accounting for 9,2% province area and 13,8% province population. The population density of the district is the third highest in Lam Dong province: 185 people/ km^2.

Duc Trong district is one of districts which playing an important role in developing society and economy of Lam Dong province. Duc Trong district has great potential in many fields; therefore, the development of Duc Trong district is comprehensive development including agriculture, forestry, industry, handicraft, commerce and services. Duc Trong district is also one of a familiar landmark for both domestic and oversea tourist. There are some well-known waterfalls such as Lien Khuong, Gougah, Poongour which are very attractive to tourists. The planning Nam Son Lake will become a tourism destination and many cultural and sport activities will be organized there. The district has Lien Khuong airport which is the gateway to Da Lat by air.

Society – Economy

Duc Trong has a developed commercial network, all communes of the district have market, and shop system, purchasing agency, and trading. The market in Lien Nghia district has a large scale and is improved to develop as a commercial center of the district. Some favorable conditions in nature and facility infrastructure has contributed into the comprehensive development of Duc Trong district and into the positive structure transfer and into the high growth rate of the district. The total products value in the district under the actual value in 2009 is 2.744.290 million VND. Agriculture and forestry output value accounts for 59.96%, industry – construction value make up of 13, 92%, commercial services value is 26,12%.

At present, the district has five foreign invested projects funded more than 9 million USD of the initial investment funds focusing on vegetables, flower, fruit planting and vegetable processing, dairy cattle raising and milk processing.

Agriculture and forestry production is the major sector, attracting 84, 6% social labor. In the past few years, based on the positive influence of agricultural and forestry encouragement, the credit supporting has reached a high growth rate (11, 42%) which is much more than that of province and twice the rate of nationwide.

E1. <u>Ninh Gia Commune</u>

The total natural area of Ninh Gia commune is 14.369,24 ha, in which 5.007,14 ha is agricultural land, 7.043,24 ha is forestry land (3.500 ha is used to plant coffee), 316,30 ha is unused land, and the rest is non-agricultural land. The population of the district is 12.785 people; the density is 89 people/ km^2. There are 294 commerce – service bases in the district, 111 poor house hold accounting for 3, 45% the total number of the district's household.

E2. <u>Phu Hoi Commune</u>

Phu Hoi commune has 10.729,78 ha natural land including 4.755,85 ha agriculture land, 4.517,77 ha forestry land, 317,96 ha unused land. Up to November 31st 2009, Phu Ho commune has 4.029 household with 17.930 people living in 13 hamlets and the population density is 166 people/ km^2.

E3. <u>Lien Nghia District</u>

The total natural area of Lien Nghia district is 37, 70 km^2. The district has 10.691 household and 43.171 people living in. The economic growth rate reaches 24% per year. The production value is 2.147 billion VND, in which agriculture and forestry sectors account for 32%, handicraft and construction sectors make up of 22%, trade and service sectors are 45, 6%. The district has 2.255,19 ha agriculture land in which the cultivated area is 4.271 ha, subsidiary crops is 3.765 ha with 30 ha cultivating vegetable and flower following a high technology. The most potential sector of the district are: processing agriculture and forestry products, food and food staff, mechanic, construction materials, agricultural equipments, fertilizers, The ratio of poor household of the district now is 1, 67% and malnourished children are 15%.

E4. Hiep Thanh Commune

Hiep Thanh commune has owned 3.094,34 ha natural area, in which 1.180,70 ha is used to agricultural production, 1.025,08 ha is forestry area, 505, 43 ha is unused area. The district has 4.140 household and the density is 488 people per km^2. Trade and service activities in the district are developed remarkably. In addition, transportation sector is also developed favorably.

E5. <u>Hiep An Commune</u>

The natural area of Hiep An commune is 5.975,45 ha, including 5.512,92 agricultural land (3.872 ha forestry land and 1.640 ha agriculture production), 319, 99 ha non-agriculture land, 142,54 unused land. The population of the commune is 11.040 people with 2.816 household. The total production value reaches 195,5 billion VND. The GDP of the district is 18, 3 million VND per capita per year. There are 1 brocade weaving workshop, 3 agricultural tools repairing workshop, 90 small enterprises which have a sustainable income and there are 28 developed enterprises attracting many local labors.

G. Da Lat City

Da Lat is Lam Dong provincial city, located in Lam Viet high land, and the altitude is 1.500m. Owned many beautiful landscapes, Da Lat is one of the most well-known city in terms of tourism.

Geology and nature

Da Lat city is situated in Lang Biang high land, in the North of Lam Dong province. In the North, Da Lat is bordering with Lac Duong commune, in the East and the South East is bordering with Son Duong commune, in the West and the South is bordering with Lam Ha and Duc Trong commune. The total area of Da Lat city is 393,29 km^2, surrounded by high and continuous mountains. Da Lat geology is divided into two oblivious levels:

+ Low geology level is the central area which has basin shape including round topped hills, gentle slope and the altitude is around 25-100 m, waving shape and weak cleavage, the medium height is 1.500m.

+ Surrounding the basin area is the top mountain with 1.700 m height creating a belt preventing central area from wind. In the North East, there are two low mountains: Hon Ong (Lap Be Bac 1.738 m) and Hon Bo (Lap Be Nam 1.709 m). In the North, there are Lang Biang high land including Ba mountain (Lang Biang) with 2.169 m height which is extended under Northeastern – Southwestern axis from Da Sar spring (pouring into Da Nhim) to Da Me spring (pouring into Da Dong). The East is blocked by Gio Hu mountain range (1.644m). In the South West, mountains is directed into Ta Nung mountain locating between Yang Soreng and the typical mountain peaks are Pin Hatt (1.691 m) and You Lou Rouet (1.632m).

Outside the highland, there are some mountain slopes at 1.700 height pouring into the below high lands suddenly which has 700 m to 900m height.

Climate: Because of the influence of the altitude and surrounding pine, Da Lat climate is characterized as the cold zone. The average temperature is 18 – 21^{o}C, the highest temperature has never passed over 30^{o}C and the lowest is not lower than 5^{o}C. Da Lat has two oblivious seasons. The raining season is from May to October, the dry season is from December to April. In summer, it will rain in the afternoon and sometimes is hail. The average rainfall is 1562 mm and the humidity is 82%.

Economy:

Agriculture: the scale and area used to plant the annual tree has tended to increase year by year because of the adjustment of crops structure, the enforcement of reclamation on the area which has agricultural potential and unused, the increase of crops, intercropping. Up to 2005, the area cultivating annual plant reached 97.134 ha, increasing 19.550 ha compared to 2000, the scale and area cultivating annual plant increase continuously in five years and the average increasing of each year is 4.6%. The food crops area increase quickly from 21.816 ha in 2000 to 32.719 ha in 2005, the average annual increase is 8.4%; in which the area using to cultivate vegetable and flower also increase, the area cultivating vegetable increases from 962 ha in 2000 to 2.270 ha (increasing 1.308 ha).

The food plant cultivating area alone is sustainable from 50.000 to 51.000 ha in five years.

The potential of Da Lat's economy is tourism and planting vegetable and flower. Most of professionally flower planting area of Lam Dong province is in Da Lat city. The total agriculture cultivation area of Da Lat is 9.978 ha. The annual vegetable productivity is 170.00 tons, including 35.00 tons exported to the North East Asian countries and ASEAN. The annual flower productivity of Da Lat is 540 million branches, including 33.3 million branches exported. The total budget of the city in 2007 is more than 960 billion VND, and the GDP of the city is 890 USD, the economic growth rate is over 17%.

Paralleling with planting, cattle breeding is also developing sustainably, the number of some kinds of cattle increase sharply and captures an important role in agriculture production such as milk cow and pig. In breeding, the number of buffalo increases slowly because the breeding area is narrowed and the traction by buffalo is changed to use machine.

Forestry sector: Da Lat's forest includes many primary forests with various plants and animals, especially Da Lat has the special usage forest and protection forest. Da Lat's forest has many kinds, more than 400 kinds of wood including some worthy woods such as green pomu, Cam Lai, Gio, Sao, 2 leaves and three leaves pine, and others valuable forestry products.

Tourism: Tourism is a strong point but also is an element changing Dalat towards urbanization. With intrinsic advantages, Dalat is able to simultaneously organize many different types of tourism such as tourism resorts, ecotourism, cultural tourism - festivals, sports tourism and conference tourism, and tourism combined with scientific research. Da Lat is becoming the most attractive tourism destination for both domestic and foreign tourists.

G1. Ward 3

Ward 3 is the gateway to Da Lat with the total natural area of 27.24 km^2. The average population in 2009 is 16,801 and the density is 617 people per km2. The ward now has 527.68 hectares of agricultural land, 1,940.04 hectares of forestland, 240.35 hectares of non- agricultural land and 15.91 hectares of unused land.

G2. Ward 10

Many government agencies located in the ward, residents is large. The ward has the total area of 1379.37 ha, of which 491.71 hectares of agricultural land, 387.36 ha of forest land, 493.93 hectares of non- agricultural land and 6.37 hectares of unused land. The population of the ward is 15,147 people, the density is 1098 people per km2. The agricultural activities on the ward mainly focus on planting vegetables and flowers in greenhouses (over 17ha). The oriented economic development model of the ward is "Services - tourism - commerce combining with agriculture and forestry."

G3. Ward 11

Ward 11 has a total natural area of 1643.89 hectares, of which 658.9 hectares of agricultural land (including the types of artichoke, vegetables, flowers with the productivity of 15 thousand tons of vegetables and over 200 million cut flowers of all kinds), 684.32 ha of forest land, 285.04 hectares of non- agricultural land, 15.63 hectares of unused land. As of 2009, the ward has 9,102 people, the density is 554 people per km2.

G4. Xuan Tho Commune

Xuan Tho ward's population is 6157 people living in an area of 6246.62 hectares and the density is 99 capita per km2. Currently, Xuan Tho has 1590.55 ha of agricultural land, 4146.57 ha of forest land, 268.71 hectares of non-agricultural land and 240.79 hectares of unused land.

G5. Xuan Truong Commune

Xuan Truong commune is located quite far from the center of Dalat city, has the total natural area of 35.64 km^2. The average population in 2009 is 5943 people; the density is 167 capita per km2. The fruit output rose more than 100 tons, 100.000 tons of coffee, 10 hectares of vegetables and beans, tea is of 200 ha. The poverty household is 16 accounting for 1% of all households in the commune.

H. Don Duong district

Don Duong District is located in the southeast of Da Lat, in the South of Lam Vien Plateau, with the altitude above 1000 m. The natural area is 61,032 ha, including 16,816.5 ha of agricultural land 38,344.8 ha of forest land. The district has 1 town, 9 communes with the population of 94,268 people, of which the ethnic minorities account for nearly 30%.

In the economic development prospection, the district converged many favorable factors – Being passed across by Highway 27, adjacent and the gateway to the central province of Lam Dong Da Lat, adjacent to the economic center of DucTrong, the characteristic of land is suitable for many crops, especially vegetables. On the other hand, in terms of tourism, the district can become the stop of visitors go to Da Lat to enjoy the mountainous scenery such as the Ngoan Muc Pass, Da Nhim Lake...

The terrain of the district is divided into three main forms: high-mountain terrain, gently sloping and wavy terrain, valleys and streams terrain.

Kinds of soil: Including “phu sa doc tu” soil, alluvial rivers, alluvial soil which lack of annual alluvion, red brown soil on basalt, red yellow soil on shale , red yellow Daxit Gzanit humus.

Infrastructure

- Transportation: The area has 34km of Highway 27 running through under the level 4 standard.

- System power supply: The completed power network covers all districts (except for 02 new hamlets has just separated from Kadon commune), supplying stable and being able to exploit the advantages of hydropower will create favorable conditions for developing the grid to meet power demand and production in the coming years and is the driving force for production development, particularly the processing industry.

- Telecommunications: Telecommunications Network thrive with the post office system, the operator have met the majority of local needs. All communes and towns already have telephones; the town center area has the post office points providing communication service for local people.

H1. Dran Town

The town has the total natural area of 13,544.4 ha, in which 968.3 ha of agricultural land, 10,046.2 ha of forest area and 364 ha of unused land. Currently, the town has 3654 households with 13,755 people living in, the density is 101.4 people per km2. Some towns achieve targets for 2010 as followed: Economic growth of GDP reached 15%, the

GDP is 15-16.trieu VND per capita per year, the children malnutrition rate is 11.9%; poverty rate is 6.78%.

2.2.3. DISTRIBUTION OF SENSITIVE RESIDENTIAL AREA AND BASEMENTS LOCATED ALONG THE PROJECT AREA.

Because of High Way 20 has been established long ago and is an important traffic route of the Dong Nai and Lam Dong province, many residential areas and schools, health care center on both sides have established.

2.2.3.1. Residential area distribution along the project area

Along with route, there are the residential clusters on both side of the road at some detailed destination:

Table 2.25. Distribution of the residential clusters along the project.

No.	1.5.11.4.1Agglomeration	Location
1	Agglomeration of Bau Ham 2 commune	Km3+500 - Km4+500
2	Agglomeration of Quang Trung commune	Km5+900 - Km7+500
3	Agglomeration of Gia Kiem commune	Km9+500 - Km15+700
4	Agglomeration of Phuc Tuc 2 commune	Km18+800 - Km22+500
5	Agglomeration of La Nga commune	Km34 - Km35
6	Agglomeration of Dinh Quan	Km45 - Km49
7	Agglomeration of Tan Phu Town	Km57 - Km60
8	Agglomeration of Phuong Lam commune	Km64 - Km67
9	Agglomeration of Phu Son commune	Km71 - Km73
10	Agglomeration of Magagui Town	Km77 - Km79
11	Agglomeration of Dambri Town	Km93+900 - Km94+600
12	Agglomeration of Bao Loc City	Km116 - Km122
13	Agglomeration of Loc Nga commune	Km126 - Km127
14	Agglomeration of Loc An commune	Km132 - Km133
15	Agglomeration of Hoa Ninh intersection	Km137 - Km140
16	Agglomeration of Di Linh Town	Km155 - Km159
17	Agglomeration of Gia Hiep commune	Km169 - Km171
18	Dai Ninh agglomeration	Km185 - Km187
19	Agglomeration of Lien Nghia Town	Km199 - Km206
20	Agglomeration of Phi Nom intersection	Km208 - Km209

21	Agglomeration of Da Lat City	Km229 - Km234
22	Trai Mat agglomeration	Km237 - Km239
23	Agglomeration of Xuan Tho commune	Km241 - Km242
24	Agglomeration of Xuan Truong commune	Km251 - Km252

2.2.3.1. Distribution of sensitive objects along the project area

Thanks to survey, investigation a long the Project line, sensitive establishments such as schools, hospitals, medical aid stations or populated areas such as markets are collected and shown in Table 2.26.

Table 2. 26. Distribution of sensitive establishments of project line

Ordinal number	Sensitive establishments	**Location**	**Distance from the line**
1	Ninh Phat church	Km6	50
2	Thang Long secondary school	Km9	60
3	Dau Giay general hospital	Km9+100	80
4	Vo Dong, Thanh Son Parish	Km10	60
5	Bach Lan Parish (Gia Tan)	Km13+400	50
6	Nguyen Ba Hoc Primary school (Thong Nhat district)	Km14	50
7	Phu Cuong Church	Km17 +050	60
8	Phu Cuong market (Phu Cuong market)	Km19 +100	30
9	Nguyen Du Primary school	Km45	50
10	Nguyen Thi Minh Khai High school	Km45+400	60
11	Tho Lam Parish	Km64	50
12	Phuong Lam market	Km65	30
13	Phuong Lam Parish	Km65+500	60
14	Trung Phu Trung highschool	Km69+500	50
15	Phu Lam Parish	Km70	50
16	Dai Lao health care centre	Km110+900	60
17	Loc Chau market	Km116+700	30
18	Hai Bà Trưng Hai Ba Trung primary school	Km117+050	50
19	Bao Loc high school and Training college	Km119	60
20	Hoa Lu kindergarten	Km123	50
21	Loc Son – Bao Loc primary school	Km123+200	45
22	Loc An B primary school	Km131+150	45
23	Loc An high school	Km131+800	50
24	General clinics of Loc An region	Km132	60

Ordinal number	Sensitive establishments	Location	Distance from the line
25	Loc An A primary school	Km132+200	45
26	Le Hong Phong high school	Km137+400	50
27	Hoa Ninh market	Km137+450	30
28	Vo Thi Sau primary school	Km154	45
29	Tan Nghia II primary school	Km160	50
30	Tan Nghia church	Km160+250	50
31	Phuoc Lac pagoda	Km160+600	60
32	Dinh Lac Market	Km162+300	30
33	Dinh Lac secondary school	Km163	45
34	Tan Phu church	Km165+450	45
35	Gia Hiep secondary school	Km170	50
36	Phu Hiep Parish	Km170+600	50
37	Phú Hiệp secondary school	Km171	45
38	Hiep Thuan primary school	Km184	60
39	Ninh Gia primary school	Km186+700	50
40	Ninh Gia secondary school	Km188+200	50
41	Son Trung high school	Km189+500	45
42	Nguyen Thai Binh high school	Km192+700	45
43	Son Trung primary school	Km196+800	50
44	K’Long primary school	Km214+600	60
45	K’Long church	Km214+700	60
46	Hiep An secondary school	Km216+400	50
47	Đinh An primary school	Km217+600	60
48	Tran Phu high school	Km235	100
49	Phan Chu Trinh secondary school	Km235+300	100
50	Xuan Tho medical aid station	Km242+800	45
51	Đa Loc – Xuan Tho church	Km243+900	50
52	Xuan Tho high school	Km245+200	70
53	Xuan Truong primary school	Km254+150	80
54	Xuan Truong high school	Km257+800	80
55	Tram Hanh – Xuan Truong church	Km259+300	70

CHAPTER 3
ENVIRONMENT IMPACT ASSESSMENT

3.1 IN PREPARATION PHASE

3.1.1 EFFECT SOURCES

In the preparation phase, some following main construction items in the project will affect natural and socio-economic environment:

- To occupy land (including area of land clearance and temporarily occupied area in implementation phase);
- To demolish existing works and clear the construction plan;
- To form the plan at the construction site.

The above activities cause some environmental effects as listed in Table 3.1.

Table 3.1. Sources causing arisen effect during preparation phase.

Order number	**Sources causing arisen effect related waste.**	**Type of waste arising**
1	*Clearing the ground for construction*	
1.1	Destroying old constructions	Waste: brick, debris, wood, various of steel and iron, rubbish, dust.
1.2	Cutting the trees, clearing the ground.	Wood, debris, waste.
2	*Making construction site*	
2.1	Building concrete mixing station.	Waste from plants.
2.2	Installing power source, water source	Waste from plants
2.3	Building materials stock, ground for casting paddle, camp for employees.	Waste from plants
3	*Making service road*	Rubbish, dust
Order number	**Unrelated waste**	**Factors causing effect**
1	Work of clearing the ground	Leaving and resettling in place, reducing agriculture land and aquaculture, disordering life of affected households, interrupting electric supplying , interrupting contact.
2	Destroying old construction	noise
3	*Making construction site*	Reduced agriculture land currently, noise

3.1.1.1 Effect sources relating to waste

a) Wastes from demolishing and forming the construction plan

In the site clearance, it is required to demolish 1,098m2 of houses of all kinds in 6 districts of Dong Nai province and 11,130 m2 of houses in 6 districts of Lam Dong province (*details stated in Table 1.13, section 1.5.5.2 - Cost estimate of volume for site* *clearance*), resulting in stone and soil wastes of about 80 m3 in Dong Nai province and 780 m3 in Lam Dong province. Main compositions are bricks, stones, and concrete and construction wastes … suitable to sub-grade. Besides, other materials such as milled wood, waste sheets and steel of kinds arise in this phase but it is difficult to quantify because the houses to be demolished are built with different materials. In general, volume of stone and soil wastes is little; all waste materials are reusable and non-toxic. They only make landscape bad-looking if not being cleaned.

In the site clearance, it is also required to cut down 15,370 trees in Dong Nai province and 26,890 trees in Lam Dong province (*details stated in Table 1.13, section 1.5.5.2 - Cost estimate of volume for site clearance*), resulting in a significant volume of wastes such as tree-trunks, branches and leaves. Normally, they are used for different purposes; however, small branches and leaves and milled wood remain much at the position and are collected to ensure landscape and environmental sanitation.

Spatially, these wastes are distributed along the route. These wastes are arisen within about 10 days at each position.

b) Wastes from preparation of the construction site

Wastes are arisen mainly from cleaning construction site, installing power and water supply system, constructing material storage, steel processing shops, beam casting yard and site hut for workers.

Main compositions of these wastes are milled wood, papers, steel and iron, bags and nylon … Its volume is difficult to evaluate because of diversification of machines and skills of workers. They are solid wastes and except for nylon bags, most of them are non-toxic and reusable.

Spatially, these wastes are mainly arisen at 16 construction sites in the preparation phase including Km1+880, Km35+712, Km65+056, Km86+700, Km88+850, Km97+900, Km129+500, Km139+300, Km149+303, Km177+800, Km183+376, Km189+200, Km194+771, Km217+810 and Km254+254, Km263+100.

c) Dust

- Upon demolishing old works (houses) in the scope of site clearance, a significant volume of dust arises. Up to now, there is no document to quantify a volume of dust emitted from this activity. In fact, this volume of dust is subject to method of demolishment and weather conditions. So, it is difficult to quantify satisfactorily. In empirical practice, dust concentration upon demolishing houses often exceeds 2-3 times as the allowable limit under QCVN 05:2009/BTNMT in a radius of 30-40m and Dust effect lasts 5-10 minutes after demolishment.
- Sub-grading the construction plan generates a significant volume of dust, especially on sunny days and wind speed of V > 1 m/s. In a range of 20m from the site boundary

windward, dust concentration often exceeds twice as the allowable limit under QCVN 05:2009/BTNMT in the sunny and windy weather condition. The construction sites along the route listed in item b are affected by dust effect. Dust effect lasts about 2 months in preparation phase.

3.1.1.2 Effect sources not relating to waste

a) Resettlement

Total area of residential land and houses permanently occupied is listed in Table 3.2.

Table 3.2. Quantity of soil, house and works to be cleared

Order number	Items	Unit	Dong Nai	Lam Dong	Total
1	Land tenure	m^2	157.891	130.761	288.652
2	Cultivated land	m^2	9.612	1.618.049	1.627.661
3	C4 house	m^2	451	1.935	2.386
4	Flat roof house	m^2	-	1.510	1.510
5	Floor house	m^2	9	2.788	2.797
6	Current house	m^2	638	4.897	5.535
7	Number of households must leave	household	32	32	64
8	Various of electric poles	pole	299	927	1.226
9	Fiber cable	md	148	58.747	58.895

b) Reduction of agricultural land area

+ Dong Nai province:

- *Agricultural land permanently occupied*

Total agricultural land permanently occupied is 9,612 m2.

- *Agricultural land temporarily occupied*

Total agricultural land temporarily occupied to arrange the construction sites is 1,200m2 for no more than 3 years.

+ Lam Dong province:

- *Agricultural land permanently occupied*

Total agricultural land permanently occupied is 1,618,049 m2.

- *Agricultural land temporarily occupied*

Total agricultural land temporarily occupied to arrange the construction sites is 4,700m2 for no more than 3 years.

c) Interruption of power supply source

1,226 electric poles (including 299 ones in Dong Nai and 927 ones in Lam Dong) are removed. Electric infrastructure has been serving for production and daily activities of communes in 3 districts of Dong Nai (Thong Nhat, Dinh Quan and Tan Phu) and 5 districts of Lam Dong (Da Huoai, Bao Lam, Bao Loc, Di Linh, Duc Trong and some wards of Da Lat city).

d) Interruption of communications

58,895m optical cables which serve for communications for communes in Dong Nai and Lam Dong provinces are removed.

e) Noise effect

Two main types of machines used for demolishing houses and relevant works are bulldozers and trucks. Maximum noise level of these construction machines in a distance r1=15m from the noise source is 94 dBA. In the distance r2, noise level is calculated in the following formula:

$$L_2(dB) = L_1 - 20\lg\left(\frac{r_1}{r_2}\right)^{1+\alpha}$$

Where: α: sound absorption coefficient of the ground (α=- 0.1 for asphalt road surface; and α=0). For the empty area, noise level is reduced down 6 dB with doubled distance.

As calculated above, the maximum noise level in the 120m distance is about 75 dBA. Thus, noise in radius of 120m from the noise source is higher than the limit value under QCVN 26:2010 for residential apartments, single/ adjacent houses, hotels, hostels and agencies. This effect last about 1 week at each demolished position.

3.1.2 AFFECTED OBJECT

From assessment of effect sources and volume of wastes in the preparation phase, the affected object includes natural and socio-economic environment, even people.

3.1.2.1 Quality of air environment

According to the observation data of the Environmental Center under Da Lat Nuclear Research Institute in November – December 2010 and May 2011, quality of air environment in the project area is rather good; dust concentration and hazardous gases emitted from the traffic vehicles are smaller than the limit value under QCVN 05:2009/BTNMT.

In the preparation phase, quality of air environment is reduced for the following reasons:

a) Dust pollution from demolishing old works within the scope of site clearance

Dust concentration upon demolishing houses often exceeds 2-3 times as the allowable limit in a radius of 30-40m. Dust emitting source is demolishing 12,228 m2 houses, especially 4,307 m2 of flat roof houses and two-storey houses. Dust pollution discontinuously happens all day but 5-10 minutes each after demolishment and lasts about 1 week. Reduced quality of air environment affects living environment of people, animals and plants.

However, only 64 households cleared are mostly distributed along the length of over 220km and other households are partly cleared. Thus, the dust emitting sources only locally affect with small intensity and scope. It is an interest in dust effect from demolishing the old works in sunny and windy days. *It is required to take mitigative measures*.

b) Dust pollution from sub-grading the construction site

Within the scope of 20m from the site boundary windward, dust concentration often exceeds twice as the allowable limit under QCVN 05:2009/BTNMT in the sunny and windy weather condition. Positions polluted by dust are 16 construction sites along the route (Details stated in Table 1.1.6 – Arrangement of construction site).

Among the above works, 6 works near the residential areas and schools cause significant effect:

+ Construction site No.2 (La Nga Bridge, Km35+712) near La Nga residential area (Km34 - Km35);
+ Construction site No.3 (Phuong Lam Bridge, Km65+056) near Phuong Lam Market (Km65) and Phuong Lam Parish (Km65+500);
+ Construction site No.11 (Hiep Thuan Bridge, Km183+376) near Hiep Thuan Primary School (Km184);
+ Construction site No.12 (Dai Ninh Bridge, Km189+200) near Son Trung Primary School (Km189+500);
+ Construction site No.14 (Dinh An I Bridge, Km217+810) near Dinh An Primary School (Km217+600);
+ Construction site No.15 (Dat Bridge, Km254+254) near Xuan Truong Primary School (Km254+150).

Dust effect last 1 month in the preparation phase. Reduced quality of air environment affects living environment of people, animals and plants. *It is required to take mitigative measures*.

3.1.2.2 Economy

a) Economic loss caused by the occupied land

+ Dong Nai province:

- Total agricultural land permanently occupied is 9,612 m2.
- Total agricultural land temporarily occupied for 3 years is 1,200m2.

+ Lam Dong province:

- Total agricultural land permanently occupied is 1,618,049 m2
- Total agricultural land temporarily occupied for 3 years is 4,700 m2

Based on statistical data on agricultural production value in Dong Nai and Lam Dong province [6, 7], economic loss caused by the occupied land is evaluated and listed in Table 3.3.

Table 3.3. Economic damage due to land area occupied by the project

Local	Occupied land area (ha)	Economic value/ha/year (million)	Yearly economic damage (million/year)
1. Dong Nai			
- Perpetually occupied land	0,9612	36,8	35,37
- Three-year occupied land	0,12	36,8	4,42
2. Lam Dong			
- Perpetually occupied land	161,80	59,34	9.601,21
- Three-year occupied land	0,47	59,35	27,89

b) Economic loss caused by interruption of drainage system

In the project implementation, there is no rehabilitation of the canals and ditches; thus, the drainage system in the project area may be only effected by installation of cross-culverts. The project route only expands the old one; basically, aperture of the existing cross-culverts remained unchanged but prolonged due to expansion of the road-base. Prolonging the cross culverts or rehabilitating some drainage positions do not meet standards before embanking the expanded part.

Therefore, the drainage system in the project area is mostly interrupted. Economic loss caused by interruption of drainage system for agricultural production is eliminated.

c) Economic loss caused by interruption of power and communications system

1,226 electric poles are expected to be removed. The design of traffic works, in principle, must ensure continuous power source. So, new electric poles will be built before power cut. After completing and commissioning, the project will require the locality’s power management agency to transfer to the new power line. Cost of this construction item is estimated in total investment. Time is interrupted power source is insignificant. Economic loss caused by interruption of power source for production is mostly eliminated.

For the communications system, 58,895m cables are removed. Similar to the power system, the communications system will be newly built before destroying the old system. The local post & telecommunications agencies will connect machines to the new line until completing a new system. Time is interrupted communications system is short and then its effect is insignificant.

d) Economic loss for the trading households

Along two sides of National Highway No.20, income of many trading households is affected in the project implementation, especially food and beverage trading households. Higher dust concentration than the normal level in the air influences food and the number of guests everyday. Effect lasts until ending the dust pollution. *It is required to take mitigative measures.*

e) Reduction of crop output due to increased dust concentration

Higher dust concentration in the air than the normal level at the positions of demolishing houses and works and at construction site in progress effects on crop output due to effect on photosynthesis of leaves. Evaluation of effect level is difficult because of lacking data and guiding documents.

Positions significantly affected are 16 works mentioned above. This effect lasts 1 crop. *It is required to take mitigative measures.*

g) Economic loss caused by the compensation of land acquisition

Compensation to recover the public works, houses, cash crops and other properties of the local people is about VND 696,928 million.

3.1.2.3 Society

The preparation phase affects living quality of the local people in the project area by the following factors:

- *Dust*

Local people residing around the demolished positions or the construction sites are influenced on health due to higher dust concentration than the normal level, especially 6 construction sties near the residential areas as stated in item 3.1.2.1 (b) (including construction site No.2, Km35+712; construction site No.3, Km65+056; construction site No.11, Km183+376; construction site No.12, Km189+200; construction site No.14, Km217+810; and construction site No.15, Km254+254).

Local people residing about 40km from the construction sites must face with bad quality air environment due to dust concentration exceeding 0.30mg/m3; increasing risks of anti-ophthalmic and respiratory diseases for this residential group. Reduced air quality at these positions for 1 months but the local people's health are affected in future. *It is required to take mitigative measures*.

- *Noise*

People residing in the radius of 120km from the demolished position or the boundary of construction sites must withstand noise level of about 75 dBA, higher than the limit value for about 1 week. The high noise level may have adverse effects on health, especially people with medical history of cardiovascular disease, vestibular disorder, gastritis and insomnia. However, because the road route goes through the thinly populated area, this effect is insignificant. But, *it is required to take mitigative measures*.

- *Resettlement*

It is required to remove and resettle 32 houses in 3 districts of Dong Nai province and 32 households in 5 districts of Lam Dong province. The households to be removed are having stable life with power, drilled well and convenient road. Upon being removed to a new place, these households will be effected by the following:

+ Change in community relation: This is an important relation in life for Vietnamese rural people.

+ Change in customs and occupation: Some small trading households along the national highway must change form of business at the new residence.

+ Change in living conditions: Some households having rather good living conditions, near road, school, medical clinic or market … will be disadvantageous upon transferring to a new residence and spend a certain time to adapt to this new residence.

In fact, the affected households do not want to live from the old residence. Results of interviews show that 100% the affected households want to resettle on the spot. It is indicated that if resettlement is suitable to aspiration of the affected people, social effect caused by resettlement will reduce significantly; when the households are provided opportunity to select resettlement, social relation and occupation of the resettled people are handled satisfactorily. It is required to take mitigative measures.

- *Removal of power and communications system*

As mentioned above, it is required to remove 1,226 electric poles along the old road-sides. However, new electric poles and transformer are built at the new places before power cut. After completing and commissioning, the project will require the locality’s power management agency to transfer to the new power line. Cost of this construction item is estimated in total investment. Time is interrupted power source is insignificant. Economic loss caused by interruption of power source for production is mostly eliminated.

Similar to the power system, the communications system will be newly built before destroying the old system. The local post & telecommunications agencies will connect machines to the new line until completing a new system. Time is interrupted communications system is short and then its effect is insignificant.

3.2 IN CONSTRUCTION PHASE

3.2.1 EFFECT SOURCES

Main construction items of the project:

- Road: To rehabilitate and expand 227.9 km road, including 20km of the tertiary flat road; 164.4 km of the tertiary mountainous road; 36km of the quadruple mountainous road and 7.9km of the urban road.
- Bridges and culverts: To build 16 river bridges and 298 cross-culverts.

- Main activities:
    + Activity of construction sites;
    + Activity of construction equipment, machines;
    + Activity of means of material transport;
    + Activity of workers.

The above activities causing effects with and without wastes are listed in Table 3.4.

Table 3.4. Sources causing arisen effect during construction phase

Order number	Related waste	Type of waste arised
1	**Road construction**	
1.1	*Road construction, intersection*	
-	Digging for filling road base	Dust, waste
-	Constructing for stabilized aggregate, making surface	Dust
-	Completing	Hard waste
1.2	*Drain construction*	
-	Grader for making site	Dust, waste
-	Filling earth to prevent water, digging foundation	Waste earth and rock
2	**Bridge construction**	
2.1	*Construction lower part*	
-	Digging foundation	Rejected earth and rock
-	Constructing abutent, pillar by auger- cast piles technology.	Earth with bentonite, bentonite
2.2	*Construction upper part*	Hard waste
2.3	*Completing*	Hard waste
3	**Activities related waste**	
3.1	*In works*	
-	Concrete mixing station, ground for materials storage.	Dust, hard waste, waste water
-	Station of repairing constructing machines.	Waste oil, waste water
-	Camp for employees	Waste water, rubbish from activity
3.2	*Waste earth transportation*	Dust and poison gas
3.3	*Transportation of earth, sand, rock and others.*	Dust and poison gas
3.4	*Operation of constructing equipments*	Dust and poison gas
TT	**Unrelated waste**	**Effecting factor**
1	**Road construction**	
1.1	*Constructing of line and intersection*	
-	Digging for filling road base	Sliding, aggrading, flood partially
1.2	*Drain construction*	

Order number	Related waste	Type of waste arised
-	Digging foundation	Interrupting watering, flood partially
-	Constructing of drain's pipe	Interrupting watering, flood partially
2	**Bridge construction**	
2.1	*Construction lower part*	
-	Digging foundation	Aggrading, noise
-	Constructing abutent, pillar by auger- cast piles	Aggrading, noise
-	Constructing abutent, pillar by slot drill technology	Noise, vibrating
-	Installing lift system and steel pale blockade to construct pillars in runoff.	Obstructing the waterway traffic
2.2	*Construction upper part*	Noise
3	**Relevant activities**	
3.1	*Activities in work*	
-	Gathering many employees	Security, social evils
-	Concrete mixing station	Noise
3.2	*Pouring waste earth*	Noise, spilling
3.3	*Material transportation*	Noise, road damage
3.4	*Operation of constructing equipments*	Noise

3.2.1.1 Effect sources relating to waste

As mentioned in Table 3.4, waste in the construction phase includes soil, dust and toxic gas, solid waste, waste water and waste lubricant, The next is to evaluate these types of waste in details,

a) Spoil

- **Road construction**: Total quantity of spoil is 597,078 m3; where:

+ Dong Nai province: (Km0 – Km71): 54,356 m3

+ Lam Dong province: Km71 – Km123: 166,550 m3; Km123 – Km268: 376,173 m3

- **Bridge construction**:

+ To excavate abutment, pier and bridge end: Total quantity of spoil is 49,600 m3

- Dong Nai province (Km0 – Km71): 9,300 m3
- Lam Dong province: Km71 – Km123: 7,556 m3; Km123 – Km268: 32,744 m3

+ To build cast-in-situ bored pile using bentonite:

Bentonite mixed soil: Total soil arisen in this phase is calculated by drilled volume in soil and equal to 5,935 m3, including:

- Dong Nai province (Km0 – Km71): 5,425 m3
- Lam Dong province (Km71 – Km268): 483 m3

Overflowed bentonite: Quantity of overflowed bentonite is about 40% in reverse circulation construction technique and equal to 2,374 m3,

- Dong Nai province (Km0 – Km71): 2,181 m3
- Lam Dong province (Km71 – Km268): 193 m3

- Totality of the project: Total quantity of spoil is 652,613 m3, including:

- Dong Nai province (Km0 – Km71): 69,081 m3
- Lam Dong province: Km71 – Km123: 174,106 m3;
  Km123 – Km268: 409,426 m3

This type of spoil is non-toxic but must be removed at the designated place to avoid bad effects on soil and surface water environment and deposit conditions. The spoil areas are agreed with the localities and under instruction and supervision of the localities during project implementation.

b) Dust and toxic gas

Dust and toxic gas are mainly from the following activities:

- Excavation and embankment of road-base, bridge foundation, bridge and culverts;
- Transport of soil, rock and materials on the roads;
- Means of construction.

Loading of emission volume and transmission of emission volume relative to the fair wind distance will be evaluated in details in the next part.

b1. Dust emitted by excavation, embankment and transport of construction material

- Total quantity of excavated and embanked soil:

Total quantity of excavation and embankment in the project is listed in Table 3.5.

Table 3.5. Total quantity of excavation and embankment

Order number	Items	Amount (m^3)
1	**Road**	
	- Amount of digging	1,609,741
	- Amount of filling	1,047,365
2	**Bridge**	
	- Amount of digging	165,334
	- Amount of filling	263,969
Total		3,086,409

- Total quantity of transported soil:

Total quantity of soil and sand transported in the whole project is 1,365,746 tons.

- Dust emission coefficient:

According to the statistical figures of WHO (1998), dust emission coefficient in loading and transporting materials is as follows:

+ Loading materials generates 0.17 kg dust/ ton soil;

+ Transporting materials generates 0.134 kg dust/ ton soil.

- Total quantity of dust emitted:

As the figures above, total quantity of excavation and embankment are 3,086,409 m3 (corresponding to 3,703,691 tons – average density of 1.2 t/m3) and total quantity of transport of construction material is 1,365,746 tons. Quantity of dust emitted by excavation, embankment and transport of construction material is evaluated in Table 3.6.

Table 3.6. Quantity of dust emitted by excavation, embankment and transport of construction material

Items of job	**Coefficient of dust dispersion *(kg/ton)***	**Amount*(ton)***	**Total of dust *(kg)***
Scooping up earth	0,17	3,703,691	629,627
Transportation	0,134	1,365,746	183,010

b2. Dust and toxic gas emitted by transport of construction materials

<u>- Total quantity of construction materials transported:</u>

The quantity of construction materials used in the project is transported to the construction place in an average length (for 1 truck) as listed in Table 3.7. Therefore, total length of transport of construction materials is calculated for 1 truck:

Table 3.7. Quantity and length for transport of material in the project

TT	**Items of job**	**Average stretch of road(km)**	**Amount (ton)**	**Total of stretch of road(km)**
1	Transportation of plastic concrete	6	76,580	91.896
2	Transportation of plastic concrete	27	334,255	1,804,974
3	Transportation of plastic concrete	32	246,275	1,576,158
4	Transportation of plastic concrete	54	39,844	430,316
5	Transportation of filling earth	10	672,184	1,344,368
6	Transportation of filling earth	15	233,007	699,020
7	Transportation of filling earth	25	150,357	751,783
8	Transporting longitudinal aggregate to fill	5	13,127	13,127
9	Transportation of rejected earth	7	179,883	251,836
10	Transportation of rejected earth	10	469,743	939,485
11	Transportation of rejected earth	13	74,588	193,930
12	Transportation of sand, rock	10	116,035	232,070

13	Transportation of sand, rock	15	1,011,705	3,035,116
14	Transportation of sand, rock	20	212,554	850,216
15	Transportation of iron, steel and others	12	10,485	2,5164
16	Transportation of iron, steel and others	25	10,460	52,298
17	Transportation of iron, steel and others	30	4,507	27,044
	Total of stretch of road/ unit of transportation			**12,318,800**

- Total quantity of dust and toxic gas emitted:

In the transport of construction materials, dust is emitted from 2 main sources:

+ Loading from the road surface;

+ Emitting from internal combustion engine.

(*i) Dust emitted from road surface due to transport of material:*

Dust emitted from the road surface is evaluated in the following formula (according to Air Chief, US Environmental Protection Agency, 1995) [1]:

E = 1.7K(s/12)(S/48)(W/2.7)0.7(w/4)0.5)[(365 - p)/365] (3.1)

Where: E – Dust volume emitted (kg/truck/km);

K – Coefficient considering dust size (K = 0.3 for dust < 10μm);

s – Coefficient considering the road surface (urban road s = 5.7);

S – Average speed of the truck (S = 30 km/h);

W – Weight (ton);

w- Tire;

p – Average rainy days in the year.

Apply the formula (3.1) for the truck W = 10 tons, number of tires w = 6, coefficient considering dust size K = 0.3; Coefficient considering the road surface s = 5.7; Average speed of the truck S = 30 km/h; p = 125 for the project implementation area, dust intensity emitted from the road surface and total dust emission volume during the operating truck are assessed in Table 3.8.

Table 3.8. Loading of emission volume from road surface due to transport of material

Strength of waste arising E (kg/vehicle/km)	Total of stretch of road VC. (km)	Total of waste arising (kg)
0,3936	12,318,800	4,848,930

- Dust and toxic gas emitted from internal combustion engine:

The quantity of dust and toxic gas emitted from internal combustion engine of the construction material trucks is assessed based on the emission coefficient announced by

World Health Organization (WHO) for trucks using DO lubricant and weighting 10 tons. According to WHO, the quantity of dust and toxic gas emitted from 10ton truck in the length of 1,000 km is 0.9 kg dust; 2.075 S kg SO2; 14.4 kg Nox; .9 kg CO and 0.8 kg HC (Under QCVN 01:2009/BKHCN, S = 0.05% - is the limit of sulfur content in diesel). Emission from internal combustion engine of the construction material truck during construction phase is listed in Table 3.9.

Table 3.9. Total emission volume from internal combustion engine of transportation vehicles

Order number	Pollutant	Amount of waste/1.000 km (kg)	Total of stretch of road (km)	Total of waste (kg)
1	SO_2	2,075 S	12,318,800	12,78
2	NO_x	14,4	12,318,800	177,391
3	CO	2,9	12,318,800	35,725
4	HC	0,8	12,318,800	9,855
5	Dust	0,9	12,318,800	11,087

b3. Dust and toxic gas emitted from means of construction

- *Quantity of motor vehicles used in construction:*

Main construction equipment and machinery used in the project are listed in Table 1.12 of item 1.5.3 - Workforce and machinery used in construction

- *Emission coefficient:*

The following emission coefficients are used for 1 liter of diesel (Source: US. EPA, Locomotive Emissions Standard, Regulatory Support Document, April, 1998): HC – 2.83 g/l; CO – 7.25 g/l; Nox – 66.0 g/l; PM10 – 1.80 g/l.

Fuel consumption of machines is according to Circular No.06/2005/TT-BXD dated 15/4/2005 of the Ministry of Construction.

- *Total dust and toxic gas emitted:*

Emission of construction machines is assessed from the emission coefficient and fuel consumption. The figures are listed in Table 3.10.

Table 3.10. Total exhaust volume in a production shift of equipments

Machine	Fuel (litre/shift)	Total of waste/shift(g)			
		HC	CO	Nox	PM10
Grader 110 CV	46.20	131	335	3048	83
Bladder 110 CV	38.88	110	282	2565	70
Grader 140CV	58,80	166	426	3880	106
Compressor 25T	54.60	155	396	3602	98

Machine	Fuel (litre/shift)	Total of waste/shift(g)			
		HC	CO	Nox	PM10
Compactor 10T	26.40	75	191	1742	47
Tyre roller 16T	37.80	107	274	2494	68
Vibrating roller 25T	67.20	190	487	4434	121
Spreader 50 - 60 m^3/h	33.60	95	244	2217	60
Spreader 130 - 140 CV	50.40	143	365	3325	91
Truck watering tar 7T	45.90	130	333	3028	83
Compressor 600 m^3/h	38.40	109	278	2534	69
Excavator 1.65 m^3	75.24	213	545	4964	135
mixing station 60 T/h	1836.00	5197	13309	121137	3303
Digging machine 1.6 m^3	113.22	320	821	7470	204
Watering truck 5 m^3	22.50	64	163	1485	40
Rammer	3.57	10	26	236	6
Craning K33-60	232,56	658	1686	15344	418
Pneudraulic machine 240m^3/h	27,54	30	77	704	19
Pneudraulic machine 360m^3/h	34,56	98	251	2280	62
Pneudraulic machine 660m^3/h	38,88	110	282	2565	70
Sprocket craning 25T	47,00	159	408	3710	101
Sprocket craning 16T	45,00	158	404	3677	100
Digging machine 0,8 m^3	64,80	30	76	693	19
Digging machine 1,25 m^3	82,65	161	412	3748	102
Borer VRM	51,60	97	249	2262	62
Sprocket craning 63T	56,25	115	296	2690	73
Electric generator kW	45,00	195	499	4541	124

b.4. Assessment of dust and toxic gas emission in the air

❖ ***Dust and toxic gas emitted by excavation, embankment and transport of construction materials***

Emission relating to excavation, embankment and transport of construction materials is continuously contributed on the whole route. Therefore, it is considered that emission source is the basis for assessing transmission of pollutants windward.

Dust and toxic gas concentration in a distance x at the end of windward from the road source is assessed in the adapted model of Sutton as follows: [1]:

$$C(x) = 0.8E\{\exp[-(z+h)^2/2U_z^2]+\exp[-(z-h)^2/2U_z^2]\}/(U_zV) \qquad (3.2)$$

Where:

$C(x)$ – Concentration of air pollutant in a distance x (mg/m^3);

E - Emission, mg/ (m/s);

z - Elevation (m);

U_z - Diffusion coefficient in axis Z; with atmospheric stability B: $U_z = 0.53x^{0.73}$;

V – Average velocity (m/s);

h – Height of road surface (m).

Construction duration is 36 months (26 working days per month). Parameters in the model are assessed as follows:

- Total volume of dust emitted = dust from excavation, embankment + Dust emitted from road surface due to transport of material + dust emitted from truck engine = 5,672,655 kg;
- Total volume of emission from truck engine is taken from Table 3.9;
- Other parameters of the model: Point elevation z = 1.5 m; average velocity V = 3m/s; height of road surface above two sides of ground h = 0.2 m.

Total emission strength for road sources is listed in Table 3.11.

Table 3.11. Total emission strength for road sources

Order Number	**Agent**	**Total of waste *(kg)***	**Strength of waste source *(mg/m/s)***
1	Dust	5.672.655	0,7611
2	SO_2	12,78	0,000002
3	NO_x	177.391	0,0238
4	CO	35.725	0,0048
5	HC	9.855	0,0013

Dust concentration in the air relative to the fair wind distance is at 1.5m height in the model (3.2) and results are listed in Table 3.12 and Table 3.13.

Table 3.12. Dust concentration in the air relative to the fair wind distance at 1.5m height (wind velocity V = 3 m/s)

Distance x (m)	5	10	20	40	60	80	100	120	140	160

Concentration (mg/m^3)	0,161	0,124	0,082	0,051	0,038	0,031	0,026	0,023	0,021	0,019

Table 3.13. Gas emission concentration in the air relative to the fair wind distance at 1.5m height (wind velocity V = 3 m/s)

Distance (m)	5	10	15	20	25	30	35	40	45
SO_2 (mg/m^3)	3,6E-07	2,8E-07	2,2E-07	1,8E-07	1,6E-07	1,4E-07	1,3E-07	1,1E-07	1,1E-07
NO_x (mg/m^3)	0,0050	0,0039	0,0031	0,0026	0,0022	0,0019	0,0017	0,0016	0,0015
CO (mg/m^3)	0,00101	0,00078	0,00062	0,00051	0,00044	0,00039	0,00035	0,00032	0,00029
HC (mg/m^3)	0,00028	0,00022	0,00017	0,00014	0,00012	0,00011	0,00010	0,00009	0,00008

Comments:

- Dust concentration in the air significantly increases in construction compared to background dust concentration before construction (background dust concentration in a range of 0.012 – 0.106 mg/m3; average dust concentration of 0.038 mg/m3). However, in a distance of > 5m from the road edge, dust concentration is 0.20 mg/m3 smaller than the allowable value in 24 hours under QCVN 05:2009/BTNMT.
- Dust emitted from road surface due to construction material trucks is about 85% of total dust from 3 main emission sources.
- Gas concentration in the air from the construction material trucks is smaller than the allowable value under QCVN 05:2009/BTNMT.

❖ ***Dust and toxic gas from construction machines in the project***

Construction machines in the project such bulldozers and excavators ... (listed in Table 3.10) operate in a narrow scope in a shift. Therefore, the point source model is used to assess gas emission from these machines.

From emission in a shift from construction machines in Table 3.10, there emission capacity is calculated and listed in Table 3.14 (machines continuously operate in 7 hours/ shift).

Table 3.14. Gas emission capacity of construction machines in the project

Machine	**Pouring capacity M (mg/s)**			
	HC	**CO**	**Nox**	**PM10**
Grader 140CV	5,20	13,29	120,95	3,29
Grader 110CV	4,37	11,19	101,79	2,78
Bladder 110CV	6,15	15,71	142,94	3,89
Compressor 25T	2,98	7,58	69,13	1,87

Machine	Pouring capacity M (mg/s)			
	HC	CO	Nox	PM10
Compactor 10T	4,25	10,87	98,97	2,70
Tyre roller 16T	7,54	19,33	175,95	4,80
Vibrating roller 25T	3,77	9,68	87,98	2,38
Spreader 50 - 60 m^3/h	5,67	14,48	131,94	3,61
Spreader 130 - 140 CV	5,16	13,21	120,16	3,29
Truck watering tar 7T	4,33	11,03	100,56	2,74
Compressor 600 m^3/h	8,45	21,63	196,98	5,36
Excavator 1.65 m^3	206,23	528,13	4807,02	131,07
Mixing station 60 T/h	12,70	32,58	296,43	8,10
Digging machine 1.6 m^3	2,54	6,47	58,93	1,59
Truck watering tar 5 m^3	0,40	1,03	9,37	0,24
Rammer	26,11	66,90	608,89	16,59
Craning K33-60	1,19	3,06	27,94	0,75
Compressor 240m^3/h	6,31	16,19	147,22	4,01
Sprocket craning 25T	6,27	16,03	145,91	3,97
Sprocket craning 16T	1,19	3,02	27,50	0,75
Digging machine 0,8 m^3	8,13	20,83	189,76	5,16
Towboat 150cv	6,39	16,35	148,73	4,05
Digging machine 1,25 m^3	3,85	9,88	89,76	2,46
Borer VRM	4,56	11,75	106,75	2,90
Sprocket craning 63T	7,74	19,80	180,20	4,92
Electric generator 75 kW	5,20	13,29	120,95	3,29

In this case, model Gauss may be used to assess gas transmission windward [2]:

$$C_{(x,z)} = \frac{M}{2\pi\sigma_y\sigma_z U}\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] \qquad (3.3)$$

Where: (x,z) – Pollutant concentration at points x, y = 0, z (mg/m3);

x – Distance from the source in direction x – wind direction (m);

z – Height of calculated point (m);

M – Capacity of pollutant emission (mg s-1);

H – Effective height of exhaust outlet;

U – Average wind velocity in height H;

σ_y – Diffusion coefficient in lateral direction y (m);

σ_z – Diffusion coefficient in vertical direction y z (m).

Pollutant concentration at 1.5m height in different distances fro construction machines is anticipated by model Gauss as listed in Table 3.15 (Table 3.15.1 ÷ Table 3.15.22) in case average velocity at outlet is 3m/s and atmospheric stability in calculation is A-B.

Table 3.15. Exhaust gas concentration at height of 1.5 m at fair wind points from sources (wind velocity U = 3 m/s; height of exhaust outlet subject to machines)

Table 3.15.1. Grader 110 CV (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0501	0,0269	0,0143	0,0073	0,0047	0,0033	0,0024
CO	0,1283	0,0688	0,0365	0,0187	0,0120	0,0084	0,0061
Nox	1,1683	0,6264	0,3325	0,1700	0,1094	0,0765	0,0559
PM10	0,0319	0,0171	0,0091	0,0046	0,0030	0,0021	0,0015

Table 3.15.2. Bladder 110 CV (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0422	0,0226	0,0120	0,0061	0,0039	0,0028	0,0020
CO	0,1080	0,0579	0,0307	0,0157	0,0101	0,0071	0,0052
Nox	0,9832	0,5272	0,2798	0,1430	0,0920	0,0644	0,0470
PM10	0,0268	0,0144	0,0076	0,0039	0,0025	0,0018	0,0013

Table 3.15.3. Compressor 25T (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0592	0,0318	0,0169	0,0086	0,0055	0,0039	0,0028
CO	0,1517	0,0813	0,0432	0,0221	0,0142	0,0099	0,0073
Nox	1,3807	0,7403	0,3929	0,2009	0,1292	0,0904	0,0660
PM10	0,0376	0,0202	0,0107	0,0055	0,0035	0,0025	0,0018

Table 3.15.4. Compactor 10T (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0286	0,0154	0,0082	0,0042	0,0027	0,0019	0,0014
CO	0,0733	0,0393	0,0209	0,0107	0,0069	0,0048	0,0035
Nox	0,6676	0,3579	0,1900	0,0971	0,0625	0,0437	0,0319
PM10	0,0182	0,0098	0,0052	0,0026	0,0017	0,0012	0,0009

Table 3.15.5. Tyre roller 16T (U = 3 m/s, H = 2.0 m)							
Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0410	0,0220	0,0117	0,0060	0,0038	0,0027	0,0020
CO	0,1050	0,0563	0,0299	0,0153	0,0098	0,0069	0,0050
Nox	0,9558	0,5125	0,2720	0,1391	0,0895	0,0626	0,0457
PM10	0,0261	0,0140	0,0074	0,0038	0,0024	0,0017	0,0012

Table 3.15.6. Vibrating roller 25T (U = 3 m/s, H = 2.0 m)							
Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0729	0,0391	0,0207	0,0106	0,0068	0,0048	0,0035
CO	0,1867	0,1001	0,0531	0,0272	0,0175	0,0122	0,0089
Nox	1,6993	0,9111	0,4836	0,2472	0,1591	0,1113	0,0813
PM10	0,0463	0,0248	0,0132	0,0067	0,0043	0,0030	0,0022

Table 3.15.7. Spreader 50 - 60 m^3/h (U = 3 m/s, H = 2.0 m)							
Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0365	0,0195	0,0104	0,0053	0,0034	0,0024	0,0017
CO	0,0933	0,0501	0,0266	0,0136	0,0087	0,0061	0,0045
Nox	0,8496	0,4556	0,2418	0,1236	0,0795	0,0557	0,0406
PM10	0,0232	0,0124	0,0066	0,0034	0,0022	0,0015	0,0011

Table 3.15.8. Spreader 130 - 140 CV (U = 3 m/s, H = 2.0 m)							
Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0547	0,0293	0,0156	0,0080	0,0051	0,0036	0,0026
CO	0,1400	0,0751	0,0398	0,0204	0,0131	0,0092	0,0067
Nox	1,2745	0,6833	0,3627	0,1854	0,1193	0,0835	0,0610
PM10	0,0347	0,0186	0,0099	0,0051	0,0033	0,0023	0,0017

Table 3.15.9. Compressor 660m^3/h (U = 3 m/s, H = 0.8 m)							
Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0439	0,0235	0,0125	0,0064	0,0041	0,0028	0,0021
CO	0,1124	0,0603	0,0319	0,0163	0,0104	0,0072	0,0053
Nox	1,0233	0,5485	0,2908	0,1481	0,0947	0,0659	0,0479
PM10	0,0279	0,0150	0,0079	0,0040	0,0026	0,0018	0,0013

Table 3.15.10. Excavator 1.65 m^3 (U = 3 m/s, H = 2.0 m)							
Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m

HC	0,0816	0,0438	0,0232	0,0119	0,0076	0,0053	0,0039
CO	0,2090	0,1121	0,0595	0,0304	0,0196	0,0137	0,0100
Nox	1,9026	1,0201	0,5415	0,2768	0,1781	0,1246	0,0910
PM10	0,0519	0,0278	0,0148	0,0075	0,0049	0,0034	0,0025

Table 3.15.11. Digging machine1.6 m^3 (U = 3 m/s, H = 2.0 m)

Pollutants	Concentration following distance (mg m^{-3})						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,1228	0,0659	0,0350	0,0179	0,0115	0,0080	0,0059
CO	0,3145	0,1687	0,0895	0,0458	0,0294	0,0206	0,0150
Nox	2,8630	1,5351	0,8148	0,4165	0,2680	0,1875	0,1369
PM10	0,0781	0,0419	0,0222	0,0114	0,0073	0,0051	0,0037

Table 3.15.12. Rammer (U = 3 m/s, H = 0.8 m)

Pollutants	Concentration following distance (mg m^{-3})					
	5 m	10 m	20 m	40 m	60 m	80 m
HC	0,0040	0,0022	0,0011	0,0006	0,0004	0,0003
CO	0,0103	0,0055	0,0029	0,0015	0,0010	0,0007
Nox	0,0940	0,0504	0,0267	0,0136	0,0087	0,0061
PM10	0,0026	0,0014	0,0007	0,0004	0,0002	0,0002

Table 3.15.13. Sprocket craning 25T (U = 3 m/s, H = 2.0 m)

Pollutants	Concentration following distance (mg m^{-3})						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0510	0,0273	0,0145	0,0074	0,0048	0,0033	0,0024
CO	0,1306	0,0700	0,0372	0,0190	0,0122	0,0086	0,0062
Nox	1,1885	0,6372	0,3382	0,1729	0,1112	0,0778	0,0568
PM10	0,0324	0,0174	0,0092	0,0047	0,0030	0,0021	0,0016

Table 3.15.14. Sprocket craning U=3 m/s, H = 2.0 m)

Pollutants	Concentration following distance (mg m^{-3})						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0488	0,0262	0,0139	0,0071	0,0046	0,0032	0,0023
CO	0,1250	0,0670	0,0356	0,0182	0,0117	0,0082	0,0060
Nox	1,1379	0,6101	0,3239	0,1656	0,1065	0,0745	0,0544
PM10	0,0310	0,0166	0,0088	0,0045	0,0029	0,0020	0,0015

Table 3.15.15. Digging machine 0,8 m^3 (U = 3 m/s, H = 2.0 m)

Pollutants	Concentration following distance (mg m^{-3})						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m

HC	0,0703	0,0377	0,0200	0,0102	0,0066	0,0046	0,0034
CO	0,1800	0,0965	0,0512	0,0262	0,0169	0,0118	0,0086
Nox	1,6386	0,8786	0,4663	0,2384	0,1534	0,1073	0,0784
PM10	0,0447	0,0240	0,0127	0,0065	0,0042	0,0029	0,0021

Table 3.15.16. Burer VRM 1500/800HD (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0560	0,0300	0,0159	0,0081	0,0052	0,0037	0,0027
CO	0,1434	0,0769	0,0408	0,0209	0,0134	0,0094	0,0069
Nox	1,3048	0,6996	0,3713	0,1898	0,1221	0,0855	0,0624
PM10	0,0356	0,0191	0,0101	0,0052	0,0033	0,0023	0,0017

Table 3.15.17. Sprocket craning 63T (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0610	0,0327	0,0174	0,0089	0,0057	0,0040	0,0029
CO	0,1563	0,0838	0,0445	0,0227	0,0146	0,0102	0,0075
Nox	1,4224	0,7627	0,4048	0,2069	0,1331	0,0932	0,0680
PM10	0,0388	0,0208	0,0110	0,0056	0,0036	0,0025	0,0019

Table 3.15.18. Moving electric generator 75 kW (U = 3 m/s, H = 1.5 m)

Pollutants	**Concentration following distance (mg m^{-3})**						
	5 m	10 m	20 m	40 m	60 m	80 m	100 m
HC	0,0498	0,0267	0,0142	0,0072	0,0046	0,0032	0,0024
CO	0,1276	0,0684	0,0363	0,0185	0,0119	0,0083	0,0060
Nox	1,1619	0,6229	0,3304	0,1686	0,1081	0,0755	0,0550
PM10	0,0317	0,0170	0,0090	0,0046	0,0029	0,0021	0,0015

Table 3.15.19. Mixing station 60T/h (U = 3 m/s, H = 5 m)

Pollutants	**Concentration following distance (mg m^{-3})**								
	10 m	30 m	50 m	100 m	150 m	200 m	250 m	300 m	350 m
HC	0,833	0,307	0,188	0,085	0,045	0,026	0,016	0,010	0,007
CO	2,134	0,786	0,480	0,217	0,116	0,067	0,041	0,027	0,018
Nox	19,424	7,152	4,374	1,979	1,059	0,611	0,376	0,245	0,167
PM10	0,530	0,195	0,119	0,054	0,029	0,017	0,010	0,007	0,005

Table 3.15.20. Craning K33-60 (U = 3 m/s, H = 2.0 m)

Pollutants	**Concentration following distance (mg m^{-3})**								
	10 m	20 m	40 m	60 m	80 m	100 m	120 m	140 m	160 m
HC	0,135	0,072	0,037	0,024	0,017	0,012	0,009	0,007	0,005
CO	0,346	0,184	0,094	0,060	0,042	0,031	0,023	0,018	0,014

Nox	3,153	1,674	0,856	0,550	0,385	0,281	0,211	0,162	0,126
PM10	0,086	0,046	0,023	0,015	0,011	0,008	0,006	0,004	0,003

<u>Comments:</u>

- Hot asphalt batching plants are the biggest pollutants in all the above machines. With 5m high chimney and distance of 20m from the sources windward, dust concentration in the air exceeds 0.30mg/m3 under QCVN 05:2009/BTNMT; and 1.8 times higher than allowable value in a distance of 10m. From the sources to 300m windward, Nox concentration in the air exceeds 0.20mg/m3 under QCVN 05:2009/BTNMT and 15 times higher than allowable value in a distance of 10m.
- The second polluting machines among the above machines is overhead gantry crane K33-60 with NOx concentration of 0.211 mg/m3 in a distance of 120m.
- The remaining do not generate dust concentration exceeding the limit value under QCVN 05:2009/BTNMT; however, most of them emit NOx gas exceeding 0.20mg/m3 under QCVN 05:2009/BTNMT in the range of 30 m - 50 m from sources.
- Besides hot asphalt concrete mixers, construction machines emit CO gas and PM10 dust to the air environment but their concentrations do not exceed the allowable value under QCVN 05:2009/BTNMT.

c) Solid waste

Types of solid waste arising during construction phase are listed in Table 3.16.

Table 3.16. Solid waste arising during construction phase

No.	Activities of construction	Type of hard waste	Note
1	***Road construction***		
-	Road and intersection	wood, rubbish	Hard waste of Construction
-	Drain construction	Concrete, brick, wood….	
2	***Bridge***		
-	Construction lower part	Steel, iron, rubbish	Hard waste of Construction
-	Construction upper part	Rubbish, waste	Hard waste of Construction
3	***Relevant activities***		
-	Concrete mixing station	packages, waste	
-	Machines for work	rag with oil for cleaning machine	Dangerous waste
-	Machine maintain	rag with oil for cleaning machine	Dangerous waste
-	Camps for employee	Rubbish from living	

❖ ***Construction solid waste***

Solid waste includes construction wastes such as milled wood, concrete, broken brick, material bags, steel and iron… It is difficult to forecast waste quantity subject to many factors during construction phase. In fact, traffic road projects show that this type of solid waste is much less than soil and rock of kinds.

❖ ***Domestic solid waste***

According to recent assessments [2.4], average volume of domestic wastes of Vietnamese people is about 0.5 kg/person/ day (except big urban areas)

With the number of workers of 1,124 people/ day, the average volume of domestic solid waste of the workers is about 562 kg/day. It averages 35 kg/day at each construction site.

Besides normal waste, domestic wastes emit toxic substances from organic components easily decomposed and bacterium which may enter surface water sources in case of ineffective solid waste management and treatment.

❖ ***Hazardous solid waste***

Hazardous solid waste arising during construction phase is mainly normal solid waste adhering to lubricant such as wipers, lubricant bearing wastes due to leakage ... It is impossible to quantify this waste, but in the empirical fact, this type of waste is insignificant.

d) Waste water

Waste water during construction phase is listed in Table 3.17.

Table 3.17. All types of sewage during construction phase

Order number	Activities of construction	cared components in waste	Note
1	***Works***		
-	Concrete mixing station	High Level pH	Waste water of construction
-	Camps for employee	Objects of physical chemistry,bacillus coliform	Waste water for living
-	Machine maintain	Waste oil	Dangerously waste water
2	Machines for work	Leak out oil	Dangerously waste water

❖ ***Waste water from the batching plant***

Waste water is mainly from the batching plants at construction sites. In this project, 16 construction sites are arranged along the route – positions of bridge and beam casting. Arranging the batching plants and specific capacity at construction sites has not clearly determined in this phase. Therefore, total volume of waste water for each phase and average volume of waste water for the construction sites are assessed. Calculation of emission volume is based on quantity of necessary concrete for the project and rating of the batching plants (the batching plant needs 87m3 of water to wash aggregate and 10m3 water to mix concrete; in which 80% used to wash aggregate is reused). Figures of emission from the project for 36 months are listed in Table 3.18.

Table 3.18. Sewage from batching plants in project

Amount of concrete (m^3)	Amount of water used (m^3)	Total of waste (m^3)	Average waste per day (m^3)	Amount of works	Average per work (m^3/day)
68.695	37.714	23.975	19,2	16	1,2

This waste water contains suspended residues, 4-6 times as high as the allowable value under QCVN 24:2009/BTNMT (compared to column B) and pH is often higher than the allowable value.

❖ ***Domestic waste water***

The number of workers on the construction route is about 1.124 people/ day. Average volume of domestic water consumed at construction sites is about 100 liters/ person/ day [3].

Daily loading of pollutant volume into water environment [2] is listed in Table 3.19.

Table 3.19. Daily loading of pollutant volume into environment for one person

Order number	**Pollutants**	**Tonnage (g/person/day)**
1	BOD_5	45 - 54
2	COD	(1,6 - 1,9) x BOD_5
3	Total of hard material	170 - 220
4	Hanging hard material	70 - 145
5	Oil	10 - 30
6	Alkali (Following $CaCO_3$)	20 - 30
7	Clo (Cl-)	4 - 8
8	Total Nitro (N)	6 - 12
9	Free Amoni	3,6 - 7,2
10	Total Phospho	0,8 - 4
	Bacillous	**Total amount in 100ml of waste water**
11	Total Bacillous	$10^9 - 10^{10}$
12	Coliform	$10^6 - 10^9$
13	Feacal	$10^5 - 10^6$
14	Helminth	$\sim 10^3$
15	Virus	$10^2 - 10^4$

From the above statistic figures, daily loading of pollutant volume into environment is listed in Table 3.20.

Table 3.20. Loading volume and concentration of pollutants discharged by workers into environment

Order number	Objects of pollution	Amount of amount(kg/day)	Concentration of waste in Water (mg/l)	VNS 14:2008/ MONRE column B (mg/l)
1	BOD_5	289 - 346	450 - 540	50
2	COD	10 - 12	780 - 945	-
3	Total dissolving hard material	1091 - 1411	1.700 - 2.200	1000
4	Hanging hard material	449 - 930	700 - 1.450	100
5	Non-mineral lubricant	64 - 192	100 - 300	20
6	Alkali (following $CaCO_3$)	128 - 192	200 - 300	-
7	Clo (Cl^-)	26 - 51	40 - 80	-
8	Total Nitro (N)	38 - 77	60 - 120	-
9	Total Phospho	5 - 26	8 - 40	-
10	Coliform (in 100ml)		10^6 - 10^9	5.000

Note: QCVN 14:2008 – National Technical Regulation on Domestic waste water.

Comments:

Pollutant concentration in domestic wastewater at construction sites is much higher than the allowable limit (QCVN 14:2008/BTNMT). If a large number of workers concentrate on any place and untreated wastewater is discharged directly to the receiving source, this cause local pollution of surface water sources in the area.

❖ ***Hazardous waste water***

Hazardous waste water includes lubricants periodically replaced and wastewater mixed with lubricants in maintaining motor vehicles.

Quantity of lubricants in the project area is subject to the following factors:

- Number of motor vehicles at construction sites;
- Periodic replacement of lubricants and maintenance of machinery;
- Quantity of lubricants per replacement/ maintenance

Results of waste lubricant survey in some areas are as follows:

- Quantity of waste lubricant from means of transport and motor vehicles is 7 liter/ replacement.
- Lubricant replacement and machine maintenance average 120 shifts (80-160 shifts for lubricant replacement subject to operational strength and means of transport).

Results of assessing waste lubricants are listed in Table 3.21.

Table 3.21. Quantity of lubricants discharged from maintenance activities for construction machines

Total machine shift	**Cycle of changing (Shift)**	**Times of changing**	**Total lubricant (lít)**	**Average per month (litre per month)**
2.885.227	120	24.044	168.308	3.506

3.2.1.2 Effect sources not relating to waste

a) Noise and vibration from construction activities

a1. Noise

Construction activities are the main cause for noises for the project area and the surrounding residential areas. Table 3.22 presents noise level of main construction machines in distance r1 = 15 m from generating source.

Table 3.22. Noise level from construction machines

Equipment	**Noisy level (dBA), From source 15 m**	
	Material (1)	**Material(2)**
Gadder	93,0	-
Compressor(roller)	-	72,0 – 74,0
Backhoe excavator	-	72,0 – 84,0
Backhoe	-	72,0 – 93,0
Puller	-	77,0 – 96,0
Land scraper, compactor	-	80,0 – 93,0
Paving road machine	-	87,0 – 88,5
Truck	-	82,0 – 94,0
Concrete mixing machine	75,0	75,0 – 88,0
Concrete Pumping	-	80,0 – 83,0
Concrete Roller	85,0	-
Moving crane	-	76,0 – 87,0
Deric Crane	-	86,5 – 88,5
Electric Generator	-	72,0 - 82,5
Compressor	80,0	75,0 - 87,0
Piling machine	75,0	95,0 - 106,0

Sources: (1): Nguyen Dinh Tuan and et al, 2000; (2): Mackernize, 1985

In the distance r_2, noise level is calculated in the following formula:

$$L_2(dB) = L_1 - 20\lg\left(\frac{r_2}{r_1}\right)^{1+a} \quad (3.4)$$

Where: α: sound absorption coefficient of the ground (α =-0.1 for asphalt road surface; and α= 0). For the empty area, noise level is reduced down 6 dB with doubled distance.

During project implementation, the following machines often generate aloud noise:

- *Batching plant*

Maximum noise level in the distance of 15m is 90dBA and noise level in the further distance is determined in principle of 6dBA reduction and doubled distance. Thus, the batching plant is at least 120m from the residential area and at least 650m from the sensitive areas such as schools, hospitals and resorts.

- *Soil movement*

As required, some types of motor vehicles related to excavation work and soil transport include bulldozers, tractors, graders and trucks. This means that the maximum noise level is 90 dBA in the distance of 15m. This means that 70dBA in the distance of 1520m. Thus, beyond the radius of 120m, noise level is smaller than the allowable value under QCVN 26:2010 applying for normal areas (apartment buildings, separate/ adjacent houses, hotels, hostels and administrative agencies).

For the areas having medical establishments, libraries, kindergarten, schools, churches, temples and pagodas, in order to limit noise level (55 dBA) smaller than the allowable value, it is required to arrange machines or transport route in the distance of at least 750m.

- *Power generators*

Power generators generate noise level controlled by screen. This noise level is no higher than 82dBA in the distance of 15m. This means that it is required to locate machines in the distance of 60m from the residential area (maximum noise level of 70dBA) and at least 340m from schools, kindergartens and hospitals.

- *Pile drivers*

Pile drivers generate average noise level of 97dBA in the distance of 15m. The noise level is about 70dBA in the distance of 320m and 50 dBA in the distance of 1,900m. So, to satisfy regulations of QCVN 26:2010, the pile drivers must operate in the distance of at least 300m and at least 1,900m from the resorts, hospitals and kindergarten.

- *Comments on effects of noise:*

Schools, hospitals and resorts in the project area are built near the residential areas and the existing traffic roads to travel conveniently such as QL20, QL27, QL28, QL55, DT721, DT724 and DT763. The road route across 24 concentrated residential areas and 55 sensitive establishments such as schools, hospitals and pagodas as listed in Section 2.2.3 – Population distribution and the sensitive objects along the route, Chapter 2

Noise level affects life of local residents on two road-sides because noise level in construction phase is higher than the allowable limit. Attention is paid to effect level of noise for the concentrated residential areas and the sensitive establishments and it is required to take mitigative measures.

a2. Vibration

Vibration level of the emission source is the maximum vibration of one of the construction machines. Vibration level of construction machines is listed in Table 3.23.

Table 3.23. Vibration level of some construction machines at distance of 10 m.

Order number	Equipment	Reference vibrating - dB (following stand upward)
	Excavator	80
	Grader	79
	Truck for transporting earth	74
	Wheelchair	82
	Compressor	81
	Hammers	98

Vibration level in the distance is calculated in the formula:

$$L\ (dB) = L_0 - 10\log(r/r_0) - 8.7\ a\ (r - r_0) \qquad (3.5)$$

Where: L – Vibration level calculated by dB in the distance r (m) to the sources;

L_0 - Vibration level calculated by dB in the distance r_0 (m) to the sources;

a - intrinsic reduction coefficient of vibration, for clay base $a \approx 0.5$

Forecast for vibration level is listed in Table 3.24.

Table 3.24. Forecast for vibration level relative to the distance from the source

Order number	equipment	Vibrating source (r_0=10m)		Vibrating level at distance							
				r = 12m		r = 14m		r = 16m		r = 18m	
		L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)
1	Excavator	80	1.72	70.5	0.58	61.1	0.20	51.9	0.07	42.6	0.02
2	Grader	79	1.53	69.5	0.51	60.1	0.17	50.9	0.06	41.6	0.02
3	Truck	74	0.86	64.5	0.29	55.1	0.10	45.9	0.03	36.6	0.01
4	Wheelchair	82	2.17	72.5	0.73	63.1	0.25	53.9	0.08	44.6	0.03
5	Compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03
6	Hammers	98	12.9	88.0	4.33	78.6	1.47	69.4	0.51	60.1	0.18
VNS 27:2010 – allowed level 75 dB from 6 hours- 18 hours											

The maximum vibration level arises from mechanical hammer in bridge construction; the scope of vibration level only exceeds the allowable limit in the radius of 15m. With such vibration level, construction activities without causing vibration level affect the existing works because the route is far from the residential areas and the important works.

b) Soil erosion and sedimentary deposit

b1. Evaluation of volume of eroded soil

Soil erosion and sedimentation of the water drainage system in the project implementation mainly occur by the following works:

❖ ***Sub-grading, excavating and embanking the road-base:***

During project implementation, about 2,657,106m3 soil is excavated and embanked. In wet season, a part of soil is slid and filled the water drainage system in the project area, leading reduction of drainage. It is difficult to assess the actual quantity of soil eroded in project implementation because it depends on time of excavation and embankment, rainfall in construction phase and measures.

For the mountain terrain of the project area, it averages 0.1% of soil eroded due to rain during construction phase. Thereby, the quantity of soil eroded and washed is over 2,660m3; i.e about 11.7m3 per km road. Risk of eroding and washing soil on the road length of 227.9km and during construction of road base; in which more attention is paid to road sections with high gradient such as Km62 – Km76+700; Km79+800 - Km98 and Km240 - Km268.

❖ ***Construction of bridge abutment, pier and bridge ends:***

During building 16 bridges, about 429,300m3 of soil is excavated and embanked at abutments, piers and bridge ends. Averagely, about 0.1% of the eroded and embanked soil is eroded by rain during construction phase with about 429m3 of eroded soil on all bridge building positions. Soil quantity to be eroded and washed at position for bridge building is assessed in Table 3.25.

Table 3.25. Forecast for soil quantity to be eroded and washed at position for bridge building

Order number	Name of bridge	Route	Amount of filling (m^3)	Amount of potential erosion (m^3)
1	Gia Duc	Km1 + 880	24.403	24
2	La Nga bridge	Km35+712	31.426	31
3	Phuong Lam	Km65 + 056	29.088	29
4	Darleu bridge	Km86+700	25.049	25
5	Dại Quay bridge	Km88+850	21.866	22
6	Damrhe bridge	Km97+900	21.933	22
7	Dại Nga	Km129 + 500	27.513	28
8	Dinh Trang Hoa	Km139 + 300	26.887	27
9	Lien Dam	Km149 + 303	38.645	39
10	Dar le	Km177 + 800	28.549	29
11	Hiep Thuan	Km183 + 376	26.215	26

Order number	Name of bridge	Route	Amount of filling (m^3)	Amount of potential erosion (m^3)
12	Dại Ninh	Km189 + 200	31.286	31
13	Xom Trung	Km194 + 771	20.385	20
14	Dịnh An I	Km217+810	24.414	24
15	Cau Dat	Km254+254	21.732	22
16	Cau Xeo	Km263+100	29.108	29

b2. Evaluation of sedimentary deposit

❖ ***Total volume of eroded soil:***

According to results assessed in section b1 about total quantity of eroded and washed soil, total quantity of soil eroded is 2,660m3 in building road base 429m3 in building bridge on the whole route during construction phase.

❖ ***Distribution of eroded soil in the basin:***

- According to research figures of Vietnam Society of Soil Science, soil in the project area has the following mechanical compositions:
    - o 2.0 mm - 0.2 mm: 0.5%
    - o 0.2 mm - 0.02 mm: 21%
    - o 0.02 mm - 0.002 mm: 32%
    - o < 0.002 mm: 46.5%

- Eroded soil enters the river and stream system in the project area. In water, deposition velocity of grain is expressed in the formula:

$$W = \frac{gd^2}{18\eta} s\left(\frac{\gamma_s - \gamma}{\gamma}\right) \qquad (3.6)$$

Where: d – Grain diameter;

η - Viscosity of water (η = 0.008007 with t = 30^{0}C);

γ_s - Grain density, γ - water density;

g - Gravitational acceleration

From (3.6), mud deposition time to water source and its scope of effect in the project area is assessed. Deposition time and travel distance of grains with diameter of 0.02mm, 0.05mm and 0.5mm in water with depth of 1m, 3m and 5m and flow velocity of 0.5 m/s as listed in Table 3.26.

Table 3.26. Deposition time and travel distance of grains with diameter of d (mm) in water with flow velocity 0.5 m/s

	d = 0,02 mm			d = 0,05 mm			d = 0,5 mm		
The depth of water	1 m	3 m	5 m	1 m	3 m	5 m	1 m	3 m	5 m

Speed of dropping(cm/s)	0,045	0,045	0,045	0,28	0,28	0,28	28,08	28,08	28,08
Time of depositing(minute)	37,1	111,3	185,5	5,9	17,8	29,7	0,06	0,18	0,30
Stretch of road (m)	1.113	3.339	5.565	178	534	890	1,8	5,3	8,9

- Water drainage system in bridge and road building positions in this project has low water depth in a range of 1 – 3m. Thus, about 21% of eroded soil (equivalent to 650m3) is deposited in range of 1,000m - 3,000m from the construction position; the remaining is deposited in rivers and streams in the distance > 3,000m from the eroded position downstream.

c) Erosion of the river banks, road-base and bridge end

Building new bridges and bridge piers change water flow (flow distribution and velocity …) in the bridge building position. With characteristics of rather flow discharge in flood season in bridges, the river banks at two end of the bridge may be eroded and slid. All 16 bridges built in the project have this potential risk during construction and operation phase.

d) Local inundation

Local inundation occurs due to drainage surface area obstructed in building bridge. On the route, some stream bridges has small cross-section and flow discharge is little in dry season and no more in wet season. Thus, narrowing or obstructing the water flow in bridge construction may not cause local inundation in dry season or light rains but cause local inundation in heavy rains. Positions with this potential risk are Gia Duc Bridge (Km1+880), Phuong Lam Bridge (Km65+056), Dinh Trang Hoa (Km139 + 300), Lien Dam (Km149 + 303), Dar le (Km177 + 800), Hiệp Thuận (Km183 + 376), Xom Trung (Km194 + 771), Dinh An I (Km217+810), Dat Bridge (Km254+254) and Xeo Bridge (Km263+100).

Cross culvert building easily causes local inundation in wet season for the reasons of (i) water flow cross section narrowed or obstructed; (ii) water flow temporarily closed to build some construction items; (iii) high rainy intensity (maximum daily rainfall observed for 10 past years in Da Lat: 98mm, Duc Trong: 122mm, Di Linh: 162mm and Bao Loc: 153mm); and (iv) high gradient of the basin and rate of surface flow. Local inundation occur in all positions of building, repairing or lengthening the cross culverts for 7 rainy months.

e) Traffic jam and traffic unsafety

National Highway No.20 has rather heavy traffic density. This is the only road directly connecting Da Lat City and Bao Loc City to Ho Chi Minh City. During rehabilitating and upgrading the National Highway No.20, the traffic density remains unchanged as prior to project commencement because there is no bypass. Positions causing traffic jam and unsafe traffic are as follows:

– Construction of intersections:

+ Intersection with National Highway No.1 at Dau Giay T-junction, Km0+000

+ Intersection with National Highway No.55 at Bao Loc town, Km123+900

+ Intersection with National Highway No.20B (Mimosa road), Km222+350

+ Intersection with National Highway No.20B (Mimosa road), Km233+950

+ Intersection with National Highway No.27 at Dran T-junction, Km268+000

– Intersections between National Highway No.20 with national and provincial roads:

+ Intersection with National Highway No.28 at Km153+650 and Km154+400

+ Intersection with National Highway No.27 at Km206+390

+ Intersection with Provincial Road No.762 at Km6+900

+ Intersection with Provincial Road No.763 at Km22+535

+ Intersection with Thanh Son – Xuan Bac provincial road at Km40+663

+ Intersection with Cao Cang provincial road at Km47+520

+ Intersection with Provincial Road No.721 at Km77+680

+ Intersection with Provincial Road No.713 at Km93+880

– Road sections through the populous area (as listed in Table 2.25 – Distribution of residential areas along the project area)

– Road sections through schools (as listed in Table 2.26 – *Distribution of sensitive establishments along the project area).*

f) Crowded workforce

The number of workforce mobilized on a daily basis in project area may increase to 1,124 people. Crowded workforce in 16 site huts effects as follows:

– Internal contradiction between workers and local people;
– Social evils such as gambling, drug addiction, drinking;

Spreading social diseases such as HIV...

g) Soil compression

Activities at the construction sites and trucks beyond the road route will cause soil compression and change in physico-mechanical properties of soil in the temporarily occupied land area.

3.2.2 AFFECTED OBJECT

3.2.2.1 Soil environment

A. Effects on soil environment due to road construction

Sources adversely affecting soil environment are as follows:

- Excavation and embankment change in topography, vegetation cover and natural imbalance;
- Waste gravel and stone in construction phase, concrete mortar and waste asphalt concrete at construction site and domestic solid waste of workers;
- Wastewater of the batching plants, lubricants discharged from construction machines and domestic water of workers;
- Fuel leakage from construction machines and temporary fuel stores; lubricants spreading upon treating road surface to cover asphalt concrete in wet season.

The affected area is a strip of land along the project route in the scope of several meters from the road edge. In spite of the small scope of effect, soil environment will be affected for a long time in case of bad waste management in construction phase.

a) Excavation and embankment

Excavation and embankment cause erosion and sedimentation in soil environment as follows:

- Filling agricultural land area;
- Local inundation

a1. Filling agricultural land area

As assessed in the previous part, total quantity of excavation and embankment is 3,086,409 m3. While waiting for embanking or transporting, soil may be slid to agricultural land area on two road-sides, filling crops and effecting on crop output. At construction sites, heaped spoil may be slid to the cultivated land area in wet season.

Besides, due to erosion of the road surface and the bridge, culvert construction site, its products in the agricultural land area change its inherent physio-chemical properties.

Scope of effect:

- Strip of agricultural land area on two road-sides in the scope of 50m.
- Bridge building position (16 positions listed in Table 3.25)
- Duration of effect: 36 months.

a2. Local inundation

Local inundation may occur in the depressed land area on two road-sides because excavation and embankment obstruct natural flow or change natural topography. Local inundation may occur in the following areas:

- Stream bridge building position (Table 3.27);
- Cross-culvert building position (298 positions).
- Maximum duration of effect: 36 months.

Table 3.27. Bridge building position, which possibly cause flood in rain season

No.	Name of bridge	Route	Order number	Name of bridge	Route
1	Gia Duc	Km1 + 880	6	Hiep Thuan	Km183 + 376
2	Phuong Lam	Km65 + 056	7	Xom Trung	Km194 + 771
3	Dinh Trang Hoa	Km139 + 300	8	Dinh An I	Km217+810
4	Lien Dam	Km149 + 303	9	Cau Dat	Km254+254
5	Dar le	Km177 + 800	10	Cau Xeo	Km263+100

b) Soil pollution due to waste

b1. Solid wastes

Solid wastes such as concrete, broken bricks, mortar or gravel, nylon waste and domestic waste arise at construction sites. Beside, waste asphalt concrete, gravel and stone exist in building road surface. All wastes cause impairment of soil quality.

Scope of effect:

- Spatially, adjacent agricultural land area around 16 construction sites (Table 1.16 – Arrangement of construction sites).
- Land strip of 50m along two road-sides
- Duration of effect: over 36 months.

b2. Normal liquid wastes

Total volume of waste water from the batching plants for 36 months is 23,975m3 (about 19.2m3/day). Waste water of the batching plants has high pH, causing impairment of soil quality if directly discharging to environment. The affected scope is the area around 16 construction sites. Duration of effect: over 36 months of construction.

b3. Lubricant bearing waste

Total quantity of waste lubricant emitted for 36 months of construction is 168,308 litters, averaging about 3,506 litters/ month. Waste lubricants from construction machines in maintenance, lubricants leaked from construction machines and temporary fuel stores pollute agricultural land area for a long time. The affected area includes 30m on two road-sides. Duration of soil pollution is 36 months but its effect after pollution lasts later.

B. Effects on soil environment due to bridge construction

a) Erosion and sedimentation

Constructing abutment, pier and bridge ends may cause 429m3 soil eroded and washed to the field, lake and river (as mentioned in Table 3.25 – Forecast for soil quantity to be eroded and washed at position for bridge building). About 20% (grain composition < 0.02 mm) is deposited in the downstream agricultural land area at the eroded position.

For normal land area, cash crops are significantly damaged by thick sedimentary layer, effecting on growth and development of crops. This effect only occurs in the narrow cultivated area at two ends of the bridge and lasts 1 crop.

For spoils containing bentonite, in case of overflowing the fields, with its swelling property, a rather thick cover on the fields affects the crops.

Attention is paid to erosion of river banks in the bridge building position to significantly mitigate by techniques in the design such as turf on the slope, stone embankment on two sides of the river in the bridge building position.

b) Wastes

Composition and properties of waste as well as its effects on soil environment in bridge construction are similar to road construction as mentioned above.

3.2.2.2 Atmosphere

A. Effects of road construction

Quality of air environment is degraded by dust and waste gas with the following degree and scope:

- Effects of dust: Results of air quality before project implementation show that background dust concentration is very low (average background dust concentration: $C_{background}$=0.038mg/m3). During construction phase, as calculated in section 3.2.1.1 (Table 3.12), in the scope of 5 - 60m distance windward, dust concentration in the air at 1.5m height is 2-5 times as high as the background dust concentration as previously observed. Increase in dust concentration affects life quality in the project area. The degree and scope of effect will be assessed in Section 3.2.2.6 – Population and community health.

- Effects of waste gas: As assessed, all construction machines such as graders, bulldozers, rollers, excavators and asphalt spreader emit Nox gas exceeding 0.20 mg/m3 (which is the allowable value under QCVN 05:2009/BTNMT) in the segmental radius r=30–50m from the waste source. Some machines emit Nox gas on a large scale such as overhead gantry crane K33 60 (with NOx concentration of 0.211 mg/m3 in a distance of 120m), hot asphalt concrete mixers with capacity of 60 tons/h (NOx concentration exceeding 0.20 mg/m3 in the radius r = 300 m). The degree and scope of effect will be assessed in Section 3.2.2.6 – *Population and community health.*

B. Effects of bridge construction

Loading volume of dust and gas emitted in bridge construction is much less than one in road construction. Dust is emitted in building foundation and bridge pier in sunny days; the affected scope is area at two ends of the bridges. As forecast, dust concentration in the distance of 40m from the bridge exceeds the allowable value under QCVN

05:2009/BTNMT. Dust pollution last 36 months in dry season. *It is required to take mitigative measures*.

Pollution caused toxic gas is similar to one in road construction as mentioned above because of the same construction machines.

3.2.2.3 Surface water and deposit condition

A. Effects on surface water and deposit condition in road construction

a) Water pollution due to increase in suspended solids density

Surface water source is polluted by the following factors:

- *Land erosion:*

As assessed above, total quantity of eroded soil in the whole route is about 2,660m3, of which about 21% of eroded soil (corresponding to 532m3) is deposited in the distance of 1,00m–3,000m from the road route; the remaining is deposited in rivers and streams in the distance of several kilometers downstream has total suspended solids (TSS) higher than the current background level ($TSS_{background}$ = 18.1 – 49.4 mg/l; averaging 32.9 mg/l) and water sources have TSS exceeding the allowable value for B1 class surface water under QCVN 08:2008/BTNM on quality of surface water (allowable value for B1 – for purpose of irrigation is 50 mg/l).

Due to the road route across many flows in La Nga and Dong Nai river basin system, quality of surface water is impaired and alluvial content is higher than the background content in wet season. *It is required to take mitigative measures*.

- *Directly receiving construction waste water:*

Total volume of waste water from the batching plants for 36 months of construction is 23,975m3 (about 19.2m3/day). This waste water contains suspended residues, 4-6 times as high as the allowable value under QCVN 24:2009/BTNMT (compared to column B) and pH is often higher than the allowable value, resulting in increase in suspended solids content in water in areas directly receiving waste source. This effect, together with effect from eroding and washing the road base in wet season, reduces water quality in most of the flows under Dong Nai and La Nga River Basin system. This potential risk lasts 36 months of construction. *It is required to take mitigative measures*.

b) Sedimentation of the reservoirs

Due to rather gradient of rivers and streams in the project area with an average of 6%, most of soil eroded and deposited in the river and stream system is finally discharged to the reservoirs. Thus, prompt sedimentation in the reservoirs results in drastically reducing their service life.

The affected reservoirs are Tri An hydroelectric reservoir (capacity of 400 MW) and hydroelectric reservoirs of DamRi, Da Ton, Tan Rai, Loc Thang, Da Teh, Da Ham, Nam Phuong 1, Nam Phuong 2 and Tay Di Linh.

c) Oil pollution

- *Receiving waste oil in machinery maintenance:*

Total quantity of waste oil emitted for 36 months of construction is 168,308 litters, averaging about 3,506 litters/ month. Harmful waste discharging to the surface water sources pollutes for a long time on a large scale. As a consequence, aquatic organism and species in the oil spreading area die and pollute deposits. Spatial effect of this waste depends on a volume of oil overflowing to water source. Risk of oil pollution is potential during 36 months of construction but its effect after pollution lasts later. *It is required to take mitigative measures*.

- *Receiving storm water overflowing on the construction route:*

Storm water composition overflowing on the road surface and at construction site may contain lubricant pollutants due to leakage from construction machines. Lubricants spreading at the construction site cause serious pollution of surface water source and aquatic system. Risk of oil pollution is potential during 36 months of construction but its effect after pollution lasts later... *It is required to take mitigative measures*.

d) Pollution of organic substances and micro-organism

- *Receiving domestic waste water:*

Total average quantity of domestic waste water is about 112m3 and 105,190m3 in the whole construction phase. Loading volume of pollutants daily discharged to environment from workers and pollutant concentration in waste water are assessed in Table 3.20. Pollutant concentration in domestic wastewater at the construction site is much higher than allowable limit under QCVN 14:2008/BTNMT. Untreated domestic wastewater discharged directly to surface water system causes water pollution as follows:

+ Increase organic content and reducing saturated oxygen content, effecting on living conditions of shrimp, fishes and other aquatic species;

+ Increase content of nutrients, result in eutrophication, create outbreak of alga and seaweed; and negatively affect development of aquaculture and irrigated water supply;

+ Increase harmful microbe (cholera, dysentery, typhoid ...) and affect human health;

+ Facilitate microbial decomposition, causing bad smell and effecting on landscape and tourist development.

A. Receiving overflowed storm water:

Storm water overflowing the domestic waste dump with easily decomposed organic substances causes surface water pollution with the similarities as domestic water. Potential risk of water pollution lasts 36 months. *It is required to take mitigative measures*.

B. Effect on surface water and deposit in bridge construction

a) Water pollution due to increase in suspended solids density

- *Erosion and washing in the foundation pits*

Constructing abutment, pier and bridge ends may cause 429m3 soil eroded and washed to the field, lake and river (as mentioned in Table 3.25 – Forecast for soil quantity to be eroded and washed at position for bridge building). About 80% (grain composition < 0.02 mm) enters surface water sources in Dong Nai and La Nga River Basin System, increasing suspended alluvial content. This effect mainly lasts 36 months of construction. *It is required to take mitigative measures*.

- *Eroding and washing bentonite mixed soil and overflowed bentonite*

In constructing bridges, there is 5,935m3 soil mixed with bentonite and 2,181m3 bentonite flowing in the whole project. This increase suspended solid density in water due to swelling bentonite. On other hand, bentonite mixed with land is swollen and deposited at the bottom, seriously affecting life of the bottom species. Spatial effect level depends on flow speed and wastes discharged to river, but it generally extends several kilometers towards bridge downstream. *It is required to take mitigative measures*.

- *Directly receiving construction waste water:* Similar to the road construction
- *Receiving domestic waste water:* Similar to the road construction
- *Receiving waste lubricant and lubricant-bearing waste:* Similar to the road construction

b) Sedimentation of the reservoirs

Total quantity of excavation and backfilling in bridge construction is 429,303 m3 (See details of bridges in Table 3.25), resulting in about 429 m3 of soil eroded and washed.

Direct effect is sedimentation in the drainage system of Dong Nai River Basin, La Nga River and reservoirs such as Tri An hydroelectric reservoir (capacity of 400 MW) and hydroelectric reservoirs of DamRi, Da Ton, Tan Rai, Loc Thang, Da Teh, Da Ham, Nam Phuong 1, Nam Phuong 2 and Tay Di Linh. As a consequence, this effect of the project contributes to reduce service life of the reservoirs in the project area. Soil is eroded for 36 months but effect of sedimentation (position, degree) in the river and stream system lasts in next years due to continuous deposit movements. *It is required to take mitigative measures*.

c) Pollution due to lubricant-bearing solid wastes

During pier construction for some long river bridge such as La Nga, Dai Ninh, Dai Quay and Dai Nga, the floating platforms are arranged. Everyday there is 3 ÷ 7 kg of lubricant bearing wipers here. This type of waste, without being collected and stored as designated, may penetrate into water sources in the following ways:

- To sweep away wiper of kinds (machine filter papers) together with storm water to the water source

- To directly penetrate into water sources for unintentional and intentional action of the workers.

For lubricant bearing wipers, upon throwing into water enterprises, lubricant is promptly separated and spread on the water surface; lubricant bearing wipers sink into the flow bottom after suspending for a certain time. Thus, lubricant bearing wipers, upon penetrating into the water sources, will generate:

- Risk of water pollution because lubricant spreading on the water surface reduces photosynthesis of vegetation in water;
- Sedimentation and accumulation on the deposit surface, causing damage to bottom aquatic animals.

This potential risk exists during operation of floating platform (about 18 months) and brings long-term consequence on a large scale for the water eco-system.

3.2.2.4 Underground water

a) Pollution due to additives in cast-in-place pile drilling

Upon entering water retaining layers, a part of the bored cast-in-place pile body with bentonite additive is in the water retaining complex. The spatial scope of polluted waters and the pollution level depend on time of hardening the drilling wall. Normally, it lasts 24 hours. Ground water source is main domestic water sources of the local people in the project area. It is required to take measures to mitigate pollution.

b) Pollution due to dirty surface water overflowing to drilling wall

Dirty water from the construction site may overflow to gaps and penetrating into ground water artery. This potential risk exists in drilling a drill hole due to hardened drill-hole wall. Thus, if dirty water overflows to the drill hole, the scope of pollution is larger than additive pollution in space and time. In the project, 8 bridges apply bored cast-in-place pile, in which the drill hose is 60m in depth for La Nga Bridge and 8 - 29 m in depth for other bridges (Table 3.28).

Table 3.28. Bridges applied with bored pile drilling and drill-hole depth

Order number	Name of bridge	Route	The depth of drilling pile	Order number	Name of bridge	Route	The depth of drilling pile
1	Gia Duc	Km1 + 880	23	5	Hiep Thuan	Km183 + 376	8
2	La Nga	Km35 + 717	60	6	Dai Ninh	Km189 + 200	36

Order number	Name of bridge	Route	The depth of drilling pile	Order number	Name of bridge	Route	The depth of drilling pile
3	Phuong Lam	Km65 + 056	23	7	Dịnh An I	Km217+810	29
4	Dai Nga	Km129 + 500	12	8	Cau Dat	Km254+254	20

1.5.11.5 Agriculture

- Due to the dust: the dust concentration in air increases higher than normal at the positions of construction sites along the route, which affects the crop yields because of reducing the photosynthetic capacity of leaves. The quantitative assessment of the effect were difficult because of lack of data and guiding documentation. The effects time is 36 months of construction; affected spatial scale is around 60 m on either side of the project route. This effect requires mitigation measures.

- Factors that can reduce the soil quality (*as evaluated in Section 3.2.2.1*) will also lead to the reduction of crop yields. However, it is difficult to assess the effect due to lack of data and guilding documentation.

1.5.11.6 Traffic status

a) Road

Road traffic on the national road 20 (QL20) will be affected during the construction period of this route. The level of effect on the traffic depends on the traffic density on each period, execution organization task, applied mitigation measures, weather, etc. .. The project construction will affect the road traffic in the area by the following aspects:

- Construction of the intersection:
  + Interchange QL1 at Dau Giay intersection, km0 +000
  + Interchange QL55 at Bao Loc town, Km123 +900
  + Interchange QL20B (Mimosa Street), Km222 +350
  + Interchange QL20B (Mimosa Street), Km233 +950
  + Interchange QL27 at Dran intersection , Km268 +000
- The locations that QL20 intersects with national roads and provincial roads:
  + Intersecting with QL28 at: Km153 +650 and Km154+400
  + Intersecting with QL27 at: Km206 +390
  + Intersecting with provincial road DT 762 at: Km6+900
  + Intersecting with provincial road DT 763 at: Km22 + 535
  + Intersecting with provincial road Thanh Son-Xuan Bac : Km40+663
  + Intersecting with provincial road Cao Cang at: Km47 +520
  + Intersecting with provincial road DT 721 at: Km77+680
  + Intersecting with provincial road DT713: Km93 +880
- Activities transporting construction materials causing traffic corridor encroachment and swamped road. The sections with high population density, large traffic density as listed in Table 3.29.

Table 3.29. Positions in route, which possibly cause traffic jam

Order number	Population clusters	Lý trình
1	Population clusters in Bau Ham 2 comnune	Km3+500 - Km4+500
2	Population clusters in Quang Trung commune	Km5+900 - Km7+500
3	Population clusters in Gia Kiem commune	Km9+500 - Km15+700
4	Population clusters in Phu Tuc commune	Km18+800 - Km22+500
5	Population clusters in La Nga commune	Km34 - Km35
6	Population clusters in Dịnh Quan street	Km45 - Km49
7	Population clusters in Tan Phu street	Km57 - Km60
8	Population clusters in Phuong Lam commune	Km64 - Km67
9	Population clusters in Phu Son commune	Km71 - Km73
10	Population clusters in Magagui street	Km77 - Km79
11	Population clusters in Damri street	Km93+900 - Km94+600
12	Population clusters in Bao Loc city	Km116 - Km122
13	Population clusters in Loc Nga commune	Km126 - Km127
14	Population clusters in Loc An commune	Km132 - Km133
15	Population clusters in turning point of Hoa Ninh	Km137 - Km140
16	. Population clusters in Di Linh street	Km155 - Km159
17	Population clusters in Gia Hiep commune	Km169 - Km171
18	Population clusters in Dai Ninh commune	Km185 - Km187
19	Population clusters in Lien Nghia street	Km199 - Km206
20	Population clusters in turning point of Phi Nom	Km208 - Km209
21	Population clusters in Đa Lat city	Km229 - Km234
22	Population clusters in Trai Mat	Km237 - Km239
23	Population clusters in Xuan Tho commune	Km241 - Km242
24	Population clusters in Xuan Truong commune	Km251 - Km252
Order number	**Sensitive base**	**Route**
1	Ninh Phat church	Km6
2	Thang Long Secondary school	Km9
3	Dau Giay hospital	Km9+100
4	Vo Dong parish,Thanh Son parish	Km10
5	Bach Lan parish (Gia Tan)	Km13+400

6	Nguyen Ba Ngoc Primary school	Km14
7	Phu Cuong church	Km17 +050
8	Phu Cuong market (Phu Cuong commune)	Km19 +100
9	Nguyen Du primary school	Km45
10	Nguyen Thi Minh Khai secondary school	Km45+400
11	Tho Lam market	Km64
12	Phuong Lam market	Km65
13	Phuong Lam market	Km65+500
14	Phu Trung secondary school	Km69+500
15	Phu Lam parish	Km70
16	Dai Lao market	Km110+900
17	Loc Chau market	Km116+700
18	Hai Ba Trung primary school	Km117+050
19	Bao Loc secondary and vocational shool	Km119
20	Hoa Lu preschool education	Km123
21	Loc Son - Bao Loc primary school	Km123+200
22	Loc An B primary school	Km131+150
23	Loc An secondary chool	Km131+800
24	Loc An clinic	Km132
25	Loc An A primary school	Km132+200
26	Le Hong Phong secondary school	Km137+400
27	Hoa Ninh market	Km137+450
28	Vo Thi Sau primary chool	Km154
29	Tan Nghia II primary school	Km160
30	Tan Nghia church	Km160+250
31	Phuoc Lac pagoda	Km160+600
32	Dinh Lạc market	Km162+300
33	Dinh Lạc primary school	Km163
34	Tan phu church	Km165+450
35	Gia Hiep secondary school	Km170
36	Phu Hiep parish	Km170+600
37	Phu Hiep secondary school	Km171
38	Hiep Thuan primary school	Km184
39	Ninh Gia primary school	Km186+700
40	Ninh Gia secondary school	Km188+200
41	Son Trung secondary school	Km189+500
42	Nguyen Thai Binh secondary school	Km192+700

43	Son Trung primary school	Km196+800
44	K'Long primary school	Km214+600
45	K'Long church	Km214+700
46	Hiep An secondary school	Km216+400
47	Dịnh An primary school	Km217+600
48	Tran Phu high school	Km235
49	Phan Chu Trinh secondary school	Km235+300
50	Xuan Thọ healthy centre	Km242+800
51	Da Loc - Xuan Thọ church	Km243+900
52	Xuan Thọ secondary school	Km245+200
53	Xuan Truong primary school	Km254+150
54	Xuan Truong primary school	Km257+800
55	Trạm Hanh - Xuan Truong protestant church	Km259+300

b) Waterway

- System of rivers and streams in the project area has steep gradient, dangerous terrain so they are not usually used as a waterway transportation system. Therefore, the construction of bridges in the project does not effect the water transport in the region.

1.5.11.7 Population and public health

A. Effects of road construction

Residential communities in the project area and workers who directly construct the route will be affected by the following factors:

a) By dust

***- The effects of dust on the residents living on two sides of the project route*:**

As in the previous assessment, at a distance <60 m from the edge of the road, the dust concentrations is 2-5 times higher than the background level; at a distance of 120 m from the road, the dust concentrations is about 0.038 mg/m3 equivalent to the background dust concentration value of the project area. The health of the inhabitant living within 60 meters from the road will be affected due to the increased dust concentration. With an average population density of communes along the project route in Dong Nai of 250 people per km2, it is estimated that 1,400 people will be affected by airborne dust concentrations higher than the background level before project. The communed passed through by the route in Lam Dong Area has an average population density of 80 people per km2; the number of people affected by airborne dust concentrations higher than background levels before the project is 1,200. The areas with high population density living along both sides affected by dust most significant as listed in Table 3.28 above.

On QL20, there are 55 sensitive basements on both sides affected by dust during the construction and transportation of raw materials. The locations that are sensitive and has the potential dust concentration as the low wind speed V = 1m / s and average wind speed V = 3m / s are given in Table 3.30.

Table 3.30. Sensitive basements and potential dust concentration **when wind speed V = 1m / s and V = 3m / s**

Order number	Sensitive base	Route	Distance (m)	Concentration of dust, V=1m/s (mg/m^3)	Concentration of dust V=3m/s (mg/m^3)
1	Ninh Phat church	Km6	50	0,130	0,043
2	Thang Long secondary shool	Km9	60	0,114	0,038
3	Dau Giay secondarys chool	Km9+100	80	0,093	0,031
4	Vo Dong parish, Thanh Son parish	Km10	60	0,114	0,038
5	Bach Lan parish	Km13+400	50	0,130	0,043
6	Nguyen Ba Ngọc parish	Km14	50	0,130	0,043
7	Phu Cuong church	Km17 +050	60	0,114	0,038
8	Phu Cuong market	Km19 +100	30	0,186	0,062
9	Nguyen Du primary school	Km45	50	0,130	0,043
10	Nguyen Thi Minh Khai secondary	Km45+400	60	0,114	0,038
11	Thọ Lam parish	Km64	50	0,130	0,043
12	Phuong Lam market	Km65	30	0,186	0,062
13	Phuong Lam parish	Km65+500	60	0,114	0,038
14	Phu Trung secondary school	Km69+500	50	0,130	0,043
15	Phu Lam parish	Km70	50	0,130	0,043
16	Dại Lao healthy centre	Km110+900	60	0,114	0,038
17	Loc Chau market	Km116+700	30	0,186	0,062
18	Hai Ba Trung primary school	Km117+050	50	0,130	0,043
19	Bao Loc secondary and vocational school	Km119	60	0,114	0,038
20	Hoa Lu preschool education	Km123	50	0,130	0,043
21	Loc Son - Bao Loc primary school	Km123+200	45	0,140	0,047
22	Loc An B primary school	Km131+150	45	0,140	0,047
23	Loc An secondary chool	Km131+800	50	0,130	0,043
24	Loc An clinic	Km132	60	0,114	0,038
25	Loc An A primary school	Km132+200	45	0,140	0,047
26	Le Hong Phong secondary school	Km137+400	50	0,130	0,043
27	Hoa Ninh market	Km137+450	30	0,186	0,062
28	Vo Thi Sau primary chool	Km154	45	0,140	0,047
29	Tan Nghia II primary school	Km160	50	0,130	0,043
30	Tan Nghia church	Km160+250	50	0,130	0,043
31	Phuoc Lac pagoda	Km160+600	60	0,114	0,038
32	Dinh Lạc market	Km162+300	30	0,186	0,062
33	Dinh Lạc primary school	Km163	45	0,140	0,047
34	Tan phu church	Km165+450	45	0,140	0,047

Order number	Sensitive base	Route	Distance (m)	Concentration of dust, V=1m/s (mg/m^3)	Concentration of dust V=3m/s (mg/m^3)
35	Gia Hiep secondary school	Km170	50	0,130	0,043
36	Phu Hiep parish	Km170+600	50	0,130	0,043
37	Phu Hiep secondary school	Km171	45	0,140	0,047
38	Hiep Thuan primary school	Km184	60	0,114	0,038
39	Ninh Gia primary school	Km186+700	50	0,130	0,043
40	Ninh Gia secondary school	Km188+200	50	0,130	0,043
41	Son Trung secondary school	Km189+500	45	0,140	0,047
42	Nguyen Thai Binh secondary school	Km192+700	45	0,140	0,047
43	Son Trung primary school	Km196+800	50	0,130	0,043
44	K'Long primary school	Km214+600	60	0,114	0,038
45	K'Long church	Km214+700	60	0,114	0,038
46	Hiep An secondary school	Km216+400	50	0,130	0,043
47	Dịnh An primary school	Km217+600	60	0,114	0,038
48	Tran Phu high school	Km235	100	0,079	0,026
49	Phan Chu Trinh secondary school	Km235+300	100	0,079	0,026
50	Xuan Thọ healthy centre	Km242+800	45	0,140	0,047
51	Da Loc - Xuan Thọ church	Km243+900	50	0,130	0,043
52	Xuan Thọ secondary school	Km245+200	70	0,103	0,034
53	Xuan Truong primary school	Km254+150	80	0,093	0,031
54	Xuan Truong primary school	Km257+800	80	0,093	0,031
55	Trạm Hanh - Xuan Truong protestant church	Km259+300	70	0,103	0,034

In general, the dust concentration at the locations mentioned above shall not exceed the specified value for 24 hours according to Vietnam standard of 0.20 mg/m3. However, during the windless period of the project area (in March and April, average monthly wind speed is 1.2 m / s, the windless frequency is over 50%), the dust concentration is higher than the background level before building the project from 2-5 times and there are some locations approximate to the limited value. This also affects the life quality of people in these areas, so it is required to have the mitigation measures.

b) By emissions

According to the previous section, all equipment such as graders, bulldozers, machine rollers, loaders, excavators, asphalt plant are causing NOx emissions exceeding 0.20 mg/m3 - the permissible value for QCVN 05:2009 / BTNMT, in a fan zone with the radius of 30 m - 50 m downwind. With an average population density of the communes along the project route is 250 persons per km2 in Dong Nai and 80 people per km2 in Lam Dong area, it is estimated that 1,400 people in Dong Nai and 1,200 people in Lam Dong At will be affected because the NOx gas concentration increases.

c) By noise

The operation of construction machines often causes noises exceeding 70 dBA - the maximum allowed value of QCVN 26:2010 standards applies to common areas. Specifically as follows: Pile drivers with the noise levels exceeding 70 dBA in the radius r <300 m; Generator with the noise level exceeding 70 dBA in the radius r <60 m; Leveling vehicles with the noise level exceeding 70 dBA in the radius r <120 m; Concrete mixer with the noise level exceeding 70 dBA in the radius r <200 m. Such that each machine operation, it is estimated that about 10-30 people in the construction area are affected because the noise level of the construction machine exceeding the permitted level (population density in communes along the route is about 80-250 people per km2).

For sensitive basements along the route, the noise caused by the construction equipment such as land leveling machines, material handling vehicles often exceed the permitted limit value at most locations as statistics in Table 3.31.

Table 3.31. Noise level arisen from sensitive basements

No.	Sensitive base	Route	Distance (m)	Concentration of dust, V=1m/s (mg/m^3)	Concentration of dust V=3m/s (mg/m^3)
1	Ninh Phat church	Km6	50	0,130	0,043
2	Thang Long secondary shool	Km9	60	0,114	0,038
3	Dau Giay secondarys chool	Km9+100	80	0,093	0,031
4	Vo Dong parish, Thanh Son parish	Km10	60	0,114	0,038
5	Bach Lan parish	Km13+400	50	0,130	0,043
6	Nguyen Ba Ngọc parish	Km14	50	0,130	0,043
7	Phu Cuong church	Km17 +050	60	0,114	0,038
8	Phu Cuong market	Km19 +100	30	0,186	0,062
9	Nguyen Du primary school	Km45	50	0,130	0,043
10	Nguyen Thi Minh Khai secondary	Km45+400	60	0,114	0,038
11	Thọ Lam parish	Km64	50	0,130	0,043
12	Phuong Lam market	Km65	30	0,186	0,062
13	Phuong Lam parish	Km65+500	60	0,114	0,038
14	Phu Trung secondary school	Km69+500	50	0,130	0,043
15	Phu Lam parish	Km70	50	0,130	0,043
16	Dại Lao healthy centre	Km110+900	60	0,114	0,038
17	Loc Chau market	Km116+700	30	0,186	0,062
18	Hai Ba Trung primary school	Km117+050	50	0,130	0,043
19	Bao Loc secondary and vocational school	Km119	60	0,114	0,038
20	Hoa Lu preschool education	Km123	50	0,130	0,043
21	Loc Son - Bao Loc primary school	Km123+200	45	0,140	0,047
22	Loc An B primary school	Km131+150	45	0,140	0,047
23	Loc An secondary chool	Km131+800	50	0,130	0,043

No.	Sensitive base	Route	Distance (m)	Concentration of dust, V=1m/s (mg/m^3)	Concentration of dust V=3m/s (mg/m^3)
24	Loc An clinic	Km132	60	0,114	0,038
25	Loc An A primary school	Km132+200	45	0,140	0,047
26	Le Hong Phong secondary school	Km137+400	50	0,130	0,043
27	Hoa Ninh market	Km137+450	30	0,186	0,062
28	Vo Thi Sau primary chool	Km154	45	0,140	0,047
29	Tan Nghia II primary school	Km160	50	0,130	0,043
30	Tan Nghia church	Km160+250	50	0,130	0,043
31	Phuoc Lac pagoda	Km160+600	60	0,114	0,038
32	Dinh Lạc market	Km162+300	30	0,186	0,062
33	Dinh Lạc primary school	Km163	45	0,140	0,047
34	Tan phu church	Km165+450	45	0,140	0,047
35	Gia Hiep secondary school	Km170	50	0,130	0,043
36	Phu Hiep parish	Km170+600	50	0,130	0,043
37	Phu Hiep secondary school	Km171	45	0,140	0,047
38	Hiep Thuan primary school	Km184	60	0,114	0,038
39	Ninh Gia primary school	Km186+700	50	0,130	0,043
40	Ninh Gia secondary school	Km188+200	50	0,130	0,043
41	Son Trung secondary school	Km189+500	45	0,140	0,047
42	Nguyen Thai Binh secondary school	Km192+700	45	0,140	0,047
43	Son Trung primary school	Km196+800	50	0,130	0,043
44	K'Long primary school	Km214+600	60	0,114	0,038
45	K'Long church	Km214+700	60	0,114	0,038
46	Hiep An secondary school	Km216+400	50	0,130	0,043
47	Dịnh An primary school	Km217+600	60	0,114	0,038
48	Tran Phu high school	Km235	100	0,079	0,026
49	Phan Chu Trinh secondary school	Km235+300	100	0,079	0,026
50	Xuan Thọ healthy centre	Km242+800	45	0,140	0,047
51	Da Loc - Xuan Thọ church	Km243+900	50	0,130	0,043
52	Xuan Thọ secondary school	Km245+200	70	0,103	0,034
53	Xuan Truong primary school	Km254+150	80	0,093	0,031
54	Xuan Truong primary school	Km257+800	80	0,093	0,031
55	Trạm Hanh - Xuan Truong protestant church	Km259+300	70	0,103	0,034

Inhabitants living in the areas affected by the noise can lead to bad effects on their health, especially for those who have a history of cardiovascular disease, vestibular disorders, gastritis and insomniac.

d) Loss of income

Crop yields reduction due to dust and material spillage or accidental spills as mentioned in Section 3.2.2.1 and Section 3.2.2.4 will affect the incomes of people who have the production area near two sides of the project route. The economic losses to households will exist but the extend of damage is difficult to assess. This effect may last 36 months longer than the construction time until the bad effects are remedied and such lands revert to its original state.

Along the project route, the income of about 2250 small business households near the road will be affected in the process of project implementation, especially for households doing business on catering. Airborne dust concentrations higher than normal will affect the food and daily number of visitors. The affected status will prolong until the end of dust pollution. *This effect requires the mitigation measures.*

e) By the concentration of workers

The concentration of a large number of construction workers on the route (about 1120 people) during the 36 months will increase the mechanical population in the project area, which may lead to increase the risk of developing the social evils; increase the contamination risk of the social diseases from the workers to the local communities and vice versa, especially HIV disease (according to 2009 statistics, Lam Dong province has 1,398 cases of HIV infection in which 249 people died).

In addition, the concentration of workers in 16 camps will cause the bad effects such as conflicts arising within the workers and the local people; evils like gambling, drugs , drunk appear; disputes in trading, living with local people.

B. Effect by the bridge construction

a) By dust and emissions

- Effect at position of bridges construction: Who are affected are mainly people living on two sides of the bridge within a radius of 40-50 m. Due to low population density (from 80 to 250 people per km2), the number of people affected is not much. The bridge near the residential areas, including:

+ La Nga Bridge, Km35 +712 - near the residential area La Nga (Km34 - Km35);

+ Phuong Lam Bridge, Km65 +056 - near Phuong Lam market (Km65) and Phuong Lam Parish (Km65 +500);

+ Hieo Thuan Bridge, Km183 +376 - Near Hiep Thuan Elementary School (Km184);\

+ Dai Ninh Bridge, Km189 +200 - Near the Son Trung High School (Km189 +500);

+ Dinh An I Bridge, Km217 +810 – Near Dinh An Elementary School (Km217 +600);

+ Dat Bridge, Km254 +254 – Near Xuan Truong Primary School (Km254 +150).

- Effect by the materials transportation: This effect has been commonly assessed in the part of road.

b) By the noise

This effect is similar to the part of road.

c) By the concentration of workers

This effect is similar to the part of road

1.5.11.8 Ecological system

A. Terrestrial ecosystem

In the process of implementing and operating the project, there will be the following main factors causing the bad effects on the terrestrial ecosystems:

- High concentrations of dust in the air by synthesizing a variety of activities such as excavating, digging and materials transportation are the main factors affecting the terrestrial ecosystems in the area surrounding the two sides of project route. Dust will click on trees and crops along the road, which slows down the growth of trees, affects the life of insects and animals in the area. The area within 50 m from each side of the road will be affected by this effect; the time directly affected is 36 months of construction and also extended a later time.

- Emissions of construction means, especially operation of the plastic concrete mixture mixing plants affect the air environment, which affects the terrestrial ecosystem of the surrounding area. In addition, if the fire incidents occur at the plastic concrete mixing plant, the whole environment of air, soil, water and fauna in the area around the plant will be seriously affected. In normal circumstances, the affected scope may be up to 100 m from the emission source, while in case of fire, the level of effect depends on the size of the problem and the preventative measures.

- Waste plastic concrete during asphalt overlaying will affect the soil environment and terrestrial ecosystems if they are not cleaned and well managed.

- Leakages, fires and explosions in the area storing materials in the work site will cause the bad effects on the terrestrial ecosystem surrounding the storage area. Level of effect depends on the size of the problem and the preventative measures.

- Noise from construction equipment and blasting affect the animals living in close proximity of routes, which makes them migrate to new areas away from the route and will bear the risk at the strange land (being hunted, lack of food, etc. ..). The affected scope is the area near the road in the distance <150 m on the Km79 +800 - KM98; Affected duration is 18 months of the construction.

The level of effect of the factors mentioned above to the ecosystems along the route varies based on the characteristics of each region. Based on the ecological characteristics of the regions the route passes through, it can be divided into 3 regions with different characteristic (*as mentioned in Section 2.1.4.5 - Biological Resources, Chapter 2*): (i) The km0 - Km76 +700; The Km79 +800 – Km98; The Km108 - Km268. With biodiversity characteristics of each period specified, the terrestrial ecosystems in the sections Km79 +800 - Km98 is affected more significantly because there is a natural forest located near the route; the two remaining periods is affected less because people have stepped into this area many years ago.

B. Wetland ecosystems

In the project area with the wetland ecosystems is quite diverse with a variety of reservoirs and flows in the Dong Nai River Basin and the La Nga River Basin. At different aspects, the wetland ecosystem is affected from the following factors.

a) Water contaminated by suspended solids

The risk of surface water pollution by suspended solids due to soil erosion and runoff in the phase of making road base, building bridges, from maintenance activities of equipment and operation of cement concrete mixers, which was presented in *Section 3.2.2.3* above.

High water turbidity will limit the photosynthesis of phytoplankton species - primary biological products, as feed for all animals in the following food chain. However, the good circulation flow of rivers in the project area creates the better resilience of food sources. In fact, in the flood season, the river water has large turbidity as tens times compared with the dry season, but the submerged aquatic species are not in case of exhaustion of primary food source. But, during the construction in the dry season, the river flow is usually low, which increases the deposition of suspended solids. The scope of solids deposition is often narrow, so it is easy to create the bars. This condition can kill the filter feeder, because they move slowly. The fine particles of betonies easily cause asphyxiation of benthic. Compared to the aquatic species, the capacity of resilience of the benthic is generally slower. Consequences of pollution are long-term to the benthic. This effect requires the mitigation measures.

b) Water and sediments is oil-contaminated

The species that live in water and on sediments are very sensitive to pollution, especially oil pollution. Oil is toxic objects, reducing the biological productivity of waters. Generally, the effect of oil-contaminated water to animals is shown through two processes:

- The first process: rapidly decrease the amount of oxygen dissolved in water covered by oil film that prevents the penetration of oxygen from the air;
- The second process: the oil hydrocacbua directly causes toxic to the organism as they absorb the oil through the food chain. This process takes place in three stages according to the increasing oil content: the first stage – excitation; second stage - the process of slight intoxication; final stage - causing accidents, killing organisms.

The scope of the oil effect on space and time depending on the amount of oil released into the aquatic environment, but in general it is huge. Nearly 2/3 area of the Dong Nai River basin and nearly half the area of La Nga River Basin lies downstream of the project construction and it is also possible scope of oil effect. Time of effect can last for several years after project completion. This effect requires the mitigation measures.

c) Water and sediment contaminated by organic matter and microbial

The risk of organic and microorganisms contamination of water under the project area is potential during 36 months of construction. With the large flow of rivers in the year and especially in the rainy season, the possibility of dilution of the river is quite well, so the pollution scope is not large, and only occurs partially in the areas receiving waste and the risk of extensive contamination of water sources on a large scale is unlikely. Consequences for wetland organisms are negligible in the scope of space and time.

d) Water and sediment contaminated by the solid waste

Solid waste into the surface water can float on water or sink to the bottom. The floating reduces the photosynthesis of the algae, while the sunk can destroy the benthic due to collision, or cover up the residence of the benthic, which causes damages to their lives, the first damage is for the filter feeder that move slowly . On the other hand, the solid in water is a favorable environment for the development of pests, which affects the survival of other species. Therefore the ecological balance is changing for the worse.

e) Water and sediment contaminated by metals

Heavy metals can cause death to animals or reduce the quality of aquatic life. However, based on the type of materials used in the project, the risk of heavy metal pollution is very low.

3.3 IN OPERATION PHASE

3.3.1 EFFECT SOURCES

Effect sources in operation phase include:
- Operation of vehicles;
- Storm water runoff on the route;
- Appearance of abutments, piers in the river flow.

The effect sources in this period are summarized in Table 3.32.

Table 3.32. Sources causing effect during operation phase

Order number	Effects related waste	Type of waste arising
1	Activities of vehicle	Dust, poison gas
2	Spilling rain water	Dust in surface
TT	**Unrelated waste**	**Factors caused effect**
1	Activities of vehicle	Noisy, vibrating
2	Appearing new bridge	Changing mode of runoff

3.3.1.1 Effect sources relating to waste

a) Dust and gas emitted from vehicle flow

Gas emitted from motor engine is a main source of air pollution. As mentioned in the Preface (Table 0.1), the forecast vehicle flow in the future is as follows:

Table 3.33. Forecast for vehicle flow in the future

Year	Motorcycle	Car	Truck with 2 axises and bus under 25 seats	Truck with 3 axises up and big bus	Total vehicle (CPU/day &night)	Exchanging vehicle (CPU/ day and night)
2020	9671	899	4976	899	17259	16161
2025	12942	1203	6659	1203	23096	21627

Suppose that vehicle flow in rush hours is 20% more than average alue and emission coefficient assessed by WHO is appropriate. At the same time, based on the volume of fuel consumed by each type of vehicle, exhaust gas volume may be converted with the following coefficient: exhaust gas volume consumed by car is 50% of middle truck and large passenger car; exhaust gas volume by light truck and small passenger car is 75% of middle truck and exhaust gas volume by heavy truck is 127% of middle truck. Thereby, the exhaust gas volume in the route of project is assessed in Table 3.34.

Table 3.34. Forecast for exhaust gas volume in the route of project

Waste	coefficient of pouring (mg/vehicle/m)	Capacity of vehicle(vehicle/h)	Amount of waste (mg/m/h)	Strength of waste (mg/m/s)
Year 2020				
Hanging dust	0,9	951	856	0,24
SO_2	2,075 S	951	10	0,003
NO_x	14,4	951	13701	3,81
CO	2,9	951	2759	0,77
HC	0,8	951	761	0,21
Year 2025				
Hanging dust	0,9	1228	1105	0,31
SO_2	2,075 S	1228	13	0,004
NO_x	14,4	1228	17686	4,91
CO	2,9	1228	3562	0,99
HC	0,8	1228	983	0,27

❖ **Assessment of dust and gas emission in the air**

It is considered that emission sources from vehicle are to assess pollutants spread in the air windward. Dust and gas concentrations relative to the distance x at the end of windward from vehicle flow are assessed in Sutton's modified model (3.2) with strength of emission source as mentioned in Table 3.34. Results of assessment are listed in Table 3.35 with wind speed of 3.0m/s – average wind velocity in the research area.

Table 3.35. Forecast for exhaust gas concentration relative to the distance

Pollutants	Concentration of material following distance($mg\ m^{-3}$)								
	20 m	40 m	60 m	80 m	100 m	120 m	140 m	160 m	180 m
Year 2020									
Dust	0,026	0,016	0,012	0,010	0,008	0,007	0,006	0,006	0,005
SO_2	0,00029	0,00018	0,00014	0,00011	0,00010	0,00008	0,00007	0,00007	0,00006
NOx	0,41	0,25	0,19	0,16	0,13	0,12	0,10	0,09	0,09
CO	0,082	0,051	0,038	0,031	0,027	0,023	0,021	0,019	0,017
HC	0,023	0,014	0,011	0,009	0,007	0,006	0,006	0,005	0,005
Year 2025									
Dust	0,033	0,021	0,015	0,013	0,011	0,009	0,008	0,008	0,007
SO_2	0,00038	0,00024	0,00018	0,00014	0,00012	0,00011	0,00010	0,00009	0,00008
NOx	0,53	0,33	0,25	0,20	0,17	0,15	0,13	0,12	0,11
CO	0,106	0,066	0,050	0,040	0,034	0,030	0,027	0,024	0,022

HC	0,029	0,018	0,014	0,011	0,009	0,008	0,007	0,007	0,006

Comments:

NO_x gas concentration exceeds 0.20 mg/m^3 of the allowable value under QCVN 05:2009/BTNMT in the project area from the distance of 50m and 80m in 2020 and 2025 respectively. The remaining gases and dust concentration are lower than the maximum allowable value.

b) Heavy metal in overflowed storm water

The recent studies have shown that surface dirt soil contain a significant content of toxic heavy metal (Table 3.36). Storm water overflowing the road sweeps away the surface dirt soil which enter the surface water source. However, pollution level depends on many factors. So, possible content may be assessed through figures found in the world.

Table 3.36. Contents of some rates in the surface dirt soil

Order number	Object	Capactity	Order nunber	Object	Capacity
1	pH	6,7 - 7,6	7	Cr	2 - 35
2	Lubricant	5 - 73	8	Cu	24 - 310
3	Clo	0,1 - 4	9	Fe	24 - 65
4	NO_3^-	3 - 386	10	Pb	19 - 553
5	SO_4^{2-}	34 - 2.700	11	Ni	2 - 73
6	Cd	1,3	12	Zn	90 - 577

Source: Clark and nnk. CIWEM's Magazine, 2000.

3.3.1.2 Effect sources not relating to waste

a) Noise made by vehicle flow

To assess noise level made by vehicle flow, some assumptions have been admitted. Daily vehicle flow is taken as Table 3.33; average hours taken from the forecast figure of daily vehicle flow is 16 hours; vehicle flow in rush hours is 20% higher than average vehicle flow. Vehicle flow in rush hours is listed in Table 3.37.

Table 3.37. Vehicle flow in rush hours

Year	Car	Slight truck, small passenger car	Medium truck, big passenger car	Heavy truck	Total of Vehicle	(Truck+passenger car)/total
Year 2020	223	477	415	232	1347	83,5
Year 2025	303	613	550	286	1752	82,7

Average equivalent noise level of vehicle flow is assessed in the approximate formula [5]:

$$\mathbf{L_A = L'_A + \sum \Delta L_{Ai}}, \qquad (3.7)$$

Where: + L_A - Average equivalent noise level in the distance of 7.5 m at height of 1.5m (dB);

+ L'_A - Average equivalent noise level in the distance of 7.5 m at height of 1.5m; 60% truck – passenger car; V = 40 km/h (dB);

+ ΔL_{Ai} = ± 0.8 dB upon increase/ decrease of 10% truck – passenger car;

+ ΔL_{Ai} = ± 1.5 dB upon increase/ decrease V ~ 10 km/h;

+ ΔL_{Ai} = - 2 dB upon width > 60m.

L'_A is determined by statistic results in many cities in many years in former Soviet and quoted in Table 3.38.

Table 3.38. Average equivalent noise level of vehicle flow with standard condition (as document [5])

Capacity of vehicle (vehicle/h)	1000	1500	2000	3000	4000	5000	10000
Noise level L'_A(dB)	76	77	77,5	78,5	79	80	81

From formula (3.7), average equivalent noise level in the distance of 7.5 m at height of 1.5m and vehicle velocity of 100 km/h have the following values:

- By 2020: equivalent noise level ng La = 88.6 dB;
- By 2025: equivalent noise level La = 89.2 dB.

❖ *Reduction of noise level relative to the distance:*

Average distance between the vehicles is calculated in the formula:

s = 1000*V/Q, (3.8)

Where: + V – Average velocity of vehicle flow (km/hour);

+ Q – Vehicle flow (Vehicle/ hour).

[s < 20 is considered as road source; s > 200 is considered as point source; 20 < s < 200 is considered as intermediate source]. In case average speed of vehicle flow is 60 km/h in the project route, s = 48.9 by 2020 and s = 37 by 2025. Thus, this is intermediate source and noise level reduced by distance is determined by the interpolation method between calculated of noise level reduction for point source (3.9) and for road source (3.10) below.

$$L_2(dB) = L_1 - 20\lg\left(\frac{r_2}{r_1}\right)^{1+\alpha} \quad (3.9)$$

$$L_2(dB) = L_1 - 10\lg\left(\frac{r_2}{r_1}\right)^{1+\alpha} \quad (3.10)$$

Where: L_1 and L_2 are noise strength in the respective distances of r_1 and r_2; α is sound absorption coefficient of the ground (for asphalt road surface α = -0.1; for empty land area α = 0). In case of the empty land area, noise level is reduced by the distance as listed in Table 3.39.

Table 3.39. Noise level made by vehicle flow, relative to the distance from the road

Distance(m)	7,5	15	20	40	60	80	100	120	140	160	180
Noise level 2020 (dB)	87,6	83,4	81,6	77,4	74,9	73,2	71,8	70,7	69,8	69,0	68,2

Noise level 2025 (dB)	88,1	83,9	82,1	77,9	75,4	73,7	72,3	71,2	70,3	69,5	68,7

Comment:

The project route has noise level exceeding 70 dB within the distance of 140m without noise abatement wall after 2020 and within the distance of 160m after 2025.

b) Existence of the route

Effect of existence of the route is assessed by the following factors:

- Effect of separation of agricultural land area;
- Effect on drainage regime.

❖ **Effect of route separation:** The old route has existed for a long time and upgraded through the project with direction along the old route. Therefore, separation effect is insignificant.

❖ **Effect on drainage regime:**

- There are 16 bridges built in the project at the old positions with design flood frequency of 4% for small bridges and 1% for middle and large bridges. Basically, drainage regime is better than one of the old bridges.
- 298 cross-culverts are arranged at the old positions and added at the new positions on a basis of hydrographic and hydraulic calculations in the project area, ensuring drainage opening. The drainage opening of the culverts is $\Phi \geq 1$m, higher than some positions of old culverts. Thus, drainage of the new culvert system is better than the existing one.

c) Existence of bridge piers in flows

The newly built bridge piers effect on flows in the following aspects:

- To change flow velocity in the vicinity of the bridge piers at two ends and change sedimentation/ erosion regime of the river bed;
- To increase instability due to change in flow.

3.3.2 AFFECTED OBJECT

3.3.2.1 Atmosphere

Quality of air environment along the two road-sides is reduced by toxic gas emitted from motor engine. By 2020, NO_x gas concentration exceeds the allowable value under QCVN 05:2009/BTNMT in the distance of 50m. The scope of air pollution will be expanded in later years due to increase of vehicle density.

Except for NO_x as mentioned above, other gases have lower concentration than the allowable value under QCVN 05:2009/BTNMT by 2020.

3.3.2.2 Water environment

a) Hydrographic regime

As mentioned above, mostly the route is along the drainage flow in the project area. In addition, the flow bridges are designed with flood frequency p = 1%; opening and position of the cross culverts are improved compared to the old culvert system on a basis of the hydrographic figures in many years in the project area. Thus, existence of the route remains unchanged in the hydrographic regime in the project area.

b) Quality of water environment

Quality of water environment is reduced by organic dirty substances and heavy metal on the road surface discharged to the surface flow. Heavy metals are mainly from gas emitted by vehicle and gradually accumulated in water environment over time.

3.3.2.3 Economic-social situation

a) Socio-economic effects without the project

Without waterway and railway, goods exchange and travelling between Lam Dong province and surrounding provinces are mainly by roadway. Presently, road transport from Lam Dong province to Dong Nai province and Ho Chi Minh City is on National Highway No.20. Due to increasing vehicle flow, its road grade is limited while the route is across the populous towns, travelling on National Highway No.20 is limited. It takes about 7 hours from Ho Chi Minh City to Da Lat on the 320m road. Besides increase in goods freight, difficult traffic situation obstructs investors from doing business in Lam Dong province. The annual number of visitors to Da Lat is reduced by the present traffic situation.

b) Socio-economic effects with the project

b1. Positive effects:

- Upon project completion, transport on National Highway No.20 will be considerably improved, contributing to more convenient link of Lam Dong province, Dong Nai province, Ho Chi Minh City and Vung Tau City and between Southern Region and Highland Region.
- To reduce travel time from Lam Dong province to Ho Chi Minh City and Southeastern provinces; to accelerate economic development of Lam Dong province, especially tourism sector in Lam Dong in general and Da Lat City in particular.
- To contribute to push up investment of the enterprises in Bao Loc City – Lam Dong; to form economic zones in Highland Region; to reduce difference of economic development in regions nationwide; and to contribute to successfully implement the Government's poverty alleviation program.

b2. Negative effects:

- To increase dust emission due to high vehicle flow density: Dust emitted from motor engine causes air pollution (dust concentration is forecast in Section 3.3.1.2 - *Effect sources not relating to waste*).

- To increase gas emission due to high vehicle flow density: Gas emitted from motor engine causes air pollution (gas concentration is forecast in Section 3.3.1.2 - *Effect sources not relating to waste*).
- To increase noise level due to high vehicle flow density: Upon completion and operation of the project, due to high vehicle flow density, noise level exceeds the allowable value under Vietnam's Standards along two road-sides (Noise level is forecast in Section 3.3.1.2 - *Effect sources not relating to waste*).

3.3.3 FORECAST OF ENVIRONMENTAL RISKS AND PROBLEMS

3.3.3.1 Labor accidents

These risks and problems are possible during construction of different items. Similar to any large-size construction sites, a top priority is given to labor safety of the workers directly working at construction site by the investor. The following labor accidents problems can possibly occur:

- The workers are dizzy and tired, even lose consciousness under severe weather conditions and polluted air environment (mainly for female workers or weak worker).
- Because many vehicles, together with trucks which transport construction material and machines, travel on project route, labor accidents easily occur under the overcrowded condition at the construction site.
- Upon construction in rainy days, labor accidents increase due to slippery base. Besides, there are labor accidents by power failures. Soft and settled soil results in problems for workers and construction machines.

Labor accidents may occur anywhere on the whole project route, especially at 16 construction sites during 36 months of construction.

3.3.3.2 Fire and explosion

- The site huts of workers temporarily built, overcrowded workers, temporary living conditions at construction sites and high working pressure are causes for fire at the site huts, especially in 6 months of dry season. Fires may widely spread the surrounding residential areas because there are villages or populous areas in the project area.
- Fuels used for machines stored at the construction site and the number of vehicles after working hours are a notable source of fires and explosion.

Precautious measures are taken at 16 construction sites during 36 months of construction.

3.3.3.3 Blasting

Section Km240 - Km268 must use mines to excavate rock road base, resulting in potential risk of accidents in blasting. Risks include landslide on the mountainous side and labor accidents due to blasting power or indirectly throwing rocks. Precautionary measures are taken during blasting.

3.3.3.4 Slide rock

Sections to widen the road base on the mountainous side by blasting have risk of slide rock. After blasting, rock blocks on the slopes may be affected and reduced in stability. Upon other effects such as surface flows in rainy season, stability is broken and rock blocks are slid or rolled down the slopes. This problem may result in other rock blocks to be slid in line. Slide rock may cause danger for people and vehicle on the project route. Precautionary measures are taken during blasting to excavate rocks on section Km240 - Km268. Thus, precautionary measures are taken during construction and operation.

3.3.3.5 Traffic accidents

The project route has heavy traffic density during construction phase. Possibility of traffic accidents is rather high due to roads narrowed and occupied during construction phase. especially, construction process at the intersections and sections across the residential areas increases probability of traffic accidents (intersections and sections across the residential areas stated in *Item 3.2.2.5 – Traffic*). This risk lasts 36 months of construction.

3.3.3.6 Natural disasters

Flood occurs for 6 rainy months in the project area. Consequences at the construction site include:

- Land sliding in the excavated sections with high positive slope, especially section Km79+800 – Km 98 and section Km240 - Km268;
- Increasing probability of accidents upon bridge construction, especially superstructure construction;
- Threatening stability of the bridge structures; or collapses the newly constructed structured in bad case.

In general, these problems cause serious effects on socio-economy and environment. But they can be prevented by properly organizing the construction site and measures; regularly checking technical situation of machines; propagandizing to improve awareness of and compliance with the traffic rules by the vehicle owners and applying effective measures of traffic safety management on the project route.

1.4 COMMENTS ON THE LEVEL OF DETAILS AND RELIABILITY OF ASSESSMENTS

1.4.1 ASSESSMENT OF EFFECT SOURCES RELATING TO WASTE

Effect Sources	Assessment Bases	Reliability
Construction phase		
Air environment		
Effect of emissions from the transportation, construction	Load calculation based on estimated number of machines, used means of transportation and pollution coefficient established by the World Health Organization (WHO); Based on the population density distribution of the communes along the route, residential areas, schools along the route to assess the	Pollution coefficient of WHO: based on a survey of thousands of different plants, WHO proposes a way to evaluate approximately the type, load of a source on the basis of a limited number of initial parameters. WHO recommends to use this method and disseminate this document in the early 90s.

Effect Sources	Assessment Bases	Reliability
	effect on people.	In Vietnam, this method is used more, the reliability at an acceptable level.
Effect arising from dust caused by excavation and filling	Using the dust arising coefficient from the soil amount dug at the mine and filled on the road foundation of the WHO; Based on the population density distribution of the communes along the route, residential areas, schools along the route to assess the effect on people.	WHO gave an average coefficient based on a large number of actual measurement data in many countries. Reliability of the method is at good level.
Effect due to dust arising from the carriage of road materials: (i) Loading from the car way, (ii) Emissions from internal combustion engines.	- Dust rises from the road surface is evaluated by Air Chief, U.S. Environmental Agency (1995). - Dust from the engine is evaluated using the emission coefficient of WHO. Based on the population density distribution of the communes along the route, residential areas, schools along the route to assess the effect on people.	Both evaluation methods are based on actual statistics to get the average value so the reliability of the method is acceptable in the Environment Effect Assessment.
The effect of noise from the construction machine.	- Noise level is estimated based on the type of used equipments, the noise level can be caused by these equipments (statistics from some documents). - Based on the population density distribution at the commune along the routes, residential clusters, schools	This method is widely used today; Reality is acceptable in the assessment of the environmental effect.

Effect Sources	Assessment Bases	Reliability
	along the route to assess the level and the scope of effects to the public.	
Water environment		
Changing the concentration of suspended matter in the surface water	Estimation of the load of sediment in water source is based on the research result at home and abroad. The emission of sediment with flow is evaluated according to the formula used in the world.	Data evaluating the load is at the average level of precision; Emission of sediment with flow is at the high accuracy.
Domestic wastewater of construction worker.	Flow is calculated on the number of construction worker and wastewater liter/person/day. Pollutants in wastewater are statistics cited in many documents.	Flow of wastewater/person/day is the statistic in some buildings; At present, this method is widely used. Reliability is at the average level.
Solid waste		
Waste materials in the process of construction	Estimation of volume is based on the statistical results of the construction work with a similar operational scope.	Data of Reliability is average.
Domestic solid waste	Estimation of volume is based on the number of worker and the emission of domestic solid waste which is being used today.	Data of Reliability is quite high.
Hazardous waste	Estimation of volume is based on the results of monitoring of the construction with a similar operational scope.	Data of Reliability is quite high.
The operational phase		
Atmospheric environment		
Dust and gas emitted from transportation.	Estimation of load is based on the number of vehicles and using the coefficient of pollution set by WHO.	This method is widely used. Data of Reliability is quite high.

Effect Sources	Assessment Bases	Reliability
Noise from vehicles on the route	Estimation of the equivalent noise level is based on the traffic of forecasted vehicles and model applied in the Soviet Union (cited from many documents)	This method is widely used today. Data of Reliability is quite high.

1.4.2 ASSESSMENT OF EFFECT SOURCES RELATING TO WASTE

Effect Sources	Assessment Bases	Reliability
Assessment of effect caused by occupying land	Based on project design documents, data of actual survey of the consulting units, the statistics of commune.	Reliability is high
Assessment of effect in the phase of clearance and site clearance.	Assessment is limited by the comments based on the amount of compensation and site clearance of the project	Reliability is average
The effect assessment of soil erosion and sediment deposition.	Based on the amount of road embankment, number of drains and the survey statistics, the soil erosion research in Vietnam for the same type.	Reliability is quite high
Assessment of the effects to culture-society due to the concentration of large number of workers at construction sites	Based on the necessary number of worker for project, the common feature of construction worker, statistics of the social disease at the local.	Reliability is average
Assessment of the effect to transport operation on the route and traffic safety	Based on characteristics of route, distribution of residential cluster and school at 2 sides of route, traffic of vehicle and statistics of traffic accidents at the local.	Reliability is average

1.4.3 ASSESSMENT OF ENVIROMENTAL RISKS AND PROBLEMS

Effect Sources	Assessment Bases	Reliability
Labor accident at construction site	Assessment of possibility of incident is based on the content, the project scope and the practical experience of monitoring the same incidents.	Reliability is average

Effect Sources	**Assessment Bases**	**Reliability**
Fire incident	Assessment of possibility if incident is based on the project scope, machinery, the material and specific type of potential incident.	Reliability is average
Traffic accident	Assessment of possibility of accident is based on characteristics of project road, the sensitive facilities distributed along the route, the current traffic of vehicle and statistics of traffic accident at the local in the recent years.	Reliability is average.

CHƯƠNG 2
MEASURES FOR PREVENTION, MINIMIZING OF NEGATIVE EFFECT AND DEALING WITH ENVIRONMENTAL PROBLEMS

2.1 MEASURES FOR PREVENTION AND MINIMIZING OF NEGATIVE EFFECTS

2.1.1 PREPARATION PHASE

2.1.1.1 Minimizing of effects in design work

Design work plays an important role in mitigating negative effects of a project on expanding traffic road. In this project, attentions are paid to mitigation of environmental impacts in project formulation and it is required to review selection of the project scope and alternatives of expanding the existing road in the optimal manner as well as works related to the road (scope of bridge, intersection, positive slope retaining wall …). In the deployment of the phases under the approved project plan, the Project's Owner will take supplemental measures except for technical factors calculated in the design in order to mitigate adverse impacts caused by the project preparation, implementation and operation to the maximum.

2.1.1.2 Minimizing of effects in site clearance and site sub-grading

a. Mitigating dust in demolishing old works

➢ *Description of measures*

It is required to supervise dust concentration in demolishing old works in the populous areas. In case of dust concentration in the nearest residential areas exceeding maximum limit under QCVN 05:2009/BTNMT, the following mitigative measures will be taken:

- Wetting objects to be demolished: On dry and sunny days, upon demolishing the old works near the residential area, it is required to wet with water before and during the demolishment. Water is taken from the nearby ditches or provided by the water trucks in case of being far from the water source;

- Promptly clearing construction wastes: It is required to demolish the old works in principle of demolishment and clearance at the same time. Reusable construction wastes are piled up in the scope of site clearance and wetted to avoid emitting dust. Non-reusable construction wastes are not kept in the demolished area and then transported to sub-grade the designated site under supervision of the supervision consultant.

- Strictly forbidding all actions of burning refusals after demolishing at the project area.

These mitigative measures will be taken during demolishing the old works (within 1 week for each area).

- *Positions to be noted to mitigate dust*

  + *Populous sections near two road-sides:* Residential areas of Bau Ham 2 (Km3+500 - Km4+500), Quang Trung commune (Km5+900 - Km7+500), Gia Kiem commune (Km9+500 - Km15+700), Phu Tuc commune (Km18+800 - Km22+500), La Nga commune (Km34 - Km35), Dinh Quan town (Km45 - Km49), Tan Phu town (Km57 - Km60), Phuong Lam commune (Km64 - Km67), Phu Son commune (Km71 - Km73), Magagui town (Km77 - Km79), Damri town (Km93+900 - Km94+600), Bao Loc town (Km116 - Km122), Loc Nga commune (Km126 - Km127), Loc An commune (Km132 - Km133), Hoa Ninh T-junction (Km137 - Km140), Di Linh town (Km155 - Km159), Gia Hiep commune (Km169 - Km171), Dai Ninh commune (Km185 - Km187), Lien Nghia town (Km199 - Km206), Phi Nom T-junction (Km208 - Km209), Da Lat city (Km229 - Km234), Trai Mat commune (Km237 - Km239), Xuan Tho commune (Km241 - Km242), and Xuan Truong commune (Km251 - Km252).

  + *Schools, hospitals and markets near the road*: Thang Long Secondary School (Km9), Dau Giay General Hospital (Km9+100), Nguyen Ba Ngoc Primary School (Km14), Phu Cuong Market (Km19 +100), Nguyen Du Primary School (Km45), Nguyen Thi Minh Khai Junior High School (Km45+400), Phuong Lam Market (Km65), Phu Trung Junior High School (Km69+500), Dai Lao commune medical clinic (Km110+900), Loc Chau Market (Km116+700), Hai Ba Trung Primary School (Km117+050), Bao Loc Vocational School (Km119), Hoa Lu Kindergarten (Km123), Loc Son Primary School – Bao Loc (Km123+200), Loc An B Primary School (Km131+150), Loc An Junior High School (Km131+800), Loc An General Clinic (Km132), Loc An A Primary School (Km132+200), Le Hong Phong Junior High School (Km137+400), Hoa Ninh Market (Km137+450), Vo Thi Sau Primary School (Km154), Tan Nghia II Primary School (Km160), Dinh Lac Market (Km162+300), Dinh Lac Primary School (Km163), Gia Hiep Secondary School (Km170), Phu Hiep Junior High School (Km171), Hiep Thuan Primary School (Km184), Ninh Gia Primary School (Km186+700), Ninh Gia Secondary School (Km188+200), Son Trung Junior High School (Km189+500), Nguyen Thai Binh Junior High School (Km192+700), Son Trung Primary School (Km196+800), K'Long Primary School (Km214+600), Hiep An Secondary School (Km216+400), Dinh An Primary School (Km217+600), Tran Phu Junior High School (Km235), Phan Chu Trinh Secondary School (Km235+300), Xuan Tho commune medical clinic (Km242+800), Xuan Tho Junior High School (Km245+200), Xuan Truong Primary School (Km254+150), and Xuan Truong Junior High School (Km257+800).

- *Feasibility and efficiency*

These measures are easy to be taken and highly feasible. Efficiency of dust reduction depends on degree of wetting the demolished objects, i.e. frequency of wetting per day which can entirely control and adjust.

b. Mitigating dust in sub-grading the construction site

➢ *Description of measures*

It is required to supervise dust concentration in sub-grading the construction site near the populous areas on the dry and sunny days. In case of dust concentration in the nearest residential areas exceeding maximum limit under QCVN 05:2009/BTNMT, the following mitigative measures will be taken:

- Wetting the sub-graded surface with water on the dry and sunny days (at least three time a day: 9:00; 13:00 and 15:00). Water is taken from rivers and streams near the construction site.

- Taking mitigative measures during sub-grading the construction site (about 3 months).

➢ *Positions to be noted to mitigate dust*

16 positions on the road route: Km1+880, Km35+712, Km65+056, Km86+700, Km88+850, Km97+900, Km129+500, Km139+300, Km149+303, Km177+800, Km183+376, Km189+200, Km194+771, Km217+810, Km254+254 and Km263+100.

Especially, it is noted to 6 construction sites near the residential areas and schools as follows:

+ Construction site No.2 (La Nga Bridge, Km35+712) near La Nga residential area (Km34 - Km35);
+ Construction site No.3 (Phuong Lam Bridge, Km65+056) near Phuong Lam Market (Km65) and Phuong Lam Parish (Km65+500);
+ Construction site No.11 (Hiep Thuan Bridge, Km183+376) near Hiep Thuan Primary School (Km184);
+ Construction site No.12 (Dai Ninh Bridge, Km189+200) near Son Trung Primary School (Km189+500);
+ Construction site No.14 (Dinh An I Bridge, Km217+810) near Dinh An Primary School (Km217+600);
+ Construction site No.15 (Dat Bridge, Km254+254) near Xuan Truong Primary School (Km254+150).

➢ *Feasibility and efficiency*

These measures are easy to be taken and highly feasible. Efficiency of dust reduction depends on degree of wetting the sub-graded objects, i.e. frequency of wetting per day which can entirely control and adjust.

c. Mitigating impacts caused by noise

➢ *Description of measures*

For purpose of mitigating impacts caused by excessive noise under QCVN 26:2010 in the residential area near the site clearance area or the construction site, the following measures are taken at the same time:

- No demolishing at night from 22:00 to 6:00;

- Using low noise generating equipment upon demolishing or sub-grading the construction site;

- Coordinating with the commune People's Committee to inform the local people surrounding the construction site of the plan (schedule and time) to arrange life activities accordingly and sympathize towards the construction team.

Mitigative measures are taken during demolishing the old works and sub-grading the construction site.

➢ *Positions to be noted to mitigate noise*

They are the same as ones to mitigate dust mentioned above.

➢ *Feasibility and efficiency*

These measures are highly feasible and appropriate to actual conditions in Vietnam. Although impacts are not strictly handled (noise no less than 70 dBA is about 120m from schools and residential houses), these measures contribute to mitigate impacts to the minimum in the actual conditions.

d. Mitigating social impacts caused by site clearance and resettlement

➢ *Description of measures*

❖ *General principle:*

- To carry out according to the site clearance plan approved by the competent authorities

- To give more priority to the in site distributed resettlement plan than the concentrated resettlement plan.

- To supervise site clearance conducted by the provincial People's Committee through an independent unit and an agency in charge of implementing the site clearance policy

- To compensate farmers for agricultural land to the maximum to make up for the recovered agricultural land and limit replacement of agricultural land upon implementing the construction site.

- To effectively propagandize for the affected objects to understand national and local benefits of the project so that they support, facilitate and cooperate in the site clearance.

- To locate to receive requirements, aspirations and proposals of the affected objects and resolve complaints about site clearance

- To ensure transparency and publicity in all activities related to land recovery and compensation

- To provide policy to use workforce in site, especially priority given to the objects affected by the project, to conducts works right after the project operation.

- To promptly rehabilitate the livelihood works on the road-sides such as power system, information network and television network … which are demolished in the site clearance phase to stabilize community life in the project area.

❖ *Procedures*

- To publicly and timely inform, on a basis of project investment, the scope of land recovery to serve for the project

- To prepare and submit the compensation, support and resettlement plan of the compensation and resettlement council to People's Committees of Dong Nai province and Lam Dong province.

- To acquire contributive opinions of the local people whose land is recovered and related people about the compensation, support and resettlement plan; and then to adjust the plan

- People's Committees of Dong Nai province and Lam Dong province approve the compensation, support and resettlement plan and make decision on land recovery

- The compensation and resettlement council make payment for compensation and in site resettlement council. Expenditures are provided from the State's budget by the Investment's Owner – PMU No.7.

- The local people whose land is recovered hand over land to the compensation and resettlement council.

❖ *Supervision*

During the project implementation, compensation, site clearance and supervision are conducted at the same time. There are two forms of supervision: internal supervision and independent supervision.

- Internal supervision is carried out by the PMU for activities, benefits, time frame and budget stated in the compensation, support and resettlement plan. Internal supervision is carried out through periodic investigation to ensure interests of the affected people.

- Independent supervision is carried out by the qualified independent organizations (local agencies or non-governmental organizations …) with a view to:

+ Appraise results of internal supervision;

+ Evaluate whether resettlement objectives are obtained or not; especially whether the livelihood conditions and living standards are improved or not;

+ Evaluate effectiveness, efficiency, impacts and sustainability of resettlement; draw lessons to guide formulation of policies and resettlement plans in future

+ Make sure whether resettlement interests are suitable to conditions of the affected people or not.

➢ *Objects needed to be mitigated*

Households are occupied a part of house, residential land and agricultural land; 64 households are removed.

➢ *Feasibility and efficiency*

Upon implementing procedures in the correct and strict manner, these measures are highly effective and feasible in fact. This is proved in many investment projects in general and traffic construction projects in particular.

e. Mitigating impacts on the agricultural households whose land is temporarily occupied

➢ *Description of measures*

- To agree with the land owner about land rental at the unit price at locality

- Upon no using, to revert the temporarily occupied land as committed and clean before handing over to the land owner (which is specified in the land lease contract)

➢ *Positions to take measures*

16 construction sites are stated in mitigating dust.

➢ *Feasibility and efficiency*

These measures are easy to be taken and highly feasible. After reverting, environment of the temporarily occupied land will be gradually recovered.

2.1.1.3 Waste treatment during preparation phase

➢ *Description of measure*

❖ *Construction treatment from site clearance*

Construction wastes from site clearance include concrete, broken brick, demolition wastes, wooden pieces, iron and steel of kinds and more. These construction wastes are collected and classified to reuse. Non-reusable construction wastes are treated under provisions of Decree No.59/2007/ND-CP dated 09/4/2007 of the Government on management of solid wastes. Thereby, collection and treatment are conducted on a daily basis through the economic contract with the urban environment companies of Dong Nai province and Lam Dong province to transport construction wastes to the local waste dumps.

❖ *Waste treatment from site clearance*

Plant waste such as branches and leaves during site clearance are collected to use for different purposes. Nylon waste is collected and treated under provisions of Decree No.59/2007/ND-CP dated 09/4/2007 of the Government on management of solid wastes. Thereby, collection and treatment are conducted on a daily basis through the economic contract with the urban environment companies of Dong Nai province and Lam Dong province to transport construction wastes to the local waste dumps.

Mitigative measures are taken during demolishing the old works (7 days at each position) and sub-grading the construction site (3 months).

- *Positions to take measures*

Old works demolished along the road route and 16 construction sites

- *Feasibility and efficiency*

These measures have been taken to collect and treat wastes at localities. With proper and close terms in the waste collection and treatment contract, these measures will be highly effective.

2.1.2 CONSTRUCTION PHASE

2.1.2.1 Measures for minimizing of effects to air environment

❖ ***Mitigating dust and waste gas emission upon transporting materials***

- *Description of measures*

As evaluated in *Section 3.2.1.1 - b4 – Evaluating dust and toxic gas emission in the air environment*, dust source from the road surface caused by transporting materials is about 0.6-0.7mg/m/s in intensity, accounting for 80% of total dust arisen from sources in the project. It is said that this figure is based on assumption that road surface upon transporting materials remains unchanged and dirty with materials. Thus, to mitigate dust concentration in the air on two road-sides or maintain at least such figure (dust concentration < 0.20 mg/m^3) in a distance of > 10m from the road edge), it is required to take the following measures during 36 months of construction:

- To only use means of transport satisfying standard on waste gas under "Decision No.249/2005/QD-TTg dated 10/10/2005 of the Prime Minister setting the roadmap for application of emission standards to road motor vehicles".
- To prepare the reasonable construction plan on the road sections for each package; not deploy construction of the whole road but segmentation to complete over each time on rolling basis to avoid overcrowded vehicles on National Highway No.20; specifically, conducting 3 segments in 3 different time periods within 36 months for package 1 (section Km0 - Km76+700); 2 segments in 2 different time periods for package 2 (section Km79+800 - Km98 and section Km108+458 - Km123+100); no more than 3 segments (10-20m length each) alternating at the same time and spacing about 30km apart for package 3 (sections of Km123+100 - Km154+400; Km159+500 - Km172; Km176+500 - Km199; Km210 - Km234 and Km240 - Km268).
- Materials on the trucks are soil or sand which is wetted to avoid dust. Priority is given to use the trucks with cover to transport soil or sand; otherwise, the trucks must use oil canvas to cover its body and it is required to secure the oil canvas.
- Speed limit of the material trucks is 35 km/h to reduce dust on the road;
- Trucks from the project area or the material pits must be cleaned with mud at the tires by using water nozzles before accessing to National Highways 20, 27, 28 & 55 and Provincial Roads 721, 724 and 763 or inter-hamlet roads or inter-commune roads. Water used for washing trucks is not directly discharged to the environment but conveyed to the sedimentation basin to be reuse at the construction site.

- To create an intermediate buffer zone of about 300 - 500 m before the trucks are from the construction site or material pits to the traffic roads (national/ provincial/ inter-hamlet/ inter-commune roads); To wet the buffer zones with water twice a day or upon dry road surface on the sunny days; To clear soil or sand on the road and these buffer zones twice a day or upon soil or sand dropped and moved to other sections.
- To wet the surface of National Highway No.20 at the sections through the residential areas with water twice a day or upon dry road surface. Sections through the concentrated residential areas needed to be watered are listed in *Table 2.25 - Chapter 2*.
- To limit transport of materials during peak hours (7:00 – 8:00; 11:00 – 12:00 and 17:00 – 18:00).
- To arrange traffic flow of the material trucks reasonably to avoid overcrowding on the same road at the same time.
- To supervise dust and waste gas concentration in the buffer zones mentioned above and to timely adjust frequency of wetting the road surface in case of excessive dust concentration.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction of the whole project or construction of each road route.

➢ *Feasibility and efficiency*

These mitigative measures are rather easy to be taken and highly effective to mitigate dust emission in transporting materials for the project. Difficulty met here is to maintain these measures on daily and regular basis during construction in dry season by the contractors. In order to ensure to regularly maintain these measures, it is required to strengthen check, supervision and proper sanctions for the violating party.

❖ ***Controlling dust pollution for sensitive objects***

➢ *Description of measures*

Some establishments are sensitive to dust and waste gas *(Table 2.26 – Chapter 2)* on National Highway No.20. Besides the above mentioned measures, the following measure is taken:

- To periodically observe dust and waste gas concentration at the sensitive positions characterized for each section (once a month within 5 months of dry season and twice in wet season). If dust concentration exceeds 0.3 mg/m^3, the supplemental measures are (i) to clean soil and sand on the road surface through the campus; (ii) to wet the road surface through the campus; and (iii) if necessary, to readjust the road to transport materials. The above measures are taken in turn to eliminate reason for causing excessive dust concentration for the sensitive establishments to the extent to lower dust concentration than the allowable limit.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction of the whole project or construction of each road route.

➢ *Feasibility and efficiency*

This supplemental measure is feasible and rather effective through the contract between the Project's Owner and the Supervision Consultant.

❖ ***Mitigating dust emission in excavation***

➢ *Description of measures*

To prevent and mitigate dust emission caused by excavation, including embankment and abutment (Position of the bridges on the road route listed in Table 3.25 – *Forecast volume of eroded soil at the position of bridge construction*) and dust emission at the material and spoil storages at the construction site (Specific position of the construction works listed in Table 1.16, Chapter 1 – *Arrangement of construction works along the project route*), the following measures are taken:

- To wet the excavation area emitting dust by spraying water at least once a day in the prolonged hot periods in wet season and at least twice a day in dry season; Use pump to wet surface evenly without being muddy. For the embankment, wetting the road surface is an obligatory technical requirement upon compaction of the road base. Water is taken from the nearest water sources or by the water truck.
- To prevent from dust emission at the material and construction waste storages by geo-textile fabric fence which is at least 0.3m higher the storage surface to prevent from dust emission.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction of the whole project or construction of each road route.

➢ *Feasibility and efficiency*

This measure is feasible and practical in many traffic construction works and proves efficiency of dust emission reduction in excavation.

❖ ***Mitigating dust emission at construction sites***

➢ *Description of measures*

- Select suitable positions of the storages: The dust emitting material storages (soil, sand and stone powder …) and the temporary spoil storages are located in the lee side and far from the residential areas.
- The dust emitting material storages (soil, sand and stone powder …) are covered with canvas or geo-textile fabric and have a gap to take materials in convenient manner. Upon taking materials, if generating dust, it is required to wet such materials without impact on quality.

- The temporary spoil storages are surrounded with geo-textile fabric fences which is at least 0.3m higher the storage surface to prevent from dust emission..
- To not crush rock at the construction site; to purchase standard rock at the nearest licensing establishments.
- To periodically observe dust concentration for some activities such as unloading the rear-dump-truck with materials or transporting materials out of and into the construction site. If dust concentration exceeds the allowable limit, the supplemental measures are promptly taken such as (i) wetting the road surface before unloading materials; and (ii) wetting the road section causing dust at the construction site at least twice a day. The above measures are taken for the same activities and in the same weather condition like observing excessive dust concentration.

Scope of application:

+ These mitigative measures are taken at 16 construction sites as listed in Table 1.6 – *Arrangement of construction site*
+ Duration of these activities is 36 months for construction.

➢ *Feasibility and efficiency*

This measure is feasible and effective to mitigate dust emission at the construction sites as well as in excavation.

❖ ***Mitigating gas emissions from means of construction***

➢ *Description of measures*

- Means of transport must ensure standard on waste gas under "Decision No.249/2005/QD-TTg dated 10/10/2005 of the Prime Minister setting the roadmap for application of emission standards to road motor vehicles".
- Construction means at each site must be only moved within the scope of assigned construction.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction.

➢ *Feasibility and efficiency*

In fact, it is difficult for means of transport at construction sites to ensure the current standard on waste gas in Vietnam. However, limit of the scope of these means is to contribute to significantly mitigate impacts of waste gas on residential community.

❖ ***Mitigating dust and waste air pollution from the hot asphalt concrete mixing plants***

➢ *Description of measures*

- To prevent from dust and waste gas pollution caused by the hot asphalt concrete mixing plants, priority is given to measure of purchasing asphalt concrete materials at the plants. The project area is now some hot asphalt concrete plants such as concrete mixing plant of 95 tons/h in Binh An ward – Binh Hoa – Dong Nai of IDICO Cuong Thuan Investment JSC; concrete mixing plant of 360 tons/h in Long Thanh – Dong Nai of Dai Hung Transport JSC; hot asphalt concrete mixing plant in Tam Bo – Duc Trong – Lam Dong of Hung Vuong Building Material Company and hot asphalt concrete mixing plant in Cam Ly – Da Lat.

➢ *Feasibility and efficiency*

With a number of the hot asphalt concrete plant in the project area, this measure is feasible and effective to significantly mitigate impacts caused by the hot asphalt concrete mixers.

❖ ***Mitigating noise***

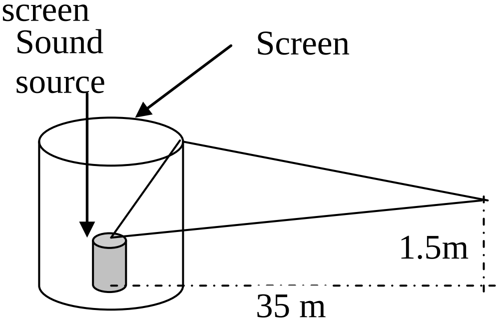
➢ *Description of measures*

To mitigate noise impacts by the following measures:

- Noise generating equipment such as concrete mixers and generators may be arranged at least 120m far from the residential areas.
- In case of not lowering noise by distance, it is required to arrange the noise lowering screen around the equipment.

For example, noise caused by the concrete mixer in a distance of about 15km is 90 dB. When arranging the noise lowering screen made of steel sheet, 1mm in thickness and 2.5m in height around the noise source and in a distance of 5m (see figure 4.1), reducing distance and screen results in noise intensity of about 75 dB [5] in a 30m distance from the noise source.

Figure 4.1. Diagram for arrangement of noise lowering screen



- For means of transport moving at the construction site without lowering noise by distance, the following measures are taken:
    - o Controlling noise sources:
        - \+ To regular check and maintain equipment and machinery to achieve standard on noise;
        - \+ To use noise reducer in accordance with technical standards for each equipment.
    - o Controlling operating time:
        - \+ To plan each equipment accordingly so that total noise level (including background noise level) is at possible minimum value;
        - \+ To not conduct construction activities generating loud noise from 22:00 to 6:00 at construction sites near the residential areas. Specifically, (i) graders in a range of < 120 m from the residential areas; and (ii) pile drivers in a range of < 300 m from the residential areas only operate from 6:00 to 11:30 and from 13:00 to 20:00 in a day.

+ Graders with large capacity and weight only operate from 6:00 to 20:00 in the residential areas.

- Improving community awareness: To publicly inform of construction plans and receive and handle claims.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge; especially paying attention to sections through the populous areas listed in Table 2.25, sensitive establishments listed in Table 2.26 and bridges near the residential areas or the sensitive establishments such as La Nga Bridge (Km35+712), Phuong Lam Bridge (Km65+056), Hiep Thuan Bridge (Km183+376), Dai Ninh Bridge (Km189+200), Dinh An I Bridge (Km217+810) and Dat Bridge (Km254+254).

+ Duration of these activities is 36 months for construction of the whole project or construction of each road route and each bridge.

➢ *Feasibility and efficiency*

These measures are highly feasible and effective to significantly mitigate noise for residential community, especially equipment generating noise and fixed as generators and concrete mixers. However, as to construction equipments which are regularly moved, this measure is not to reduce noise no less than 70 dBA in a distance of about 120m from the residential area, but to contribute to mitigate impacts to the minimum in the actual conditions.

2.1.2.2 Minimizing of effects to soil environment

❖ ***Mitigating risks of material and spoil overflow at the temporary storages***

➢ *Description of measures*

Purpose: To prevent risks of overflowing materials and spoil at the temporary storages to the surrounding environment; to handle consequences upon overflowing.

Content of the mitigative measures:

- *To select the storages*: The temporary storages are located in the construction site or the empty land area in the scope of site clearance; the positions are relatively flat and as far as from the agricultural land possible and far from the flows to avoid erosion in wet season.

- *To prevent risks of overflow and erosion at the storages:* It is not required to focus a large volume of materials on a storage (its area of no more than 20 – 25 m^2 and material heap of no higher than 1.5m) to easily protect from and avoid erosion in wet season and generate dust due to wind. The temporary storages must be are surrounded by the geo-textile fabric fences and securely reinforced to avoid collapsing.

- *To transport spoils:* Spoils are not stored at the dumps until the end of construction but transported to the sub-graded positions or the dumps with consent of the localities. Then, these dumps are treated to meet construction requirements of the next items.

- *To deal with overflowing:* In case materials or spoils are overflowed to the agricultural land, dedicated land or residential land, it is required to promptly scoop up such spoils and clean the land where spoils are overflowed. In case of spoils overflowing to the drains, it is required to recover such spoils to avoid closing channel flow.

- *To commit to compensate for damages:* Damages caused by overflowing materials and spoils to agriculture and other damages will be considered to compensate by the Investment Owner as agreed with the affected people.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge

+ Duration of these activities is 36 months for construction of the whole project or construction of each road route and each bridge.

➢ *Feasibility and efficiency*

These measures are feasible and effective to significantly mitigate a volume of soil or sand overflowed to the surrounding environment. Handling overflow and compensating for damages contribute to mitigate impacts on the adjacent soil environment to the minimum.

❖ ***Mitigating erosion and landslide in wet season in the excavation areas***

➢ *Description of measures*

Purpose: To prevent and mitigate potential risk of erosion and landslide in the excavation area due to rain, resulting in swamping in the residential land or along the transport route and depositing in the agricultural land or canals.

a) *<u>Content of the mitigative measures for the road</u>:*

- *To ensure the construction schedule:* In wet season, excavation and embankment are completed for each road base section and calculated to compact before wet season.

- *For the excavated sections:* Upon excavating through the hilly and mountainous areas with basalt soil and hilly soil weathered on clay residue granite rock, it is required to limit clearance of the vegetation cover beyond the scope of site clearance. For the excavated sections with high positive slope, it is required to excavate in dry season for the works to protect against eroding and collapsing the slope before the peak time of wet season. The protective works are expected in the project (Table 4.1).

Table 4.1a. Volume for reinforcement of slope

No.	Station	Distance (m)	No.	Station	Distance (m)
	Km210+00 - Km234+00			**Km240+00 - Km268+00**	
1	Km219+491.51 - Km219+500	8.49	6	Km248+0 - Km248+52.68	52.68
2	Km222+955.39 - Km222+964.39	9	7	Km248+255 - Km248+268.88	13.88
3	Km223+105.1 - Km223+115	9.9	8	Km248+347.26 - Km248+362.32	15.06
4	Km223+226.74 - Km223+240	13.26	9	Km249+941.48 - Km249+950.53	9.05
5	Km223+430 - Km223+436.97	6.97	10	Km250+587.96 - Km250+615.56	27.6

No.	Station	Distance (m)	No.	Station	Distance (m)
6	Km223+592.77 - Km223+598	5.23	11	Km251+535.48 - Km251+551.48	16
7	Km223+704.92 - Km223+766.86	61.94	12	Km252+0 - Km252+27.89	27.89
8	Km223+900.02 - Km223+904.35	4.33	13	Km252+773.95 - Km252+800	26.05
9	Km224+600 - Km224+620	20	14	Km252+891.9 - Km252+918.18	26.28
10	Km224+655 - Km224+669.5	14.5	15	Km253+85 - Km253+100	15
11	Km225+298.19 - Km225+300	1.81	16	Km253+485 - Km253+500	15
12	Km226+332.72 - Km226+340.72	8	17	Km255+151.38 - Km255+160.38	9
13	Km226+453.69 - Km226+493.67	39.98	18	Km255+254.75 - Km255+300	45.25
14	Km226+588.46 - Km226+595	6.54	19	Km255+600 - Km255+615	15
15	Km226+800.01 - Km226+816.25	16.24	20	Km255+700 - Km255+713.55	13.55
16	Km226+704.23 - Km226+706.23	2	21	Km255+748.39 - Km255+818.45	70.06
17	Km226+789.27 - Km226+800	10.73	22	Km259+788.47 - Km259+812	23.53
18	Km227+11.38 - Km227+50	38.62	23	Km260+472.42 - Km260+482.42	10
19	Km227+107.28 - Km227+112.28	5	24	Km260+533.91 - Km260+553.91	20
20	Km227+250.73 - Km227+259.32	8.59	25	Km261+148.69 - Km261+179.04	30.35
21	Km228+11.38 - Km228+50	38.62	26	Km261+465.15 - Km261+480.15	15
22	Km228+105 - Km228+112.28	7.28	27	Km261+590.82 - Km261+595.82	5
23	Km228+250.73 - Km228+259.32	8.59	28	Km261+703.26 - Km261+706.26	3
24	Km228+467.84 - Km228+504.68	36.84	29	Km262+622.15 - Km262+632.15	10
25	Km229+600 - Km229+606.41	6.41	30	Km263+394.45 - Km263+396.45	2
26	Km229+690 - Km229+694.84	4.84	31	Km263+479.74 - Km263+502.82	23.08
27	Km229+855.16 - Km229+860.16	5	32	Km263+723.14 - Km263+765.5	42.36
28	Km229+900 - Km229+943.21	43.21	33	Km263+800 - Km263+818.88	18.88
29	Km230+57.4 - Km230+72.55	15.15	34	Km264+91.56 - Km264+100	8.44
Total		**457.07**	35	Km264+213.69 - Km264+216.19	2.5
	Km240+00 - Km268+00		36	Km264+320.47 - Km264+335.47	15
1	Km244+672.04 - Km244+700	27.96	37	Km264+410.67 - Km264+433.67	23
2	Km246+286.3 - Km246+292	5.7	38	Km265+25.46 - Km265+37.16	11.7
3	Km246+660 - Km246+672.54	12.54	39	Km266+849.92 - Km266+908.03	58.11
4	Km247+138.76 - Km247+148.76	10	40	Km267+445.68 - Km267+448.68	3
5	Km247+794.78 - Km247+862.92	68.14		**Total**	**914.14**

Table 4.1b. Summary for quantity of retaining wall

No.	Station	Distance (m)	No.	Station	Distance (m)
1	Km35+857 - Km36+240	332,3	1	Km123+880 - Km123+990	110
2	Km44+320 - Km44+736	416	2	Km142+850 - Km142+950	100
3	Km80+557 - Km80+577	20	3	Km143+650 - Km143+700	50
4	Km80+854 - Km80+874	20	4	Km144+250 - Km144+400	150
5	Km82+438 - Km82+468	30	5	Km145+000 - Km145+200	200
6	Km82+468 - Km82+640	172	6	Km147+700 - Km147+820	120
7	Km83+305 - Km83+339	34	7	Km246+266.25 - Km246+300.00	33.75
8	Km83+375 - Km83+400	25	8	Km248+349.32 - Km248+375.32	24.89
9	Km83+462 - Km83+482	20	9	Km252+403.9 - Km252+422.9	19
10	Km83+491 - Km83+511	20	10	Km263+138.7 - Km263+192.34	53.64
11	Km84+262 - Km84+589	327	11	Km263+384.52 - Km263+413.38	28.86

No.	Station	Distance (m)	No.	Station	Distance (m)
12	Km109+950 - Km109+990	40	12	Km263+713.14 - Km263+728.14	15
13	Km123+780 - Km123+840	60	13	Km264+834.17 - Km265+24.16	64.93

- *For the embankment sections:* Upon constructing the embankment sections, it is required to complete each section, compact the road base before the peak time of wet season and growing grass in the slope subject to quantity calculated in the project (Table 4.2).

- *Water drainage system:* It is required to complete gutters along 2 road-sides and cross-culverts for the road base construction, especially paying special attention to the sections with basalt soil and weathering crust developed on the granite parent rock in order to convey surface water under the previous design without flowing over the road surface in progress. The water drainage system is completed as expected in the project.

Table 4.2. Quantity of grass in the slope

No.	Station	Unit	Quantity
1	Km0 - Km20	m²	36,007
2	Km20 - Km62	m²	65,377
3	Km62 - Km76	m²	35,192
4	Km159 - Km172	m²	25,607
5	Km176 - Km199	m²	57,994
6	Km210 - Km234	m²	52,062
7	Km240 - Km268	m²	85,640

- *To arrange the mud screen:* In wet season, it is required to arrange temporary mud screen in construction of the road embankment and the material and construction waste storages. The mud screen is made of geo-textile fabric and arranged at least 10cm depth and consolidated to avoid falling in. Upon completing each section, the mud screen is removed, cleaned and reused for the next sections. Mud in the screen is regularly collected and treated under type of soil. The screen is maintained at least twice a day to operate effectively. And then, the screens are removed.

- *To select to arrange the mud screen:* The mud screen is arranged at the outer edge of the road base area and the material and construction waste storages.

- *To handle sedimentation:* In case of sedimentation and erosion in wet season in agricultural land, residential land and traffic land, it is required to clean these lands.

- *To commit to compensate for damages:* Damage to agricultural land and others caused by sedimentation are considered to compensate as agreed with the affected people.

b) <u>Content of the mitigative measures for the bridge</u>:

- *To excavate foundation pit:* In wet season, it is required to arrange temporary mud screen around the foundation pit. The mud screen is made of geo-textile fabric and arranged at least 10cm depth and consolidated to avoid falling in. Upon completing each section, the mud screen is removed, cleaned and reused for the next abutments and piers. Mud in the screen is daily collected and treated under type of soil. The screen is maintained at least twice a day to operate effectively. And then, the screens are removed.

- *To handle sedimentation and compensate for damages:* The same is mentioned in road construction.

Scope of application:

+ These mitigative measures are taken for (a) the whole road and (b) all bridge.
+ Duration of these activities is 36 months for construction of the whole project or construction of each road route and each bridge.

➢ *Feasibility and efficiency*

The proposed measures are feasible and many construction items are taken account in technical design. Some supplemental measures are taken in constructing, handling sedimentation and compensating for damages to contribute to mitigate impacts of landslide and erosion to the minimum. The similar measures are taken in some traffic construction works to obtain good results.

❖ ***Preventing local inundation***

➢ *Description of measures*

To prevent and mitigate risks of local inundation, the following measures are taken:

- *To carried out the construction procedures:* To embank after checking that cross-culverts are in good operation; To commit to construct the water drainage system as planned in the project, especially pay special attention to complete the system before the peak time of wet season.
- *To maintain checks:* To regularly check along the construction area; if detecting local inundation, it is required to promptly clear for draining and conveying water to natural flows without roiling water source by installing the screen to collect mud and no-mud water is flowed to water source.
- *To handle sedimentation:* To collect and transport the whole of soil overflowing within and beyond the project scope upon excavating and embanking.

Scope of application:

+ These mitigative measures are taken for construction of road.
+ Duration of these activities is 36 months for construction of the whole project or construction of each road route.

➢ *Feasibility and efficiency*

The proposed measures are rather simple, easy to implement and highly effectively in preventing and timely handle inundation in construction of traffic road.

❖ ***Preventing risk of oil pollution***

➢ *Description of measures*

- *To prevent oil from penetrating into soil:*
    + The area of storing fuel, waste oil and oil-bearing wastes waiting for transport to other places will be arranged in a certain high position of the construction site and calculated in details for the casks containing the oil and oil-bearing waste which are collected from different waste sources in construction before being transported and treated.
    + The area of storing fuel, waste oil and oil-bearing wastes waiting for transport to other places must have shed and edge-supported cement floor.
- *To collect and temporarily store:* The whole of waste oil and oil-bearing wastes will be collected in the separate casks (01 cask for waste oil and 01 cask for oil-bearing wastes) and temporarily stored at the designated position of the construction site and the repair station. At the same time, 02 new standby casks are arranged to use in necessary cases.
- *To transport and treat:* Waste oil and oil-bearing wastes will be registered by the project, and then transported and treated by the transport company and the hazardous waste treatment company in Dong Nai province and Lam Dong province or the adjacent provinces in accordance with Decree No.12/2011/TT-BTNMT dated 14/4/2011 of the Ministry of Natural Resources & Environment on hazardous solid waste management.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction of the whole project or construction of each road route and each bridge.

➢ *Feasibility and efficiency*

The proposed measures are rather simple, easy to implement and highly effectively in preventing oil pollution. The similar measures are taken at some production and business establishment in past time to obtain good results.

❖ ***Preventing pollution of solid construction wastes***

➢ *Description of measures*

- *Collection:* To regularly collect solid wastes arising out of construction (concrete, broken bricks, mortar …) and temporarily store at the designated dumps in the scope of site clearance; and then transport wastes to the sub-graded positions with written consent of the local authority.
- *Regulations on waste dumps:* Solid waste dumps are surrounded by the geo-textile fabric fences and securely reinforced to avoid collapsing in wet season.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.

+ Duration of these activities is 36 months for construction.

➢ *Feasibility and efficiency*

These measures have been applied to collect and treat wastes at localities. With proper and strict terms of the waste collection and treatment contract, these measures will be highly effective.

❖ ***Preventing pollution of solid domestic wastes***

➢ *Description of measures*

- The Contractor will sign a contract with the Urban Works Management Company of the provinces to collect all wastes to the local landfills. However, to facilitate the local waste collection and treatment units and avoid waste distribution to the surrounding environment at the construction sites, the Contract must collect and temporarily store domestic wastes at the construction sites, specifically:
  + To arrange the temporary storage of domestic waste at each construction site; to arrange big garbage containers of 0.7 – 1.0 m^3 (The Contractor may equip these garbage containers or hire dedicated garbage containers of the urban environment company)
  + At the site huts, 60 liter- small garbage bins with cover are arranged at the canteen to collect daily domestic wastes; each construction site must have 3 – 5 small garbage bins subject to the scope of construction site. Domestic waste are daily collected into the small ones and then transferred to the big ones.
- To provide regulation on solid wastes at construction site, specifying strict prohibition of discharging solid wastes in uncontrolled manner to the surrounding environment and to the river flows.
- The Project Owner or his contractor undertakes to supervise solid waste management at construction sites and periodically contact representatives of the local urban environment companies to acquire recommendations and warnings from these companies about solid waste management at construction sites.

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction.

➢ *Feasibility and efficiency*

These measures have been applied to collect and treat wastes at localities. With proper and strict terms of the waste collection and treatment contract, these measures will be highly effective.

❖ ***Mitigating impact of agricultural land compression***

Its purpose is to prevent and mitigate impact of agricultural land compression beyond the scope of site clearance and at the temporarily land areas (construction sites) caused by construction activities.

➢ *Description of measures*

- To set up markers along the scope of site clearance, service road and boundary of the construction site to indicate the scope of construction; to signal on the markers to be visible (for example painting red at the end of the markers)
- To propagandize the allowable scope of construction to workers and strictly forbid means of transports to access beyond the allowable scope.
- To treat the land area compressed due to unexpected requirement or negligence during construction process by ploughing the affected land area up to cultivated depth (normally about 30cm)
- To treat the temporarily land areas (construction sites) after construction by cleaning surface and ploughing to at least 0.5m depth before handing over to the land owner (which is specified in terms of the land lease contract).

Scope of application:

+ These mitigative measures are taken for construction of both road and bridge.
+ Duration of these activities is 36 months for construction.

➢ *Feasibility and efficiency*

The proposed measure is feasible and effective to strict remedy impact of agricultural land compression.

2.1.2.3 Minimizing of effects to surface water and deposit

❖ ***Minimizing the risk of increasing turbidity***

➢ *Measure description*

The implement of the measures of minimizing the impact to the soil environment which are mentioned in section 4.1.2.2 such as: *minimizing the risk of spilled material, the waste lands at the temporary storage yard; minimizing erosion, collapse caused by rain at the digging areas* also contributes to reduce the risk of turbidity increasing. Moreover, the following measures will be applied:

- *Preventing the spill of excavation and embankment soil:*
  + Distributing the temporary yard storing material, waste land far from the flow at least 30 m;
  + Locating the temporary plates preventing mud during the time of construction surrounding the area of digging foundation.;
- *Preventing and treating bentonite mixed soil and the spill of bentonite:*
  + Not discharging bentonite mixed mud into river;
  + Taking all bentonite mud to the temporary storage yard; gathering the spilling bentonite and bringing it to the temporary yard to avoid spilling to the surrounding areas;
  + Collecting this mud after it is dry to treat as the solid waste.
- *treating the sewage from the maintenance and waste from the concrete mixture station:*

+ The surface of the concrete mixture station is built on a sand floor to filter sewage; and then leading it along gutter into tank for deposit and it can be reused.

+ All water for washing materials at the site, and the machine will be gathered and stored in a deposit pool with the minimum size of 2m x 2m x 5m. Water after depositing can be reused; sediments are collected and treated as the waste construction.

Scope of application:

+ These mitigation measures are applied for construction of road and bridge.

+ Time for maintaining these activities is during 36 month construction of whole project or construction of each route and bridge.

➢ *Feasibility and efficiency of measure*

These mentioned measures are highly feasible. Most content of these measures is quite easy to implement and effective in preventing the risk of increasing turbidity of the water source. Only the content of taking the bentonite mixed mud to the temporary storage yard requires the specialized equipments.

❖ ***Minimizing water source pollution from solid waste in the bridge construction***

➢ *Measure description*

- Forbidding the discharge of solid waste from construction and the domestic waste into rivers.

- Preventing the solid waste from construction: Using net lined with geotextile as a below barrier when implementing the construction of bridge. The net can keep the falling wastes and ensures the safety for the below objects. Net and textile is sealed for the falling waste not to pass through. Usually collecting, gathering and classifying. The unrecyclable things are moved to the construction sites and treated as waste at the sites.

- Restoring temporarily waste on the floating platform: Distributing waste baskets on the floating platform. Periodically moving them to the construction sites and treated as the waste at the sites.

Scope of application:

+ These mitigation measures are applied for construction of 16 bridges.

+ Time for maintaining these activities are during the time of bridge construction.

➢ *Feasibility and efficiency of measures*

The mentioned measure is quite simple, easy to carry out and highly effective in preventing the risk of water pollution from solid waste.

❖ ***Minimizing pollution from the overflowing rainwater***

➢ *Measure description:*

The overflowing in the area of construction is polluted because it takes many pollutants on its way. Therefore, to limit the pollution of rainwater before discharging into the receiving source, the construction Unit planned to apply some measures as follows:

- When building road in the rain season, digging gutter along the necessary areas, and taking water to the vegetation in order to avoid road erosion and keeping residues of erosion are required. It needs to plant grass at slopes as soon as the construction is finished in order to minimize erosion and limit the increasing of turbidity in the rivers.
- To prevent oil and solvent in the mixture of liquid asphalt used for covering road from entering into the water source, the construction of asphalt concrete road surface is only implemented on the dry days, and when road base is dry. If it suddenly rains, it needs to cancel the construction and prepare the dry sand to cover the road surface when adhesive asphalt is spraying.
- To minimize the amount of oil discharging into the environment of soil and river, yard for construction equipments is not close to the areas which receive water sources in river, stream; the sewage from mechanical cleaning is led to the refuse collection area for treatment.
- Strictly controlling the implement of environmental safety at the area of supplying fuel, collecting the used oils from the construction equipments and then transferring them to the treating system; collecting the dropped oils by cloth and then taking it to be treated with hazardous waste.

Scope of application:

+ This mitigation is applied for all constructions of road and bridge (the head of bridge)
+ Time of maintaining these activities is about 36 months for whole project construction or for the construction of each route and each bridge.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and highly effective in preventing the risk of toxic pollution from the overflowing rainwater.

❖ ***Minimizing pollution from domestic waste***

➢ *Measure description*

In the construction, workers will relax and live into temporary camps at 16 construction sites. Each site will be equiped with 2 portable toilets to collect about 2-4 m^3 per day of waste. This measure not only is convenient but aslo keeps environmental hygiency. Sludge from septic tank will be collected. When finishing construction, these toilets will be also removed.

Scope of application:

+ This mitigation is applied for all constructions of road and bridge (the head of bridge).

+ Time of maintaining these activities is 36 month project construction.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and gets the highest efficiency when combining with propagating training workers to follow regulations at the camps.

❖ ***Preventing the pollution risk of solid waste containing oil and used oil***

➢ *Measure description*

To prevent the water surface resource in the construction sites from the risk of oil pollution, beside the measures (mentioned in section *4.1.2.2)* , when using floating tank in river, the following measures will be applied:

- Collecting and taking the used oil and the oily rags to the separate containers on barge. Moving these containers to each construction site and keeping them at the area of collecting the used oil from the sites. Replacing the old container with a new one is done simultaneously with putting the containers which is full of oil on land;
- Forbidding all actions of recharging the solid waste containing oil into water and the estuaries.

Scope of application:

+ This mitigation is applied for construction of the head of bridge.
+ Time for maintaining these activities is 36 month of construction for whole project and for construction of each bridge.

➢ *Feasibility and efficiency of measure*

The additional measure is feasible and contributes to prevent the water surface resource in bridge construction from the risk of oil pollution.

❖ ***Measure for cleaning river and stream***

Purpose: Making the flow back to the original state as possible, preventing the risk of sediment, erosion and water resource pollution.

➢ *Measure description*

Cleaning river with some following contents:

- Implementing all mitigation measures which are mentioned in the section 4.1.2.3 - *Mitigating impacts to environment of water surface, sediment.*
- After completing bridge, cleaning up whole temporary constructions on shore as well as under the river, including steel, redundant concrete, surrounding frame.... by equipments such as excavators, bucket, crane...
- Cleaning up the temporary bridge (at 12 bridges: Gia Duc, Phuong Lam, Đarlue, Dai Quay, Đamrhe, Dinh Trang Hoa, Darle, Hiep Thuan, Xom Trung, Dinh An I, Cau Dat, Cau Xeo), excavating the cross-section of flow as original form; excavating more 0,5 m of the occupancy of road and treating solid waste at the construction sites.

- Collecting the temporary roads, removing materials of the road such as solid waste, making the plane back to its original state; digging more 0,5m of occupancy of temporary road and transferring it to the owner.

Scope of application

+ These measures are applied for all 39 flow overbridges (in Table 1.12, chapter 1 - *Statistics of flow overbridge construction)*
+ Time for these activities is as soon as finishing the bridge construction.

➢ *Feasibility ad efficiency of measure*

The mentioned measure is feasible and highly efficient in recovering environment after completing the project construction.

2.1.2.4 *Minimizing of effects to underground water*

❖ ***Preventing the pollution risk when implementing bored pile with using bentonite***

➢ *Measure description*

Normally, bentonite is not toxic to environment because it comes from nature; evenly it is used for sewage treatment. However, when using bentonite, some additives and toxic heavy metals can be used which is not under the control. Therefore, to prevent underground water from pollution when using bentonite in the implement of bored pile, some following measures will be applied:

- When implementing bored pile, it is forced to used the standard betonite in order not to use additives.

Scope of application

+ Applying for all bridges which use bentonite for implementing bored pile.
+ Time for maintaining these activities is all time of the construction of foundation and bridge piers.

To guarantee the feasibility of the mentioned measure, the cost for bentonite without using additives will be put into total investment of Project and the content of implement will be taken in the terms of contract.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible because cost can be taken into the project construction and the terms of implement with construction contractors. Efficiency of measure can be foreseen.

❖ ***Preventing water surface from the risk of intrusion***

➢ *Measure description*

Purpose is to prevent water surface from intrusion at the sites of implementing bore piles along drill pipe, making underground water polluted. The following measures can be applied:

- Arranging shores surrounding the piers of casing, minimizing the intrusion of polluted surface water.
- Maintaining and repeating at the next piers: maintaining these activities until finishing drilling hole and do it again when implementing the new one.

Scope of application

+ These mitigation measures are be applied for construction of the head of bridge.
+ Time for maintaining these activities is during the time of foundation, and piers of construction.

➢ *Feasibility and efficiency of measure*

The mentioned measures are feasible and suitable to the current construction standards. They are clearly efficient in minimizing the pollution for underground water.

2.1.2.5 Measures for minimizing of effects to creatures

❖ ***Minimizing loss to terrestrial ecosystem***

➢ *Measure description*

Purpose is to prevent and minimize the effects to the biological diversity on land along project route from construction. The following methods will be applied:

- Applying the measures minimizing effects to atmosphere at the section 4.1.2.1.
- Applying the measures minimizing effects to soil environment at the section 4.1.2.2.
- Propagating, raising awareness of worker staff to help them take part in directly biological diversity, and biological resource.
- Management board of project propagates the documents related to the protective forest, special forest such as law on forest protection and development No 29/2004/QH11; Decree No 159/2007/NĐ-CP on administrative sanction in the field of forest management, protection and forest product management; Decision No 1171/QĐ dated 30/12/1986 by Ministry of Forestry on issuing regulations of production forest, protective forest and special forest to each worker.
- Implementing the demarcation GPMB following the technical standard, and the approved design. Implementing GPMB in the right scale. Forbidding cutting tree outside demarcation GPMA. The management board of project conducts the plan to control the action of worker in this field.
- Calculating carefully the necessary area of construction to minimize the harm for forest land; only building in the scope which is discussed with the land owner and locality; at these areas, vegetation will be replanted with the local one after construction.
- Collecting and managing strictly trees and waste when cutting to avoid forest fire. Operating this program as trial before each dry season comes.

- Strictly following the design, technical procedures in the construction of road, bridge and other auxiliary construction; especially paying attention to this issue for routes (Km62 – Km76+700, Km79 - Km98, Km240 - Km268).
- Forbidding all action of destroying forest, hunting wild animal from workers.
- In the construction of digging road through mountain using mine, some measures will be used:
  + Using a measure called "Om explosion"- a kind of explosion with the vibration only occur within 50m- is used to break rock;
  + After exploiting, carrying out investigation. If finding any subnormal block of rock on the slope with the risk of collapse, the additional plan will be conducted to solve.
  + Each of explosion for breaking rock is implemented quickly, not at the same time. Mine explosion will be carried out at the time of 8 ÷11 and 2 ÷ 4 everyday. The amount of explosive will be calculated carefully to measure the bang of explosion of about 75 dBA in the distance of 150m.

Scope of application:

  + These mitigation measures are applied for whole construction of road and the head of bridge.
  + Time for maintaining activities is during 36 months of project construction.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and suitable to the characteristics of ecosystem on the widened road.

❖ ***Minimizing the loss the aquatic ecosystem***

To prevent and minimize consequences from the water surface pollution causing loss to the biological diversity of aquatic ecosystem, the project will do all the mitigation measures mentioned in the section 4.1.2.3 - *Minimizing of effects to surface water and deposit.*

2.1.2.6 Prevention of river bank bridge end road base erosion

➢ *Measure description*

- *Prevention of river bank erosion*: abutment is a part between bridge and road; beside helping vehicle run well, it functions as a retaining wall at the head of bridge for prevent the road base from erosion, collapse. Therefore, the work of designing and consulting calculated the ability of erosion of abutment based on the flow Q with the designed water level $H_{1\%}$. Based on the calculation, the construction of avoiding collapse and erosion for bridges on the route is reinforced with grass, and rock. (the detail of the volume of construction is mentioned in *the section 1.5.2.2 - Total volume of construction – Table 11),* in which:

+ Contributing cleaved rocks 685m^3
+ Tiling the 10 cm hollow brick 7.868 m^2
+ Establishing the 4m Melaleuca foundation 114.090 trees
+ Planting grass 2.611 m^2.

- *Preventing the collapse of road at the head of bridge:* To prevent the collapse of road at the head of bridge, it needs to plant grass to reinforce the surface of slope, to prevent erosion, and combine with the suitable drainage system.

Scope of application

+ This measure is applied for all 16 flow overbridges.
+ Time for implement: during the construction of abutment and head of bridge

➢ *Feasibility and efficiency of measure*

The mentioned measures are feasible because the items are calculated in the whole project. The efficiency of measure is quite clear and applied in many previous constructions.

2.1.2.7 Prevention of collapse, sliding for slope and road base

➢ *Measure description*

In this project, the following measures are chosen to prevent collapse, sliding for slope:

- *Building the drainage system: C*ontributing on the top of road, digging soil or rock at the area which has thick cover, is easy to slide to cut water from slope, not let it overflow on the surface of slope. At the points of last slot, building drop water for energy dissipation.

- *Building embankment, tiling roof:* At the small embankment on the slope with the large horizontal slope degree, the extension is only the margin of land or reinforced margin, the old road base is stable after may years of explosion, designing 1:1 roof or 1:0.75 roof with the inside of selected rocks which are inserted tightly;25cm of outside uses XM 10 Mpa mortar, the toe of slope is built with rock and XM 10 Mpa mortar. Periods of reinforcing roof of slope are listed in *the table 1.6* of chapter 1.

- *Building retaining wall:* At position with the large natural horizontal slope degree, if the old road is dug or embanked up to the designed width, the road base will be weak, easy to be collapsed, slide in the exploitation. To come over this shortcoming, retaining wall is designed to be stronger to stabilize the road base. Retaining wall is designed under 86-06X application, the wall has pour-in-place 16 Mpa concrete structure. The positions having retaining wall are listed in *Table 1.7* of chapter 1.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible because the cost for items is prepared in whole construction. Efficiency of the above measures is quite clear and is applied for many previous constructions.

2.1.2.8 Measures for minimizing of effects from worker's camp

❖ ***Preventing the risk of pollution from domestic sewage***

- *Surface water pollution*: A mentioned in the part *Minimizing pollution from domestic sewage* in the section 4.1.2.3 - *Minimizing of effects to surface water and deposit*
- *Soil pollution:* As mentioned in part *Preventing the risk of domestic solid sewage* in the section 4.1.2.2 - *Minimizing of effects to soil environment.*

❖ ***Minimizing effects to society***

➢ *Measure description*

To minimize the effects to society because of gathering many workers at camps, increasing the temporary population at locality, the following measures will be applied simultaneously:

- Increasing the use of human source of locality to reduce the amount of people at camps;
- Reporting local authority the temporary address of worker at camps to help locality have management measure;
- Making regulation in the construction sites, in which especially paying attention to the environment hygiene and security in local.
- Cleaning up drain, pool of stagnant water, killing larval and mosquitoes to prevent malaria and dengue;
- Limiting accidents among workers who work at the construction site by entertainment equipments such as TV, radio during the time of relax;
- Investor will cooperate tightly with local authority to easily control the security condition in the area of project;
- Investor in cooperation with locality at commune propagate the necessary knowledge and the social disease to workers and local people in order that they can protect by themselves.

Scope of application:

+ These mitigation measures are applied for whole construction of road and bridge.
+ Time for maintaining these activities is during 36 months of the construction.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and its efficiency depends on the ability of organizing, implementing the mentioned contents approved by both investor and contractor.

2.1.2.9 Measures for minimizing of effects to traffic activities

The following measures will be applied to minimize traffic congestion and accidents during construction:

❖ ***Minimizing the risk of traffic congestion***

➢ *Measure description*

- Dividing the road into many parts, and construction is implemented from this part to others. Particularly, for the tender package No 1 (constructing Km0 - Km76+700), implementing construction on 3 small parts at different time within 36 months; for the tender package No 2 (contributing Km79+800 - Km98, Km108 - Km154+400, Km159+500 - Km172, Km176+500 - Km199, Km210 - Km234, Km240 - Km268), implementing construction at the same time at least 3 parts (each of part has length of 10-20 km) at the same time, distance of each part is 30 km.
- Implementing construction on the extension first and vehicles can run on the old road. After basicly completing the extension, starting construction of the old road.
- Building temporary parts of road, bridge which have enough weight and width for vehicles to run while constructing the new one.
- Distributing people and tables for guiding vehicles on road; regulating diagram for vehicles transporting materials.
- Conducting the suitable plan of material provision under rule *where needs, there will be a provision* to avoid using too large amount of vehicles obstructing traffic on the road.
- Distributing lights at night or signs which are recognized remotely at the points where usually occurs accidents such as digging deeply, sudden embankment, the in-process underground drain...
- At the position of bridge construction, putting signs, lights at two head of bridge.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and applied in the project of improving roads. In reality, efficiency in reducing congestion when applying simultaneously is quite clear..

❖ ***Minimizing risk of congestion and traffic accidents at sensitive positions***

➢ *Measure description*

When contributing on roads across the sensitive positions mentioned in table 2.26 of chapter 1, beside the above measures, some additional measures need applying:

- Distributing signs at 2 head of road which is under construction, the marker posts is located in the main position, distributing 2 people at 2 heads of road to control vehicles in rush-hour.
- At the positions having schools, distributing suitably the construction plan, it is better when construction is implemented on hoildays, avoiding rush-hour such as time when students come back home from school; taking road which is wide enough for vehicles and sending officials to control traffic at 2 sides of school during the rush-

hour.

- *Feasibility and efficiency of measure*

The mentioned measure is feasible and applied for projects of improving, raising the traffic road. In reality, the efficiency of reducing congestion and accidents when applying at the same time the above measures is quite clear.

❖ ***Minimizing the risk of congestion or traffic accident at the junctions***

- *Measure distribution*

The following measures will be applied to minimize the risk of congestion or traffic accident at the construction of junctions:

- Not let materials, vehicles occupy roads crossing highway; they are put at the land of project, inside the piers.
- Putting signs of showing construction site, limiting speed of vehicle at 5km/hrs at 2 junctions and sending people to control traffic.
- Time for mounting plate girder when the traffic is lowest on the day.
- When fitting girder, sending people to stop the vehicles.
- Usually cleaning the surface of road
- Cooperating with the local police to control the traffic on the road.
- Maintaining these activities ensuring the time of construction at junctions

- *Feasibility and efficiency of measure*

The mentioned measure is feasible and is applied in the projects of improving the road, in reality, the efficiency of reducing congestion at junctions when applying simultaneously is quite clear.

❖ ***Controlling the traffic safety of project***

- *Measure description*

The purpose is to minimize the risk of unsafety when vehicles of the project run on the public roads. The following measures will be applied:

- During the rush-hour from 6 - 8a.m to 16-18p.m, not transport material on the highway (QL20, QL27, QL28, QL55), provincial highway (ĐT721, ĐT724, ĐT763) and the inter-commune roads within the scope of project.
- Do not transport over the nominal load.
- Material will be transported by the trunk with cap. In the case of having no cap, the braided fiber is used and tied at 4 corners to avoid falling soil during the transport.

Scope of application:

+ This mitigation measure is applied for whole construction of road and bridge.

+ The time for maintaining these activities is 36 month of the project construction.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and applied for the project of constructing the traffic roads. In reality, when applying the above measures, the risks of unsafely is reduced significantly.

2.1.2.10 Measures for minimizing of effects to local traffic infrastructure system

➢ *Measure description*

Purpose is to minimize degradation, damage of the system of the inter commune roads when the project uses these roads to transport material from mine, remove soil. The measure includes the following commitment of the investor:

- *Making agreement with the local before using:* having the agreement in text from the local about the temporary use of the inter-commune roads for transportation.
- *Using vehicles suitably*: Using vehicles with the load which is suitable to the real strength of the road surface; transporting enough the nominal load of vehicle and running with the speed of 30km/h.
- *Setting the suitable time for transportation*: Not transport in the time having many people, or in the holidays.
- *Maintenance and revert*: Committing to keep hygiene, traffic safety in the use; maintaining periodically and recovering the initial state when completing the transferring it to the local.

Time for applying: during the 36 month construction.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and applied for the project of construction investment. In reality, when applying the above measures, the damage of the transportation infrastructure system of the local is lower and basically recovered after completing the project.

2.1.2.11 Waste control during construction phase

To minimize the degradation of the environment along the project due to the waste generating from the activities of construction, the following measures will be applied:

a) Conducting and issuing the documents of waste management

The project owner is responsible for conducting the documents of managing the waste generating from the construction in which the form needs propagating to all the construction contractors. The contractors are responsible for reporting the situation of waste management under the issued standard to the project owner (the form includes the basic information such as: types of arising waste, time of generating waste, the volume of waste, time of removing waste, the areas of receiving and treating waste...). The documents of managing waste are conducted for both the normal waste and hazardous one. During the construction, the document of managing waste will be used by the construction unit to implement and report the arising waste of the project. The document of managing waste is one of the tested object under the requirement in the chapter of Environment Observing Program.

b) Treating the normal waste

Through the terms in the economic contract, the project owner requires the contractor treat the normal waste (the construction waste and domestic waste) under the following order:

+ The non-toxic construction waste (the main component is the removed soil, redundant concrete mortar, organic soil, bentonite mixed soil) can be used to filling background at the civil construction. They will be moved to the filling areas when being received in the local document.
+ The solid domestic waste will be treated under each steps: collecting the solid domestic waste; classified (the recyclable waste and disposal one). The unrecyclable waste will be moved to the landfill in provinces under the economic contract signed with Urban Environment Company in each province,

c) Treating the hazardous waste

Through the terms in the economic contract, the project owner requires the contractor to treat the hazardous waste (including oil scum from sewage, oily rags from the machine maintenance, the waste oil from changing oil of equipments and oil absorbent soil at the construction site) in the order as follows:

+ Registering the waste source to Department of Natural Resources and Environment in Dong Nai province before implementing the project.
+ Classifying and restoring temporarily all wastes containing oil in the separate container with a cap and marked under TCVN 6707/2000 "the hazardous waste - the warning and preventing sign".
+ Taking the waste containing oil to be treated timely under the current regulations. In the case that the oily waste must be kept for over 6 months, the project owner will register and report periodically (every 6 months) to Department of Natural Resource and Environment in the provinces.
+ Sending the officer in charge that is trained about managing the hazardous waste to control the oily waste.
+ Signing contract with the transportation owner and hazardous waste treatment owner who is licensed the hazardous management following the Circular No. 12/2011/TT-BTNMT dated 14/4/2011 by Ministry of Natural Resource and Environment on hazardous waste management for transporting and treating the oily waste from the project.
+ Some facilities of treating the hazardous waste can sign the contract:
    - o Brach of Thai Thanh Environmental Handling and trading Co., Ltd.
        - Office address: Duong Long, Thanh Tuyen Commune, Dau Tieng District, Binh Duong Province.

- Phone number: 0650.530276 Fax: 0650 756212
- Email: thaithanhco@yahoo.com
- Business Registration Certificate No: 4102000527; issue date :05/04/2006; At: Department of Planning and Investment in Ho Chi Minh City.

o ASIA MTV ENVIRONMENT SERVICE - TRADE- PRODUCTION CO., LTD

- Address: 189 Le Thuc Hoach, Phu Tho Hoa Ward, Tan Phu, Ho Chi Minh City.
- Phone number: 0839789814 Fax: 0839789615
- Email: jungle.achau@yahoo.com
- Website: http://www.moitruongachau.com.

2.1.3 OPERATION PHASE

2.1.3.1 Measure to reduce the noise

➢ *Measure description*

To reduce the noise, it needs to apply the following measures:

- Not circulate the old vehicles which is noisy; besides encouraging to use the new vehicles with the low noise under the current Standard of European and other advanced countries;
- Forbidding using air horn when going through the residential area;
- Planning residential areas suitably; not build house in the corridor of road safety or far from road about over 15m.
- Not locating any sensitive facilities such as health facilities, library, kindergarten, school within the scope of 160 m from the road.

➢ *Feasibility and efficiency of measure*

Due to habitually prefer to live near road for easy transport and business of many people and the current economic situation in the country, the application of the above measures is quite difficult. However, the authorities must take part in to early have the healthy living environment as in the developed countries nowadays.

2.1.3.2 *Measures for minimizing of dust and waste air pollution*

➢ *Measure description*

According to the evaluation of the dust and waste air pollution in the operation phase at section 3.2.1.3, toward 2020, the degree of the dust pollution exhausted from engines does not influence to people living outside the corridor. Only Nox exceeds the permissible level 0,20 mg/m^3 in the area which is far from the road about 60 m in 2020. Nox is reduced by the following measures:

- Not circulate the old vehicles exhausting the high hazardous gas, encouraging to use the next vehicles with low gas emission under the current standard in Europe and other developed countries;
- Planning residential suitably, not constructing house in the corridor of Road Safety; not locate the sensitive facilities such as health facility, library, kindergarten, school in the scope of 60 m from the road.

➢ *Feasibility and efficiency of measure*

Due to habitually refer to live near the road for easily transport and business of people and the current economic condition of our country, application of these measures is quite difficult. However, authorities must take part in to have the healthy living environment as in the developed countries nowadays.

2.1.3.3 Prevention of river bank bridge end road base erosion

➢ *Measure description*

Carrying out all following measures to prevent river bank, bridge end road base erosion in the operation base:

- The project owner plans periodically to observe the bridge, road end base collapse and erosion (every 3 months in dry season and every 1 month in rain season).
- Reinforcing timely, improving the areas of collapse, erosion as soon as occurring the damage.
- When occurring the serious collapse, confirming the reason and then applying the suitable measures such as:
    + Planting grass to reinforce the surface in combination with drainage.
    + Building system of retaining wall, combining drainage and surface reinforcement.
    + Building retaining wall or arranging rock or reinforcing surface to protect and contribute retaining wall to protect slope.

Scope of application:

+ These measures are applied for all 16 flow overbridges
+ Time for implement: during the time of the project maintenance.

➢ *Feasibility ad efficiency of measure*

The mentioned measure is feasible and applied for many current traffic project, the efficiency of the measures is not quite clear.

2.1.3.4 Prevention of collapse and road base

➢ *Measure description*

Implementing all measures to prevent the slope collapse and slide:

- The owner project plans periodically to observe the slope collapse and slide (every 3 months in the dry season, and every 1 month in the rain season). When finding collapse, implementing:
- Reinforcing temporarily the areas of collapse by:
  + Cleaning up the collapsed rock to ensure traffic;
  + Arranging temporarily 3-4 lines of rock within the height of 2-4m;
  + Reinforcing the surface by planting grass or tree.
- Next, treating sustainable by one of the measures:
  + Using the structure of anchored frame and wall; the reinforcing steel retaining wall with the pile cutting off the load, reinforcing the surface and drainage.
  + Constructing the retaining wall combining the reinforcement of the surface and drainage.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and applied for many current traffic projects; the efficiency of the measure is quite clear.

2.2 Measures for minimizing of environment risks and problems

The construction and transportation of the project, 3 kinds of problems can be occurred:

- Occupational accidents in the construction site.
- The traffic accident;
- Explosive accident;

2.2.1 **Dealing with technical problems**

➢ *Measure description*

- *Choosing the optimal measure for construction:* The construction units must submit the construction measures to the project owner. The project owner will consider these measures based on the specific regulation ad approve the most optimal and safe measures. The construction follows strictly the approved construction procedures.
- *Conducting the plan to response the accidents:* The project owner make the plan of equipment and instruments for treating accident including relief team, organizing and planning the rescue (director, the implement order) and confirming the necessary address to contact in the emergent case.
- *Time for application*: The preventative measures will be maintained during the time of 36 month construction.

➢ *Feasibility and efficiency of measure*

The mentioned measure is feasible and reduces the significant loss when occurring the problems.

2.2.2 **Measures for minimizing of industrial accident**

➢ *Measure description*

- Opening the training course on the occupational safety and the basic technology in the technical line of road construction for all workers working at the construction sites.
- Equipping enough labor protection such as clothes, glass, gloves, mask, boots and shoes... for workers according to the job they do.
- Before each work shift, testing all situation of machine and equipments; recording the situation and inform to the director at the site about the damage of machine for having the timely treatment;
- Worker having no obligation is not permitted entering the construction site;
- Locating the signs at the areas where can occurs the occupational accidents;
- Usually sending health care staff; equipping enough instruments and medicine under the regulation to rescue timely the labor accidents, for example getting hurt because of the falling rock or burning....
- Conducting the plan for rescue when occurring accident: The project owner will conduct the rescue plan when occurring the labor accidents including the relief team, organizing the rescue plan (the director, the implement order) and confirming the necessary addresses in the emergent cases including the local hospitals in Dong Nai province and Lam Dong province.
- Time for application: the preventative measures will be maintained during the time of 36 month construction.

➢ *Feasibility and Efficiency of measure:*

The mentioned measures are feasible; application of these measures will minimize the risk of occupational accidents and damage significantly when occurring the problems.

2.2.3 **Measures for minimizing of traffic accident**

Similar to the mentioned measures in the section 4.1.2.9.

2.2.4 **Measures for minimizing of firing problems**

➢ *Measure description*

- Conducting the plan for firing prevention at the construction site; propagating ordinances of fire fighting & prevention and the plan for firing prevention to all workers at the site; equipping enough instruments for fighting fire at the store of the flammable materials such as gasoline, asphalt.
- Distributing the temporary stores of fuels such as gasoline, asphalt far from the heat source about 100 m.
- The electrical system which is used at the sites is installed by the specialized officials and complies with the standard (suitable load, having equipment for overload & short-circuit prevention…)
- Usually testing machines and equipments to ensure that they are always run well.

- Forbidding worker firing outdoor; using suitably dissolvent & volatile substances.
- Establishing fire brigades for the site, organizing exercise and periodically testing the work of fire prevention of the site.
- Time for application: the measures will be maintained during 36 month construction.

➢ *Feasibility and efficiency of measure*

The mentioned measures are feasible; application of the above measures will minimize the risk of fire and the loss significantly when occurring problems.

2.2.5 **Prevention of problems caused by flood**

➢ *Measure description*

- *Prevention of problems caused by storm, heavy rain:*
    - Stopping all activities of construction when having rain and storm at level 5 or more;
    - Covering the new construction with nylon canvas when occurring rain or storm;
    - The wire of lighting rod is attached ground well with the steel structure when building the bridge to avoid thunder.
- *Prevention of problems caused by flood:*
    - When having the signs of flood (heavy rain, rapid surge), quickly moving all equipments of construction at the sites to 2 sides of dike. Firstly, transporting the fuels such as gasoline, chemicals, and then equipments;
    - Having the measures for rescue when occurring flood; particularly distributing the area for gathering assets, commodity and material when they are moved.
    - Usually observing the meteorological information to have the response timely;
    - Usually contacting to the units such as soldiers, police and cooperating with the local.
- *Time for application:* The measures will be applied during the 36 month construction.

➢ *Feasibility and efficiency of measure*

The mentioned measures are feasible and necessary to minimize the damage caused by natural disaster.

CHAPTER 5
PROGRAM FOR ENVIRONMENT MANAGEMENT AND SUPERVISION

1.1 ENVIRONMENT CONTROL PROGRAM:

1.1.1 OBJECTIVE:

The target of the environmental management program of the project is to propose a program to manage the issues of the environmental protection during the process of preparing works, the construction phase and operation phase of the project including :

- Proposing a management plan to carry out the mitigation measures of the environmental impacts approved by the authorized organs and transferred into the articles in the technical specifications of the project.
- Ensuring the proper management of the additional waste according to the current regulations; Proposing the typescript of the quick action of the issues and the environmental incident and settling the urgently the incident of the environmental issue.
- Collecting continuously the information of the change of the environmental quality during the process of the project performance to identify punctually the bad impacts on the environment and proposing the protective and mitigation measures of the environmental pollution according to the current state standards.

The information collected during the project environmental project to ensure the following basic natures:

- The data accuracy: The data accuracy related to the survey is evaluated in accordance with the measured data and the actual one.
- The data features: The data collected at the surveying point represent a fixed space.
- The data consistency: The data collected at the different points and times of the project area can be compared with each other.
- The ceaseless observation according to the time : the workforces are applied to carry out the environmental investigation program defined during the process of the project performance .
- The data consistency: The collected data has enough information of that factor itself and related factors in the scope of the space and the concerned time.

5.1.2 SUMMARY OF DETAILS FOR ENVIRONMENT CONTROL PROGRAM:

The project activities can cause the potential environmental impacts and the minimizing measures equivalent to the project performance phase summarized in the table 5.1.

Table 5.1 Summary of the project environmental management program

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Preparation phase	- Site clearance - Occupancy of houses, building lands; - Permanent Occupancy of agricultural land	- Removal and re-settlement ; - Affecting the residents' lives ; - Affecting production, business ; - Affecting local economy ; - Affecting the residents' income	*Minimizing the impacts on the affected households by occupancy of the land and re-settlement :* - Complying with the plan of the Site clearance and re-settlement as approved ; - Considering the expectation of the affected objectives of the compensation and support for the re-settlement ; - Ensuring fully and punctually the fund source for carrying out the Site clearance and re-settlement ; - Carrying out the check and supervision ; - Making priority of the compensation option of the agricultural land in the land fund of the local area ; - Compensating the permanently occupied land area according to the replacement price ; - Compensating the plants and objectives on the land according to the replacing price ; - Supporting the stability of the production, vocational training for the households with the lost agricultural land, facilitating the residents to transfer the jobs by the job training program, the capital loan - The local area creates the opportunities, the space to encourage the residents to develop the business, contributing to transfer the economic structure according to the increasing tendency of service and commerce.	879.702 million	Before project construction (the project component I: before 2012)	- Council of Site clearance of districts under the guidance of PC of provinces ; - Project Project Owner .	- PC of districts; - PC of province; - Project Owner

The phase of the project operation	**Project activities**	**Environmental impacts**	**Works, measures of environmental protection**	**Cost for carrying out the works, measures of environmental protection**	**Performance time and completion**	**Responsibility of performance unit**	**Supervision responsibility**
Preparation phase	- Removing electric, telecom system	Interrupting electric and telecom supply source	- Constructing newly the electric and telecom system, trial operation, move to the new system and then demolishing the old system .		Before construction	Project Project Owner; Power and telecom service	- Project Owner; - Supervision consultant
	Occupying temporary agricultural land	Affecting residents' income	*Minimizing the impacts to the agricultural households occupied by the temporary land :* - Agreeing on the land rental and compensation of the cultivated plants with the owner as per the local current price . - Upon no use, the temporary borrowing land plots will be restored originally as per the commitment and cleared before delivery to the owner	96,93 million	Before site leveling and grading	- Project Owner; - Construction contractor.	- Project Owner; - Supervision consultant
	- Demolishing old works	- Reducing the quality of environment, air ; - Pollution of noise ; - Affecting residents	*Controlling dust in the demolition of old works :* - Wetting the demolition objective by hose or water tank truck ; - Releasing immediately the demolished waste . - Not burning the wastes . *Controlling the noise causing source :* - Not making demolition at night from 22:00 to 6:00 AM ; - Using equipment with allowable noise level ; - Noticing the affected persons of the demolition schedule for their preparation .	35,6 million	In the demolition period	- Project Owner; - Construction contractor.	- Project Owner; - supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Preparation phase	Leveling and grading site and access	- Reducing the air quality ' - affecting residents - Affecting agriculture	*Controlling dust in the site leveling and grading :* - Water spraying for the surface (02 times/ day) by spraying hose or water tank truck ; - Performance time : about 03 months ..	15,0 million VND	In the leveling period	- Project Owner; - Contractor	- Project Owner - Supervision consultant
	- Demolishing houses - Setting up the site working space - Installing equipment	- Construction waste rises - Rise of waste	*Waste treatment* - Classifying, collecting recycle wastes and move the rest to the space leveling location . *Waste treatment :* - Signing the contract with the urban environmental sanitation company for transportation, treatment .	37,45 million VND	In the project preparation	- Project Owner - Contractor	- Project Owner - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase	Excavating, filling the enlarged road base; constructing the road base	*Impact on soil environment:* - Corrosion , sediment filling the cultivated plants ; - Causing local inundation ; - swamping building land and professional land ;	- Finalizing each base; compacting the road base before the heavy rain ; - Planting grass for the talus roof right after filling ; - Excavating the water intake canal to prevent the corrosive areas in the raining season ; - Placing the mud stopping plates temporarily at the legs of the slopes, the edge of the border of the Site clearance; clearing periodically the mud stagnated in the preventing plates ; - Clearing, dredging the muds stagnated in the sediment points; - Placing the water drainage right when constructing the base; making the ditch along the enlarged sections of the old route ; - Compensating the damages for the residents caused by sediments . - Checking usually the performance of the mitigation measures .	7.678 million VND 220 million VND 42.229 Million VND	Performance during the construction period	- Project Owner - Contractor	- Project Owner - supervision consultant
	Excavating. Filling the road base as widened, constructing the road surface	*Impact on air environment:* - Dust pollution and discharged air. - Affecting the residents and sensitive object	- *Controlling the dispersion of the dust in the excavation:* + Wetting the area with the dust dispersion (01 time in the sunny day of the raining season and 02 times in the sunny day of the dry season with the road base; watering with the double frequency at the interchanges).	55,0 million (estimated at	During the construction period	- Project Owner - Contractor	- Project Owner. - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase			+ Preventing the dust dispersion at the temporary storage yard by fence with the technical geo-textile (please refer to the temporary storage yard below). - Controlling the dust pollution at the sensitive objectives *:* - Arranging properly the material temporary storage yards, the wastes; far from the sensitive objectives with at least 100 m. - Not burning the wastes. - Supervising the content of the dust at the sensitive points.	the temporary storage yard)			
	Excavating the road bases as widened, constructing the road surface	Pollution of noise	*Noise control in construction :* - Making priority of using equipment with the standard noise . - Selecting the location of the machine placement like the concrete batching plant, generator 120m far from the residential groups . - Making anti-noise wall by metal sheet for equipment placed near the residential area or the sensitive areas ; - Not operating equipment with the noise over 75 dBA from 22:00 to 6:00 AM. - Not using the whistles in the residential area ; - Noticing in pubic the construction activities, making plan of receiving and settling the grieves, queries	56,0 tr.đ	During construction period	- Project Owner - Contractor.	- Project Owner. - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase	Excavating and filling the widened road base, executing the road bases	*Impacts on the water environment :* - Suspended solid waste pollution; increasing the impurity ; - Filling the system of canal, spring, reservoir	- *Preventing the mud overflowing from the temporary storage yards :* + Carrying out the mitigation measures to the environment above . + Arranging the material, waste storage yard temporarily and 20m far from the current . - *Preventing the collapse due to rain :* + Finalizing each road base; compacting the road base before each heavy rain ; + Planting grass right after filling ; + Excavating water intake trenches to prevent the corrosive areas in the raining season ; + Placing the mud-preventing plates temporarily at the legs of the slope, the edge of the border of the Site clearance, clearing the periodically the mud at the preventing plates; + Clearing, dredging the mud sedimented at the sediment points ;	(Included in 7.678 million VND) (included in 220 million VND)	During construction period	- Project Owner - Contractor.	- Project Owner. - Supervision consultant
	Excavating, filling the widened road, executing the road surface	*Impacts on transport:* - encroaching the traffic corridor. - Increasing the traffic non-safety	- finalizing each transitional section ; - Construction on the widen section first and placing the old route for the transportation; after completing basically the widening portion, constructing the old route ; - Placing the signal, arranging the traffic spotter ; - Arranging construction means and materials in the right position;		During construction period	- Project Owner - Contractor.	- Project Owner. - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Giai đoạn xây dựng			- Clearing the soil mud on the transportation route to avoid the road swamp ; - Coordinating with the local traffic police to regulate the transportation .				
	Transporting materials, kinds of stones (applied for the road and bridge)	*Impact on the air environment* - Pollution of dust and discharged air . - Affecting the residents and sensitive objectives at the two sides of the road	- *Controlling the dust dispersion on the material transportation road :* + Using the means to ensure the standard of the discharge air (Decision No. 249/2005/QĐ – TTg dated 10/10/2005). + The material is the soil or dry sand sprayed with the surface . Using the truck with the cover to transport soils or use the canvas to cover the truck upon transportation . + Limiting the transportation speed of 35 km/h. + the truck from the project area or the quarry are washed with the soil mud stick to the wheels by water hose . + Creating the buffering area of about 300 – 500 m before the truck comes from the site or the quarry into the traffic road. Spraying water for the buffering area periodically with 2 times/ day ; usually cleaning the road surface of the buffering area ; + Limiting the material transportation at the peak hours .	25 million VND	During the construction time	- Project Owner - Contractor .	- Project Owner. - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase			+ Arranging the material transportation diversion properly preventing the concentration of many trucks running at the same route at the same time . + Supervising the dust at the buffering areas , the sensitive area to adjust the punctually the frequency affecting the road surface .	480 million VND			
	Transporting materials, various stones (for the roads and the bridges)	*Impact on the transportation:* - Increasing the truck density, risky to the traffic jam . - Swamping the road, risky of the traffic non-safety .	- Arranging the transportation route and time properly to avoid the focus . - Not transport into the peak hours in the day - Clearing the mud to the wheels, clearing the drop soil on the route at the sections wit the crowded residents ; - Carrying out the preventive measures to the falls ; - Transporting the right load, not exceeding the specified speed (< 30 km/h).		During the construction time	- Project Owner - Contractor.	- Project Owner. - Supervision consultant
	Transporting materials, various stones (for the roads and the bridges)	*Impacts on local infrastructures :* - Upgrading, damaging the local infrastructure ;	- Contacting the local area to get the agreement in writing upon using the inter-hamlet road, inter-provincial routes to transport materials ; - Strictly complying with the minimizing measures of the bad impacts when transporting the raw materials and wastes as mentioned above. - Undertaking to repair, restore the road originally upon completion		Before construction During the construction	- Project Owner - Contractor.	- Project Owner. - Supervision consultant
Construct	Executing the river flyover :	Filling the agricultural land	*- Preventing the collapse risk due to the rain and treating the collapses :*	160 tr.đ	During the construction time	- Project Owner	- Project Owner.

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
ion phase	excavating the foundation pit		In the raining season, placing the anti-mud plates temporarily in the construction time around the location of the foundation pit excavation . The mud prevented at the prevention plates will be cleared every day and treated as soils . The prevention plate is cured at least 2 days per time to work efficiently . After construction, these prevention plates will be removed . - *Treatment upon sediment and compensating the damages*			- Contractor .	- Supervision consultant
	Executing the river flyover: Excavating the foundation pit	*Impact on environment when:* - Reducing the environment quality of the air due to the dust pollution and discharged air . - Affecting the residents and sensitive objectives in the vicinity	- *Controlling the dust dispersion from the excavation of the foundation pit :* + Spraying water into the foundation pit at leatst 01 time per sunny day of the raining season and 02 times in the sunny day in the dry season . + The material storage yard, waste soil have to get fenced by the geo-textile which is at least 0.3m from the yard surface - *Controlling the discharge of construction equipment :* + Construction means ensure the standard of the exhausted air as per Decision No. 249/2005/QĐ-TTg dated 10/10/2005 of Prime Minister . + Construction means are only allowed to move within the assigned construction scope .	(estimated at the temporary storage yard)	During the construction period	- Project Owner - Contractor .	- Project Owner. - Supervision consultant
Construct	*Executing the river flyover:*	*Impacting on water environment:*	- *Preventing collapse due to rain :* + Placing the anti-mud plates temporarily in the	(estimated at	During the construction	- Project Owner	- Project Owner

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
ion phase	*foundation pit*	- suspending solid substance pollution; increasing the impurity ; - Filling canal, spring, reservoirs	construction time around the foundation pit . Clearing the mud stagnated everyday and treated as the classified soil . - *Preventing the flow of the materials, waste soil at the temporary storage yards* (refer to the temporary storage yard in)	the temporary storage yard	time	- Contractor	- Supervision consultant .
	Executing the river flyover: Executing the bored piles ,	*Impacting on the surface water environment :* - Suspending solid substance pollution; increasing the impurity ; - Filling canal, spring, reservoirs	- *Preventing the flow of the soil contaminated with bentonite and solvent of bentonite:* + Not disposing the mud and bentonite to the river ; + Collecting soils contaminated with bentonite and bentonite flowed into the temporary storage yard with the barrier . + After being dry, recycling them as the embankment and treating them as to the solid waste .		During the construction time	- Project Owner - Contractor .	- Project Owner - Supervision consultant
	Executing the river flyover: Executing the bored piles ,	*Impacting on underground water:* - Pollution of chemicals, admixtures and dirty surface water	- using standard bentonite. - Arranging the support column embankment against the case properly .		During the construction period	- Project Owner - Contractor .	- Project Owner - Supervision consultant
	Executing the river flyover: Executing the upper bridge	Pollution of solid waste	- Not discharging the solid waste rising from the construction and domestic activities to the rivers. - Using the grating net with the geo-textile as the materials to prevent the lower part upon construction of the upper bridge.	345 million VND	During the construction period	- Project Owner - Contractor .	- Project Owner - Supervision

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase			- Arranging the garbage tanks at site, collecting, keeping temporarily and transporting the waste for treatment .				consultant
	Executing the bridge passing the river, canal	Pollution of noise	*Controlling noise upon construction of the bridge:* - Making priority of using the equipment with the standard allowable noise level . - Not operating equipment of the noise level over 75 dBA (pilling driving machine, grading machine) from 22:00 to 6:00 AM . - Turning off equipment under interrupted operation . - Noticing in public the construction activities, making the plan of receiving and settling the claims, queries .		During construction time	- Project Owner - Contractor .	- Project Owner - Supervision consultant
	Executing the bridge passing the river, canal	- Traffic obstacle ; - Changing the flow	- Constructing the temporary road, bridge for transportation . - Providing the instruction board of the by-pass, the potter at the bridge head ; - Providing the signals and alarms at the two ends of the bridge, at the bridge posts ; - Dismantling the temporary works, access, bridge on the river, restoring the river originally upon completing the bridge construction . - Stabilizing the current, river bank at the location		Construction before the bridge execution Dismantling after the bridge clearance	- Project Owner - Contractor .	- Project Owner - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase			of the bridge construction .				
	Site activities	*Impacting on the air :* - Reducing the environmental quality of the air polluted by the dust and discharge air . - Affecting the residents and the adjacent sensitive objectives	- *Controlling the dust dispersion at the construction site :* + The material storage yards can disperse dusts and the disposal temporary storage yards are placed at the area free from wind and covered by canvas or geo-textile. + Standard storage yard (*refer to the temporary storage yard below*). + No stone grinding at site + Supervising the dust content at site to some activities like dump truck, site ingress and outgress material trucks. When the dust content is higher than the allowed one , it is to carrying out the mitigation measures: (i) Spraying water to wet the material surface before placement; (ii) Watering to the road in site at least 2 times/day .	(estimated at the temporary storage yard)	During the construction time	- Project Owner - Contractor	- Project Owner - Supervision consultant .
	Site activities	Pollution of construction solid waste	*Preventing the pollution risk of the construction solid waste :* - Collecting the waste into the storage yard surrounded by the fence of the geo-textile, classifying the waste; transporting materials to take advantage of the leveling location, transporting the waste without taking advantage of the garbage yard in Dong Nai and Lam Dong provinces	Refer to the waste treatment	During construction time	- Project Owner - Contractor	- Project Owner - Supervision consultant .
Construction phase	Site activities: *Concrete batch plant*	*Impact on water environment:*	- the surface of the batching plant is constructed on on the sandy platform to filter the water, then take		During construction period	- Project Owner	- Project Owner

The phase of the project operation	**Project activities**	**Environmental impacts**	**Works, measures of environmental protection**	**Cost for carrying out the works, measures of environmental protection**	**Performance time and completion**	**Responsibility of performance unit**	**Supervision responsibility**
Construction phase		- Pollution of suspended waste, increasing the impurity.	waste water into the sediment tank and recycle; - The whole washing water of the aggregates is collected into the sediment tank. Water after being sediment will be recycled; sediment will be collected and treated to the construction waste.	192 million		- Contractor	- Supervision consultant.
	Temporary storage of materials, waste	- Filling agricultural soil and cultivated soils due to the soil disposal. - Pollution of suspended solid substance, increasing the impurity . - Filling the canal, ditch, springs and river and reservoirs - Dispersing dust, contaminating air environment	*Preventing the disposal at the material storage yards, wastes and treatment when disposal:* - Selecting the proper storage yards in the scope of the Site clearance and site; - Arranging the temporary storage yard 20m far from the current; - Area of storage yard < 25 m^2; not piling over 1,5 m; - Material, waste disposing storage yard is surrounded by the geo-textile fence 0.3m far from the yard surface . - Transporting materials, wastes out of the storage yard as soon as possible not delayed over 1 week; - After transporting materials, the disposal yard is cleaned, restored originally to carry out the next works; - Overflowing treatment: clearing the flowing materials and return originally the affected land area or trench ; - Committing to compensate to the residents upon	250 million VND	During construction period	- Project Owner - Contractor	- Project Owner - Supervision consultant.

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
Construction phase			any damage.				
	Replacing machine oils, maintaining equipment	Oil pollution	- *Preventing oil from penetrating down to the ground:* + The location for the fuel and waste oils, waste with oil on site have the shelter; the cement ground is near the barrier . - *Temporary collection and treatment :* + The waste oil and waste will be collected into the separate tank; temporarily stored at the specified location in site ; arranging 02 new back up tanks for use upon required . + Registering, transporting and treating them as per Circular No. 12/2011/TT-BTNMT dated 14/4/2011 specifying the management of the toxic waste	24 million VND	From the commencement until construction completion	- Project Owner - Contractor	- Project Owner - Supervision consultant.
	Operation of construction equipment	- Quality reduction of soil due to compaction	- Limiting the construction scope in the scope of the Site clearance by benchmark; - Cleaning the space; excavating depth of 0.5m at site; tampering violated soil out of the Site clearance scope to the cultivated depth .	48 million VNd	During construction period	- Project Owner - Contractor	- Project Owner - Supervision consultant.
	Concentrating manpower	- Domestic waste pollution - Pollution of organics and creatures	- Collecting waste into the temporary storage tanks; - using the proper wc ; - Contracting the transportation and waste treatment.	119 millionVND 400 million	During construction period	- Project Owner - Contractor	- Project Owner - Supervisi

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
				VND			on consultant.
	Executing road, bridge on the route	The ecological system is impacted due to the water pollution and deposit	*Reducing lightly the damage to the water flooding ecological system :* - Carrying out well the mitigation measure of the surface pollution as mentioned above .			- Project Owner - Contractor	- Project Owner - Supervision consultant.
	Executing road, bridge	- Causing the normal solid waste, - Causing normal waste water; - Causing toxic waste.	*Setting up, carrying out the procedure of managing the waste management :* - to the normal waste: collecting, keeping, transporting and treating as per Decree No 59/2007/NĐ-CP dated 09 April 2007 of government . - To the risky waste: Collecting, storage, transportation and treatment as per Circular No.. 12/2011/TT-BTNMT dated 14/4/2011 specifying the management of the toxic waste ..	650 millionVND	During constrtuction period	- Project Owner - Contractor	- Project Owner - Supervision consultant.
	Executing road, the river flyover	Fire and explosion	*Preventing and fighting the fire explosion:* - Keeping petrol in the own stores, away far from the heating source, locks provided, fire fighting tools provided . - Supplying means of fire figting as powder tanks, water hose, water tank, fire fighting sand at site. - Electric system at site is designed and installed in accordance with the standard of the electric branch;	300 million VND	During construction period	- Project Owner - Contractor	- Project Owner - Supervision consultant.

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
			- Installing anti-lightning system at site ; - Training usually the fire fighting course; doing practice of fire fighting at site				
	Executing road, river flyover	Labor accident	*Preventing, copying with the labor accident :* - Setting up the safety rules at site ; - Training, checking the knowledge of the labor safety for the workers . - Supplying PPE to workers; - Making plan of rescuing to the accident occurrence; - Sending the safety staff to check usually the safet status and the compliance of the safety rule .	1.686 million VND	During construction time	- Project Owner - Contractor	- Project Owner - Supervision consultant .
	Executing road, flyover	Labor accident	*Protecting, coping with the traffic accident :* - Applying fully the measures of the traffic safety as mentioned in the item above; - Making rescuing plant upon any incident occurrence		During construction period	- Project Owner - Contractor	- Project Owner - Supervision consultant.
Operation phase	Transportation vehicle on the road	Dust, toxic air dispersion	*Controlling dust, discharged air of the vehicles :* - Maintaining the road surface periodically ; - Not allowing the outdated vehicles to use ; - Encouraging to use the new brand vehicle with the efficient of the discharged air exhausting as per the European standard and developed countries; - Checking, controlling the discharged air of the vehicles transporting according to the current standard .			- Exploiting unit - Local government - Traffic police.	- - Exploiting unit - Local government - Traffic police..

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
	Vehicle transports on the road .	Noise pollution	*Controlling noise of the vehicle current:* - Not allowing the outdated vehicle to use ; - Encouraging to use the new brand vehicle of the exhausted air as per the European standard and developed countries ;			- Local government - Traffic police.	Local government - Traffic police..
	Appearance of bridges, bridge posts in the current	- Collapse of the river bank at the bridge - Collapse of the road bas at the bridge end	- Checking the settlement, bridge collapse and bridge road periodically. - Punctually consolidating, restoring the corrosive points, collapse right when it is damaged at the light level. - Upon the strict collapse, defining the cause, applying the proper methods as follows: + Planting grass to consolidate the surface and dewatering; + Constructing the retaining wall, water drainage and consolidating the surface. + Building the wall and arranging the rippon cages consolidating the surface.		Warranty period After warranty	- Project Owner - Contractor	- Project Owner - Supervision consultant.
	Appearance of excavated, filled bases	Collapse, fall of negative and positive talus	- Checking the settlement, collapse of the talus - Consolidating temporarily the points of the collapse by : + Clearing the soil of collapse to ensure traffic; + Arranging temporarily the 3 – 4 rows of stone cages not over 2 - 4m; + Consolidating surface by grass or planting trees . - Next, treating strongly it by :		Warranty After warranty	- Project Owner - Contractor -	- Project Owner. - Supervision consultant

The phase of the project operation	Project activities	Environmental impacts	Works, measures of environmental protection	Cost for carrying out the works, measures of environmental protection	Performance time and completion	Responsibility of performance unit	Supervision responsibility
			+ Using the structure of the anchoring frame, ,wall; RC wall with pile foundation and cutting, reducing load, consolidating surface and dewatering. + Building up the retaining wall and consolidating the surface and dewatering .			Exploitation unit	

5.1.3 WORKING RELATIONSHIP OF RELATED PARTIES:

The environmental management program is one of the important factors to ensure the mitigation measures indicated at the chapter 4 enforced fully, punctually adjusted to the improper issues to minimize the bad impacts during the process of preparation, implementation and the operation of the project .

To combine the consultant and Project Owner, Project Management unit will set up an environment department (or sending a staff in charge of environment) to observe and supervise the implementation of the project environmental protection.

5.1.3.1 The related parties' roles and responsibilities:

a) The preparation and construction phase:

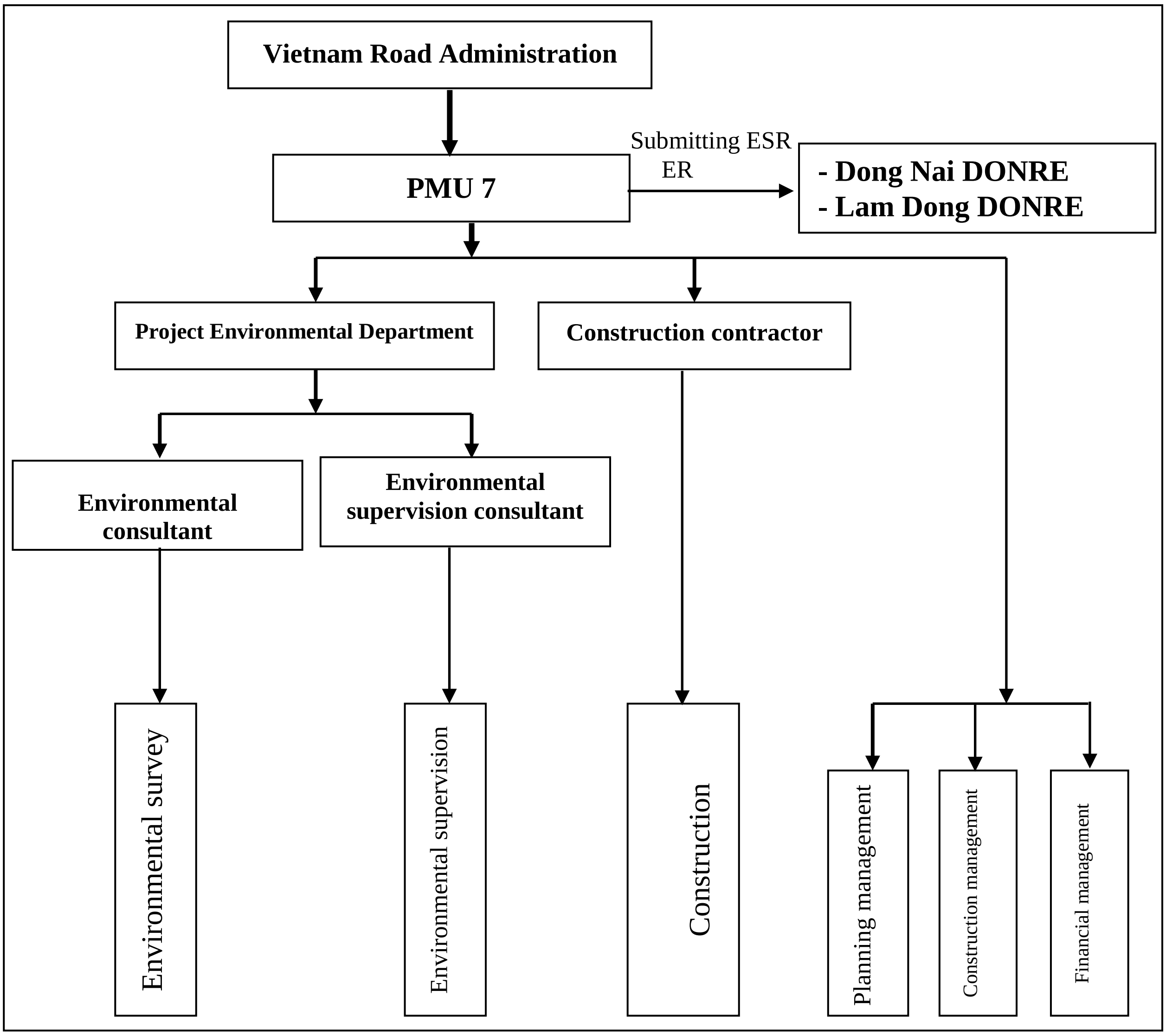
The related parties' roles and responsibilities in the environmental management in the preparation and construction phase are shown in the table 5.2 and the chart 5.1.

Table 5.2. The related parties' roles and responsibilities in the preparation and construction phase

Unit	Responsibility for environment
Project Owner (Vietnam Road Administration)	- Issuing the letters of assigning the duties to the units under its management. - Receiving and treating the issues related to the project environment (report on the environmental supervision, environmental survey, claims on environment etc) sent by PMU 7.
PMU7	- Signing the contracts with the contractors and consultants ; - Organizing, nominating the department in charge of environment of the project ; - Expecting and submitting the competent levels of the cost for the activities related to the project environmental protection ; - Receiving, treating the environmental supervision report of the consultant, periodically reporting to the Project Owner, Department of Natural resources and Environment of Lam Dong and Dong Nai .
Project environmental department	- Observing directly the performance of the environmental works, mitigation measures of the environmental impact as assigned to the construction units; - Observing the surveying activities and environmental supervision of the consultants; - Considering, analyzing the environmental supervision reports ; - Reporting PMU 7 on the duty performance of the construction units, consultants and recommend to the countermeasures if any .
Construction units	- Carrying out fully the measure of the environmental protection as indicated in the duty assignment of the Project Owner and EIA report as approved; - Bearing the supervision of the supervision consultant; - Carrying out the additional measures as per the requirement of the project .
Environmental supervision consultant	- Supervising the mitigation measures of the environmental impacts of the construction units; - Noticing the construction units of the potential environmental issues obstructing the project performance; - Making periodical report to PMU 7 and environmental department of the project.

Environmental consultant	- Surveying the environmental survey as per the content and frequency as approved ; - Reporting on the surveying results to the environmental department and PMU 7; - Carrying out the additional setting out when required .

Figure 5.1. Chart of construction and environmental management organization (preparation and construction phase)



b) Operational phase:

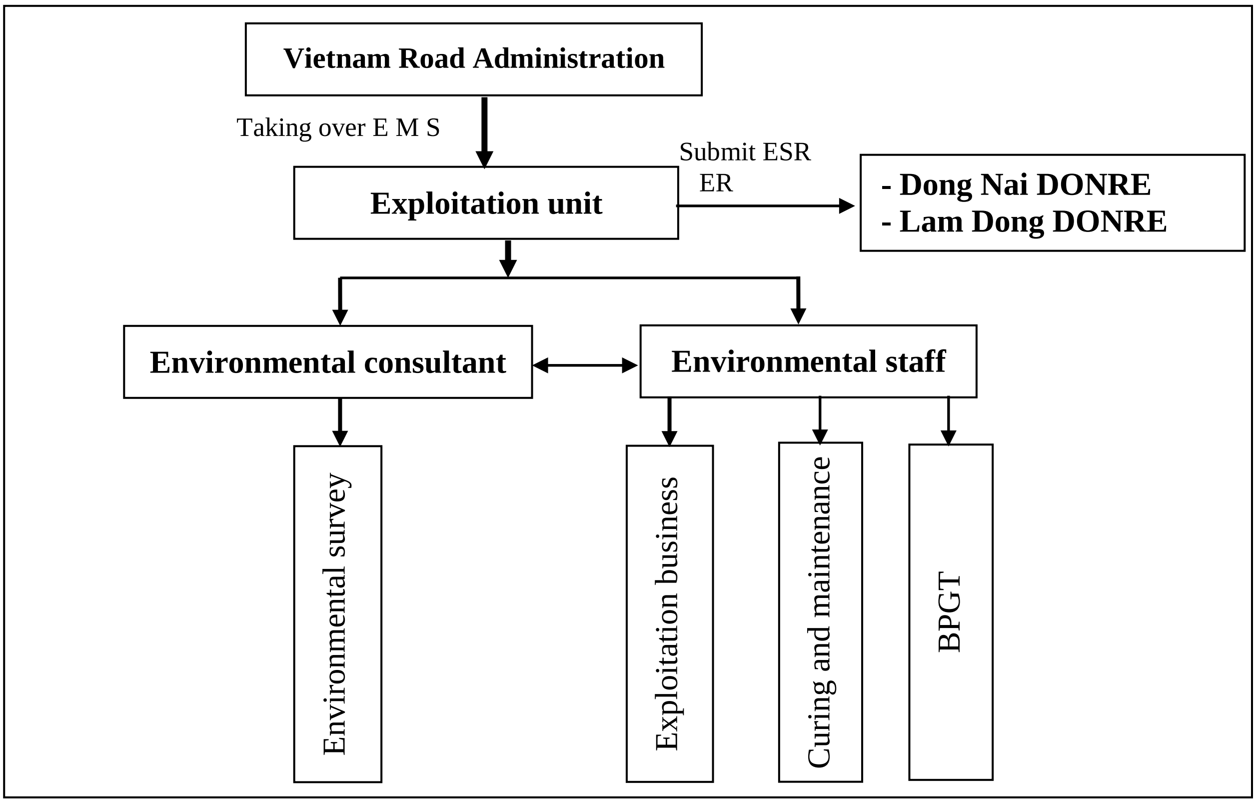
The related parties' roles and responsibilities in the environmental management in the operational phase are shown in the table 5.3 and chart of the figure 5.2.

Table 5.3. The related parties' responsibilities in the operational phase

Unit	Responsibility for environment
Project Owner (Vietnam Road Administration)	- Assigning the duties and transferring the whole results of managing and supervising the environment in the phase of the preparation and construction of the project to the exploitation unit; - Informing the environmental management unit of Lam Dong and Dong Nai provinces of taking over the works and documents related to the environment to the exploitation

	unit.
Project exploitation unit	- Receiving the documents related to the environmental protection in the preparation and construction phase of the project; - Signing the contracts related to the environmental consultants - Sending the staff in charge of the environment in the operational phase of the project ; - Expecting and supplying fully the cost for the activities related to the environmental protection in the project operational phase; - Receiving the environmental surveying reports of the consultant, periodically reporting to Department of Natural Resources and Environment of Dong Nai and Lam Dong .
Environmental staff	- Receiving, treating the environmental surveying reports of the consultant; - reporting the exploitation unit of carrying out the environmental surveying duties of the consultant and recommending the remedial measures if any.
Environmental consultant	- Setting out the environment as per the contents and frequency as approved ; - Reporting the surveying results to the environmental staffs ; - Carrying out the additional survey when required .

Figure 5.2. Sơ đồ tổ chức quản lý môi trường trong giai đoạn vận hành



- Project Owner: Taking over the whole results of managing, surveying the environment, environmental status after construction to the exploitation unit.
- Exploitation unit
  + Receiving the whole results of supervising and surveying the environment in the phase of the preparation and construction of the project as a basis for managing and supervising the environment during the operation stage (in the warranty period);
  + Supervising and surveying the environment in the period of warranty; reporting the surveying results to DONRE of Lam Dong and Dong Nai;

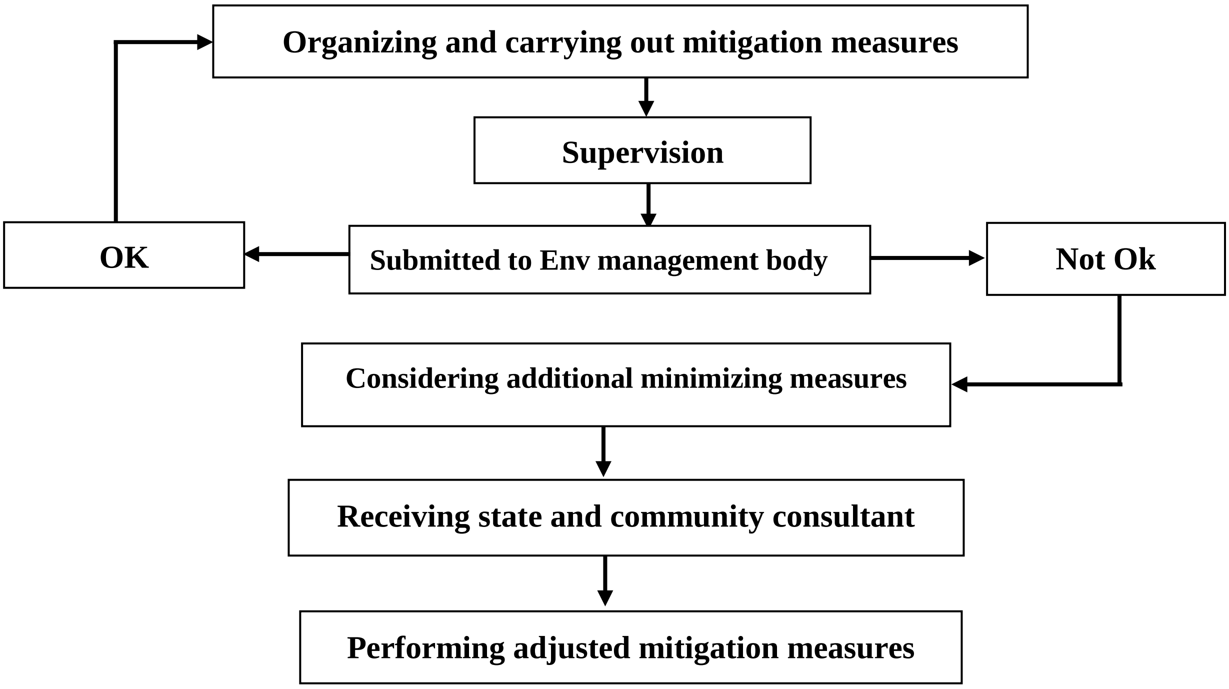
+ Carrying out the additional mitigation measures as per the actual requirement.

- The environmental staffs of the exploitation unit:
  + Observing and supervising the activities of environmental protection in the warranty period;
  + Receiving, treating the environmental surveying results from the consultant, sending the environmental surveying report to the exploitation unit.
- Environmental consultant :
  + Surveying the environmental quality as per the content as approved and bearing the responsibility for the measuring results;
  + Sending the report of the surveying results , assessing the environmental quality as per the current standards of Vietnam to the exploitation unit.

5.1.3.2 The procedure of the environmental management performance

The procedure of the environmental management in the stages is presented at the chart 5.3.

Figure 5.3. Chart of the project environmental management procedure :



5.1.3.3 Items of the environmental management

- In the preparation and construction phases, it includes the following items:
  + Managing the preparation works for the project stages ;
  + Making the safety plan in the construction works ;
  + Managing materials, construction materials and stores;
  + Planning and construction schedule for the project items ;
  + Waste management ;

+ Managing the performance of the mitigation measures ;
+ Managing the preventive plan and copying with the environmental incidents;

- The project operation phase:
  + Managing the road surface sanitation ;
  + Managing the maintenance, curing of the road surface and water drainage .

5.2 ENVIRONMENT CONTROL PROGRAM:

The environmental supervision and surveying program of the project includes the field supervision in complying with the contract terms and supervising the environmental data (the environmental survey). Supervising the compliance of the contract terms to ensure the requirements of the environment to the project and the mitigation measures as proposed in EIA report carried out fully. Supervising the environmental data to define the pollution caused by the project activities based on the standards, codes of practices of Vietnam; to evaluate the proper and efficient level of the mitigation measures as proposed and punctually adjusted; proposing the additional minimizing measures.

a) Supervising the preparation:

Supervising the selection of the construction location of the workers' camp, the points of arranging the asphalt plants. These places should be isolated from the sensitive places like the pagoda, temples, churches, schools, resorts, hospitals etc . The minimum distance from the camp construction points or the batching plant to the said sensitive places is over 200m. Considering the domestic water supply to the workers and the capacity of the water treatment; the fire fighting and prevention at the asphalt batching plant .

b) Supervising Site clearance and re-settlement:

- Supervising the Site clearance scope as per the approved master plan .

- Supervising the performance of the compensation policy and re-settlement ; evaluating the plausible level of the affected objectives; proposing the adjustment solutions if necessary .

- Violation: the affected objectives like the land, house, graves, plants, relocated households etc .

- Supervision index: The location of the Site clearance points, the actual leveling area, the compensation level for the affected objectives, the status of the affected resident life before and after re-settlement, the feedbacks from the residents; etc the information collected based on the survey, actual observation and in the form of the investigation.

- The supervision unit: An independent unit with the re-settlement policy performance unit selected by Lam Dong and Dong Nai People's committees .

c) Supervising the solid wastes:

- Supervision scope: The workers' camp, the temporary material delivery place, the construction site .

- The supervision index: The workers' domestic waste, the construction wastes (materials bags, waste stones, waste asphalt or concrete) .

- Supervision time: In the construction period and after construction.

- The unit bearing the responsibility of the supervision performance: A associated group between the person of the local urban works and PMU

d) Supervising the quality of the air, noise :

- Equipment and surveying methods: Using surveying equipment an methods specified by the standard of the Vietnam National environmental surveying system

- Standards for reference:

+ QCVN 05:2009/BTNMT. Air quality- Standard of surround air quality;

+ QCVN 06:2009/BTNMT – national Code of practices of some toxic substances in the surrounding air;

+ QCVN 26:2010/BTNMT – National code of practice of noise ;

+ QCVN 27:2010/BTNMT – National technical code of practice of the vibration.

- Surveying criteria :

+ Suspended dust content ;

+ (SO_2);

+ (NO_2);

+ (CO);

+ Noise; L_{eq}, L_{10}, L_{90}

- Surveying frequency:

+ In the construction phase: 3 times in the dry season, 01 time in the raining season (04 surveying times in a year; starting from the commencement).

+ Total: 12 times/ 36 months of construction .

- Surveying points: Surveyed at 25 points as indicated at the table 5.4 (Figure 5.4)

Table 5.4. Surveying location of the quality of the noise and air in the construction stage.

Code	Location	Station	Coordinates
A1	Dau Giay crossroad (intersecting with national road 1A)	Km00	X = 733898; Y = 1210467
A2	Gia Kiem residential area	Km9	X = 737746; Y = 1218366
A3	Residential area of Phu Cuong, Dinh Quan (Phu Cuong market)	Km19	X = 738442; Y = 1226648

Code	Location	Station	Coordinates
A4	Phu Cuong town center	Km21+500	X = 740931; Y = 1226750
A5	Residential area of La Nga	Km 34+600	X = 747097; Y = 1240093
A6	Dinh Quan town	Km48+150	X = 758436; Y = 1240456
A7	Tan Phu town	Km58	X = 765741; Y = 1246955
A8	Residential area of Phuong Lam (near Phuong Lam market, and Phuong lam church)	Km65+500	X = 772248; Y = 1249196
A9	Residential area of Madagui (Da Huoai, Lam Dong)	Km76	X = 775943; Y = 1258487
A10	Town of Damri, Lam Dong	Km94	X = 790342; Y = 1262796
A11	Residential area of Loc Chau (near Hai Ba Trung primary school, Loc Chau market)	Km117	X = 804277; Y = 1276849
A12	Residential area of Loc Son (near Loc Son primary school, Hoa Lu kindergarten)	Km123	X = 807861; Y = 1276626
A13	Residential area of Loc An (Near Loc An B primary school, Loc An high school)	Km131+600	X = 816979; Y = 1278256
A14	Residential area of Hoa Ninh (near Le Hong Phong high school, Hoa Ninh market)	Km137+400	X = 820972; Y = 1277254
A15	Residential area of Di Linh (near Vo Thi Sau primary school)	Km 154	X = 835274; Y = 1281450
A16	Tan Nghia town (near Tan Nghia II primary school, Phuoc Lac pagoda)	Km160+400	X = 838550; Y = 1285124
A17	Residential area of Phu Hiep (near Phu Hiep high school, Gia Hiep secondary school)	Km170+500	X = 846967; Y = 1287333
A18	Residential area of Hiep Thuan (near Hiep Thuan primary school)	Km184	X = 858989; Y = 1287529
A19	Hamlet 10, Lien Nghia town	Km199	X = 866619; Y = 1297686
A20	Residential area of Hiep Thạnh (near Hiep An enterprise, fruit processing plant)	Km211	X = 873930; Y = 1306180
A21	Residential area of Dinh An (Dinh An primary school)	Km218	X = 876810; Y = 1312324
A22	Residential area of Ward 9, Da Lat (Tran Phu high school)	Km235	X = 877449; Y = 1322971
A23	Residential area of Da Lpc, Xuan Tho (Xuan Tho high school)	Km245	X = 884835; Y = 1321518
A24	Residential area of Cau Dat, Xuan Truong (Xuan Truong primary school)	Km254	X = 887021; Y = 1315705
A25	Residential area of Don Duong (intersecting with national road 27)	Km268	X = 892143; Y = 1311747

e) Supervising the water quality:

- Only surveying the quality of the surface water. When finding the surface water polluted, it is to take the underground water samples in the area for further analysis.

- Equipment and surveying method: Applying the standards of the water sample taking, protecting and analysis as specified by the Vietnam national environmental surveying system. The necessary analyzing equipment like AAS, ion and other chemical analyzing technologies as per the standard of Vietnam will be applied.

- Standards for reference:
  + QCVN 08:2008/BTNMT – National technical code of practices of the quality of the surface water ;
  + QCVN 14:2008/BTNMT – National technical code of practice of the domestic waste water .

- Surveying criteria :
  + pH, Impurity ;
  + Suspended solid substances;
  + BOD_5, COD, DO;
  + Oil;
  + NO_2^-, NO_3^-, PO_4^{3-};
  + Toxic, heavy metal (As, Cu, Cd, Fe, Hg, Pb, Zn);
  + Coliform.

- Surveying frequency :
  + Surveying 04 months/ time in the construction period .
  + Total: 09 batches/ 36 construction months .

- Surveying locations:

Taking samples to analyze the quality of the surface water which is 100m far from the bridge toward the down-streams of the rivers as indicated in the table 5.5 (Figure 5.4):

Table 5.5. The surveying location of the surface water quality in the construction phase:

Code	Name of bridge	Station	Sampling frequency
W1	Gia Duc	Km1+540	1 time in day /2 water layers /01 section
W2	La Nga	Km35+712	1 time in day /2 water layers/2 section
W3	Phuong Lam bridge	Km65+056	1 time in day/2 water layers

Code	Name of bridge	Station	Sampling frequency
			/01 section
W4	Da Huoai river	Km87+350	1 time in day /2 water layers/01 section
W5	Suoi Tien	Km96+200	1 time in day /2 water layers/01 section
W6	Dai Nga bridge	Km129+500	1 time in day /2 water layers/01 section
W7	Dinh Trang Hoa bridge	Km139+300	1 time in day /2 water layers/01 section
W8	Lien Dam bridge	Km149+303	1 time in day /2 water layers/01 section
W9	Darle bridge	Km177+800	1 time in day /2 water layers/01 section
W10	Hiep Thuan bridge	Km183+376	1 time in day /2 water layers/01 section
W11	Dai Ninh bridge	Km189+200	1 time in day /2 water layers/01 section
W12	Xom Trung bridge	Km194+771	1 l time in day /2 water layers/01 section
W13	Dinh An I bridge	Km217+810	1 time in day /2 water layers /01 section
W14	Dat bridge	Km254+254	1 time in day /2 water layers/01 section
W15	Xeo bridge	Km263+100	1 time in day /2 water layers /01 section

e) Supervision the soil quality :

- Surveying equipment and method: Using surveying equipment and method as per the standard of the Vietnam national surveying system. The necessary analyzing equipment like AAS, ion and other chemical analyzing technologies as per the Vietname standards will be applied.

- Standards for reference:

+ QCVN 03:2008/BTNMT - National code of practices of the allowable limit of the heavy metal in soil ;

+ QCVN 07:2009/BTNMT – National code of practice of the sill of the toxic waste.

+ TCVN 6696:2000 Solid waste, cleaned disposal yard, common requirement of the environmental protection .

- Surveying criteria : pH, total organics, sourness , total N (T-N), total P (T-P), Cl^-, SO_4^{2-}, toxic metals (As, Cu, Cd, Hg, Pb, Zn).

- Surveying frequencies:

+ Taking sample to analyze 01 time into 06 months at the end of the project.

- Surveying points: Survey at 25 town and 7 disposal locations as indicated in the t table 5.6 (figure 5.4)

Table 5.6. The sampling location for supervising the soil quality in the construction phase .

Code	Sampling location	Station	Coordinates
Sol-1	Bau Ham 2 town	Km2+400	X = 733978; Y = 1212878
Sol-2	Quang Trung town	Km6+200	X = 735385; Y = 1216065
Sol-3	Phu Cuong town	Km14+300	X = 740931; Y = 1226750
Sol-4	Tuc Trung town	Km26+500	X = 743264; Y = 1230041
Sol-5	La Nga town	Km35+100	X = 744215; Y = 1233467
Sol-6	Phu Ngoc town	Km38+300	X = 750350; Y = 1235162
Sol-7	Dinh Quan town	Km45+400	X = 758436; Y = 1240456
Sol-8	Phu Vinh town	Km49+400	X = 758988; Y = 1241152
Sol-9	Phu Loi town	Km53+150	X = 761396; Y = 1243769
Sol-10	Tan Phu town	Km58+200	X = 765741; Y = 1246955
Sol-11	Phu Thanh town	Km61+800	X = 768299; Y = 1247502
Sol-12	Madagui town	Km77+500	X = 776618; Y = 1259760
Sol-13	DaM’ri town	Km94+300	X = 790342; Y = 1262796
Sol-14	Dai Lao town	Km109+200	X = 799411; Y = 1271487
Sol-15	Loc Son town	Km117+300	X = 807861; Y = 1276626
Sol-16	Loc An town	Km131+400	X = 816979; Y = 1278256
Sol-17	Lien Dam town	Km145+500	X = 827728; Y = 1281165
Sol-18	Gia Hiep town	Km170+100	X = 846967; Y = 1287333
Sol-19	Ninh Gia town	Km189+200	X = 861288; Y = 1290238
Sol-20	Phu Hoi town	KM193	X = 863007; Y = 1293582
Sol-21	Hiep Thạnh town	KM208	X = 871688; Y = 1304712
Sol-22	Hiep An town	Km215	X = 876276; Y = 1309734
Sol-23	Ward 11, Da Lat	Km238+500	X = 880031; Y = 1322761
Sol-24	Xuan Tho town	Km245	X = 884835; Y = 1321518
Sol-25	Xuan Truong town	Km254	X = 887021; Y = 1315705
Sol-26	Disposal yard 1	Km178+800	X = 851573; Y = 1286537
Sol-27	Disposal yard 2	Km186+500	X = 860297; Y = 1287906
Sol-28	Disposal yard 3	Km223+870	X = 878287; Y = 1315632
Sol-29	Disposal yard 4	Km247+100	X = 884840; Y = 1259196
Sol-30	Disposal yard 5	Km247+400	X = 884072; Y = 1319812

Code	Sampling location	Station	Coordinates
Sol-31	Disposal yard 6	Km251+900	X = 886079; Y = 1317054
Sol-32	Disposal yard 7	Km263+400	X = 890600; Y = 1312192

5.3 COST ESTIMATE OF ENVIRONMENT CONTTROL:

5.3.2 Cost Estimate of environment control:

Table 5.7. Cost Estimate of environment control:

No	Description	Unit	Quantity	Unit price (VND)	Amount (VND)	
					Manpower	Total
A	**Survey works**					
I	**Surveying the environmental quality of air**					
1	Sampling are at 25 points in 16 hours, 12 batches (2 persons x 25 day x 12 batches): 25*(1+1,5*0,5)*2*12	Trip	1050	123.405	129.575.250	129.575.250
2	Stay (2 persons-25 days-12 batches)	day	600	120.000		72.000.000
3	Allowance (2 persons-25 days -12)	Day	600	70.000	42.000.000	42.000.000
4	Renting means of passage, equipment for sampling	Shift	300	600.000		180.000.000
5	Analyzing air quality (25 points x 6 measuring samples /1 points x 12 batches)		1800	-	-	-
	CO	sample	1800	80.000		144.000.000
	NO_2	Sample	1800	80.000		144.000.000
	SO_2	Sample	1800	80.000		144.000.000
	Suspended dust	sample	1800	80.000		144.000.000
	Total I				**171.575.250**	**999.575.250**
II	**Surveying noise, vibration**					
2	Stay (2 persons -25 days -12 batches)	Day	600	120.000		72.000.000
3	Allowances (2 persons-25 days -12)	Day	600	70.000	42.000.000	42.000.000
4	Measuring noise in 12 hours (from 6:00 to 18:00), 1 h /time /1 point : (25 points x 12 hours x 12 batches)	Sample	3600			
	L_{eq}	Sample	3600	30.000		108.000.000
	L_{10}	Sample	3600	30.000		108.000.000
	L_{90}	Sample	3600	30.000		108.000.000
	Total II				**42.000.000**	**438.000.000**
III	**Surveying the quality of the surface water**					
1	Sampling surface water at 15 bridges: 2 persons x 6 days x 9 batches	Trip	108	123.405	13.327.740	13.327.740

2	Stay (2 persons -6 days -9 batches)	Day	108	120.000		12.960.000
3	Allowances (2 persons -6 days x 9)	Day	108	70.000	7.560.000	7.560.000
4	Renting means for taking and transporting samples	Ca	54	600.000		32.400.000
5	Sample analysis (1 point/bridge x 2 layers x 15 bridges x 9 batches)	Sample	270			
	pH	Sample	270	30.000		8.100.000
	Impurity	Sample	270	50.000		13.500.000
	DO	Sample	270	60.000		16.200.000
	COD	Sample	270	70.000		18.900.000
	BOD_5	Sample	270	80.000		21.600.000
	SS	Sample	270	50.000		13.500.000
	NO_2^-	Sample	270	50.000		13.500.000
	NO_3^-	Sample	270	50.000		13.500.000
	PO_4^{3-}	Sample	270	60.000		16.200.000
	Fe	Sample	270	60.000		16.200.000
	Cu	Sample	270	60.000		16.200.000
	Zn	Sample	270	60.000		16.200.000
	Cd	Sample	270	60.000		16.200.000
	Pb	Sample	270	60.000		16.200.000
	As	Sample	270	80.000		21.600.000
	Hg	Sample	270	80.000		21.600.000
	Oil	Sample	270	300.000		81.000.000
	Total Coliform	v	270	60.000		16.200.000
	Total III				**20.887.740**	**422.647.740**
IV	**Surveying the quality of earth, sediment**					
1	Sampling soil and sediment: 2 persons x 6 days)	Manpower	12	123.405	1.480.860	1.480.860
2	Stay (2 persons x 7 days)	Day	14	120.000		1.680.000
3	Allowance (2 persons x 8 days)	Day	16	70.000	1.120.000	1.120.000
4	Renting sampling means	Day	6	150.000		900.000
5	Soil sample analyzing (1 sample /point x 32 points)					
	pH	Sample	32	40.000		1.280.000
	Total organics	Sample	32	50.000		1.600.000
	T-N	Sample	32	80.000		2.560.000
	T-P	Sample	32	80.000		2.560.000
	Sourness	Sample	32	50.000		1.600.000
	Cl^-	Sample	32	50.000		1.600.000
	SO_4^{2-}	Sample	32	50.000		1.600.000
	Cu	Sample	32	80.000		2.560.000

	Zn	Sample	32	80.000		2.560.000
	Cd	Sample	32	80.000		2.560.000
	Pb	Sample	32	80.000		2.560.000
	Hg	Sample	32	80.000		2.560.000
	As	Sample	32	80.000		2.560.000
	Total IV				**2.600.860**	**33.340.860**
	Total I - IV				**237.063.850**	**1.893.563.850**
X	**Common cost for survey (70% for manpower cost)**	%	70%	237.063.850		165.944.695
	Total A:					**2.059.508.545**
B	**Making professional subject report and general report**					
1	Preparing the status report on the natural environmental component (air, noise, water surface) of the project area	Subject	1	5.000.000		5.000.000
2	Evaluating and predicting the impacts on the natural environment	Subject	1	5.000.000		5.000.000
24	Preparing general report		1	8.000.000		8.000.000
	Total B:					**18.000.000**
C	**Other costs**					
1	Stationery, telephone, fax etc					2.000.000
2	Printing various maps, documents, photo, reports					3.000.000
	Total C					**5.000.000**
	Total A+B+C					**2.082.508.545**
	Prepaid taxable income		6%	2.082.508.545		124.950.513
	VAT		10%	2.207.459.058		220.745.906
	Total value					**2.428.204.963**
	Rounded					**2.428.205.000**

5.3.3 Estimate of the environmental treatment works :

Table 5.8 Cost of the environmental treatment works :

No	Environmental treatment works	Performance time	Performance cost (VNĐ)
1	**Solid waste treatment works**		**519.000.000**
1.1	Septic toilets : 32 pcs	Before executing the project. Finish when finalizing the	400.000.000
1.2	Covered steel waste basket V = 0,67 m^3: 32 pcs		96.000.000

No	Environmental treatment works	Performance time	Performance cost (VNĐ)
1.3	Covered plastic waste basket V = 60 littres: 115 pcs	construction phase	23.000.000
2	**Liquid waste treatment works**		**536.000.000**
2.1	Anti-sediment 03 partition tank system to collect and treat the domestic waste water: 16 pcs	During the construction period.	192.000.000
2.1	16 tanks for collecting and treating waste water of concrete mixing		192.000.000
2.3	16 tanks for collecting and treating waste water of plants, mechanical machines		128.000.000
2.4	Supplying 48 tanks of 0,2 m^3 storing toxic wastes		24.000.000
3	**Dust treatment works**		**89.000.000**
3.1	03 water spraying trucks for the road (7 months of the dry season /year x 3 years)	Starting the project commencement . Finish after construction .	75.000.000
3.2	Standard water tapes : 30 pcs		14.000.000
4	**Soil collapse, corrosion minimizing works**		**18.724.235.084**
4.1	Mud protection fence by geo-textile: 20.000 m^2		720.000.000
4.2	Planting grass for the talus: 357.879 m^2		7.678.036.000
4.3	Talus roof		7.722.343.158
4.4	Retaining wall		2.603.855.926
5	**Anti-inundation works**		**77.456.476.970**
5.1	Horizontal drainages	Starting the project commencement . Finish after construction.	42.229.278.770
5.2	Vertical drainages, ditches		35.227.198.200
6	**Noise reducing works**		**56.000.000**
6.1	Noise reducing barrier by zinc metal sheet (applied for the generators near the residential area): 12 pcs	Starting the project commencement . Finish after construction	56.000.000
7	**Miscellaneous**		**1.986.000.000**
7.1	Supplying PPE for 1,120 persons , 3 years	During construction period	1.686.000.000

No	Environmental treatment works	Performance time	Performance cost (VNĐ)
7.2	Fire protection and fighting equipment		300.000.000
	Total		**99.366.712.054**

CHAPTER 6
CONSULTING OF PUBLIC OPINION

As specified at the sub-clause 8, Article 20 of Environmental protection law passed by the national assembly of the socialist republic of Vietnam on 29 November 2005 and coming into effect since 01 July 2006 and according to the requirement of Circular No. 26/2011/TT- BTNMT of Minister of Natural resources and environment issued on 18 July 2011 specifying some articles of Governmental Decree No. 29/2011/NĐ-CP dated 18 April 2011 of stipulating the strategic environmental assessment, the environment impact assessment, commitment of the environmental protection, employer sent the letter of the comment contribution to People's Committee of the town level where the project is carried out. It mentions the basic contents of the project, the bad impacts on the environment, the mitigation measures of the bad impacts expected to be applied and request these bodies to comment in writing .

The following is the summary of the comments from 21 towns, wards, communes of Dong Nai province and 27 towns, wards, communes of Lam Dong province of the project (details of the letter are indicated in the appendix 8).

6.1 SUMMARY OF OPINION GIVEN BY PEOPLE'S COMMITTEES OF 48 COMMUNES, WARDS:

a) Comments on the negative impact of the project to socio-economic, natural environment:

Basically, all agree the content of the bad impacts of the project as presented in the executive summary; some further comments overlap the assessments in the report .

b) Comments of the mitigation measures of the bad impacts of the project to socio-economic, natural environment :

All basically agree with the content of the mitigation measures as indicated in the executive summary. The further comments, recommendations are summarized below:

c) Recommendation with the project employer:

- Requesting the project employer to comply with the commitment as indicated in the EIA of the mitigation measures of the bad impacts, ensuring the construction according to the schedule and time.
- Requesting the project employer to treat well the points connected into the traffic urban routes , access to the school, medical stations, organizations to facilitate the transportation and minimize the accident .
- Requesting the employer to coordinate with the local government to settle well the environmental issues.
- Before starting the works, it is to make information to the residents .

- Upon using the temporary land for the project commencement, it is to make prior agreement .
- Agreeing with the local government of using the inter-rural roads, inter-town roads to transport the materials, not using the truck over 10 tons to transport the materials .
- Requesting the project employer to have the policy to recruit the local workforce together with the town government to settle the working manpower for the project .
- The workers coming and working at the local area have to be registered for temporary residence.
- The Site clearance has to be fair; the compensation and re-settlement has to comply with the withdrawn land .
- When the vehicles runs causing the environmental pollution, the contractor has to carry out the countermeasure immediately .
- The employer has to ensure absolutely the working safety issues and traffic safety on the construction route ..
- Requesting the project employer to comply closely with the law on the environmental protection, ensuring the health and life for the working residents .

6.2 SUMMARY OF OPINION GIVEN BY LOCAL PEOPLE LIVING IN PROJECT AREA

6.2.1 OPINION OF LOCAL OFFICERS:

There are total 96 investigation sheets to be issued for consultancy of the officer's comment as indicated in the table 6.1.

Table 6.1. Summary of ward, town cadre's comments:

No	Interviewing title	Agreement	Ratio %
1	**Cultural historical relics:**		
	- Having the cultural historical relics near the route	0	0
	- Not having the cultural historical relics near the route	96	100
2	**The project impact on the customs and practices**		
	- Negative impacts to the customs and practices	0	0
	- Positive impacts on the customs and practices	5	5,2
	- Not affecting the customs and practices	91	94,8
3	**The Site clearance for the project**		
	- Encountering the bib obstacles.	0	0
	- Getting insignificant obstacles	65	67,7
	- Encountering no obstacles	31	32,3

	- compensating other land plot for the missed land plot	30	31,2
	- Constructing the re-settlement area	0	0
	- Compensating amounts as specified by the Government	66	68,8
4	**The project impact on the job and work**		
	- Increasing the unemployment ratio	0	0
	- Creating the job opportunities for the local workforce	25	26,0
	- Increasing further the labor use	45	46,9
	- No affection	26	27,1
5	**The project affection to the community health care activity**		
	- Having good impacts	0	0
	-Having bad impacts	23	24,0
	-No impact	73	76,0
6	**Environmental pollution by the local project**		
	- Waste garbage	64	66,7
	- Waste water	34	35,4
	- Content of dust	96	100
	- Noise	89	92,7
	- Uneasy smell	19	19,8
7	**Interviewee's stand**		
	- Supporting the project	96	100
	- Objection	0	0
	- No comment	0	0
8	**Local requirements to the project**		
	- Arranging the unskilled workers upon constructing the project	39	40,1
	- Training the occupation for those who are much affected by the project ..	11	35,5
	- Disseminating the local residents to improve the awareness of the self-protection and the family protection before the bad impacts of the project	29	93,5

6.2.2 OPINION OF HOUSEHOLDS:

- Households consulted: 240
- The consulting information is indicated below:

1. What information related to the project does the household know?

- 21 households know the scope of the Site clearance and the confiscated land for the project.

- 144 households know the information of the project, the setting - out scope for the Site clearance, but not detailed to the compensation of the Site clearance, no official letters or conference disseminated to this matter .

- The rest only gets the general information .

2. Which detailed information is provided for the family with regards to the direct impact of the project to the family ?

- 61 households interviewed know the direct affection to them .

- 85 household know about the project and the project does not affect so much their families

- The remaining households has not concretely know of the direct affection of the project to their families.

3. Is the family disseminated with regards to the policy of the damage compensation passed by the works ?; What is the comments of that policy ?; according to the family, which environmental issues caused by the project are the most popular ?

- 85% households have not disseminated about the compensation policy passed by the works .

- 100% households requests the compensation in cash if affected upon the Site clearance, the plausible and fair price among everybody .

- The most concerned issues are the dust in the dry season, traffic jam and swamp in the raining season .

4. The family has the mitigation measures, the countermeasures of the environmental affection caused by the project . Have you got any creation or request on this issue?

- The households request the project employer to carry out the methods of checking, supervising the contractor to carry out well the law on the environmental law. During the construction process, it is usually to arrange the supervisor for the punctual reflection from the residents related to the environmental issues ..

5. What profit does the family find from the project to the local area and the family itself?

- Most of the residents to be consulted think that the project will not facilitate the family, the local area, but also the eco-social growth and national defense security .

6. The family supports or does not support the project, why ?

- 100% families to be consulted totally support the project because this is the national project in which its profit brings is very large not only to the family, the local area but the whole society as well .

6.3 OPINION OF PROJECT OWNER:

Based on the comments contributed from the people's committees of towns, wards of the project, our employer would like to comment as follows: :

1.1.The employer receives all contributed comments from the people's committees of 48 towns, wards passed by the route ;

1.2.The employer will strictly observe the methods of the environmental protection as indicated in the report ;

1.3.The plausible compensation is being coordinated with the people's committees of Lam Dong province, Dong Nai province to set up the performance option . The compensation will be carried out according to the law ;

1.4.During the construction process, the employer will fully and strictly carry out the controlling methods to minimize the impacts of causing the pollution as indicated in the report ;

1.5.The employer will pay due attention to the environmental treatment works to reduce the impacts to the surrounding environment as stated in the chapter 4 of this EIA report .

CONCLUSION AND RECOMMENDATION

A. CONCLUSION

National Highway 20 is the life-line route connecting Ho Chi Minh City, Southern economic and political center, Dong Nai province and Da Lat, is the traffic axis of Dong Nai and Lam Dong provinces. By many years of exploitation and operation, the route has badly been damaged although some sections have been commenced and invested by Ministry of Transport for recent years. However, these works are mainly to upgrade, maintain the road bases. Thus, the transportation on the route still has got many difficulties.

The investment of " rehabilitating, improving the National Highway 20 connected from Dong Nai province to Lam Dong province" of Ministry of Transport (MOT) is very necessary bring many active results of the society, contributing to accelerating the growth of the economy, national defence of Dong Nai and Lam Dong province in particular, and South-East and Tay Nguyen in general.

In addition to the economic and social impacts, during the construction process, the project will impact negatively on the environmental quality like air, water surface, underground water, soil, sediment, cause the noise and obstruct the transportation. These negative impacts have directly and indirectly affected the residents' life quality at the two sides of the road in which most of them is the impact of the dust, noise and transportation on National Road 20. Basically, the employer has evaluated the negative impacts caused by the project and proposed the plausible mitigation measures. In the other hand, the impacts in the construction stage only are of the temporary nature and only occur in a short stage. The impacts in the stage of the project operation do not impact so much the quality of the environmental components.

Being aware of the importance of the environmental protection, the employer has proposed the detailed and feasible solutions, the technologies and the management as mentioned in the Chapter 4 to minimize the possible negative impacts. With the impact mitigation measures as mentioned and with the determination from the employer carrying out strictly and fully the regulations as specified by the law on the environmental protection, the impacts on the environmental impacts will be mitigated to the acceptable level and the project operation will bring the essential interests for the society.

B. RECOMMENDATION:

For the project to be carried out on schedule and mitigate the bad impacts appearing during the project performance, the employer does wish to get the support, coordination from:

- Ministry of Natural Resources and Environment;

- Ministry of Transport ;
- Lam Dong People’s Committee;
- Dong Nai People’s Committee;
- People’s Committee of the towns passed by the route;
- Departments, branches related to the project performance.

C. COMMITMENTS:

As analyzed and evaluated at the chapter 3, during the process of construction and operation, the project will surely cause some direct and indirect impacts to the project environment and the surrounding areas. Therefore, in order to minimize the impacts on the environment during the construction process as well the project operation, we commit to carry out the following contents:

- Complying with the law on environmental protection;
- Complying with Law on Water resources;
- Complying with the construction law ;
- Complying with the land law;
- Observing the law of fire fighting and protection ;
- Complying with Decrees, Circulars, current legal documents related to the project activities ;
- Complying fully with the mitigation measures of the negative impacts in the construction stage and when the project enters operation as mentioned in the report EIA ;
- Investing the construction, completing the works of the environmental treatment on schedule as indicated in the EIA report and checked, approved by the competent bodies before entering operation ;
- Complying with the comments of the consulted community;
- Not increasing the traffic jam on the national road QL20, especially at the interchanges, sections passing the crowded areas;
- Before construction, it is to get the confirmation in writing from the local government of disposing the construction wastes and wastes ;
- Strictly observing the regulations of managing and protecting the environment of 02 provinces Dong Nai and Lam Dong ;
- The waste sources will be closely controlled and the content of the polluted substances discharged into the environment have to get the allowable standard :
  + The environmental quality of air and noise at the surrounding area passes the standard QCVN 05:2009/BTNMT and QCVN 26:2010/BTNMT;

+ The whole solid waste of the project is classified, collected and treated as per Decree No. 59/2007/NĐ-CP dated 09 April 2007 of Government;
+ The waste water is treated in accordance with the standard of QCVN 24:2009/BTNMT, Column B, Kf=1,1, Kv=1,0 before being discharge into the intake source;
+ The risky solid waste will observe Decision No. 23/2006/QĐ-BTNMT dated 26 December 2006 of Minister of Natural Resources and Environment of issuing the list of toxic waste, Circular No. 12/2011/TT-BTNMT dated 14 April 2011 of Ministry of natural resources and environment of managing the risky waste and Circular No. 12/2006/TT-BCN dated 22 December 2006 of Ministry of Industry of making guidance to implement Governmental Decree No. 68/2005/NĐ-CP dated 20 May 2005 of the safety of the chemical substances ;
+ Committing to prepare the full manpower and finance to set up the countermeasures, establishing the groups of the countermeasures and doing the practices according to the different types of scripts ensuring to minimize the damages if any incident occurs ;
+ Complying with the standards specifying the environmental protection of Vietnam and carrying out fully the measure of the environmental protection when the project goes into operation as presented in the report ;
+ Complying with the standards specifying the environmental protection of Vietnam and carrying fully out the measures of the environmental protection as well as the environmental supervision programs during the construction process and when the project enters the operation as presented in the chapter 5 of this report ;
+ Carrying out the mitigation measure as mentioned in the chapter 4;
+ Building up and operating the works of the environmental treatment indicated in the EIA report ;
+ Treating the incidents in the phase of the land acquisition and supporting the households with the relocated cultivation land;
+ Committing to bear the whole responsibility in front of the law of the Socialist Republic of Vietnam if any environmental incident happens ;
+ Undertaking to compensate the damages to the surrounding areas of the project in the construction phase as well as the project operation.

- During the operation process, any environmental factor rises, we will submit the report immediately to the local environmental management body to treat this polluted source.

SUMMARY OF ENVIRONMENT IMPACT ASSESSMENT REPORT

PROJECT FOR REHABILITATION AND IMPROVEMENT OF NATIONAL HIGHWAY NO. 20 - SECTION FROM DONG NAI TO LAM DONG PROVINCE

2.3 POSITION OF PROJECT

1.1.1. Section road in the area of Dong Nai province:

The length of the section road in the area of Dong Nai province is 76,7 km, starting from Km0 Dau Giay T-junction (intersection NR1 at Km1832+400), in Thong Nhat district, Dong Nai province. The route mainly follow the existing NRL20, passing through 21 communes, towns of Thong Nhat, Dinh Quan and Tan Phu district.

1.1.2. Section road in the area of Lam Dong province:

The length of the section road in the area of Dong Nai province is 151,2 km, starting from the connection point with Dong Nai province in NR20 (Km76+700), running along the existing NR20 before ending at Km268 in Dran town (intersection QL27 at Km200), Don Duong district, Lam Dong province.

The project road passes through 27 communes, wards, towns that belong to following districts and cities: Da Hoai, Bao Lam, Bao Loc City, Di Linh, Duc Trong, Da Lat City and Don Duong.

2.4 MAIN CONTENT OF THE PROJECT

The project’s purpose is the rehabilitation and improvement of 227,9 km road including the delta scale III, mountainous area scale III and IV (out of 268 km total length of the entire NR20); 16 new bridges are to be built, including 2 large bridges, 4 medium bridges and 10 small bridges.

2.4.1.1 Section of road

1.5.1.1.5.Scale of road

227,9 km of the project road is divided into sections with different scale, including delta scale III, mountainous area scale III and IV, lessening by TCVN4054-2005.

The existing road sections through urban areas were constructed at urban scale, therefore rational investment on pavement reinforcement, drainage system maintenance, kerb replacement, sidewalk tiling and traffic safety system are only taken into account. Details of scale could be found in the following table:

No	Chainage	Length (km)	Design scale
1	Km0 - Km20	20	Delta scale III
2	Km20 - Km62	42	Mountainous area scale III
3	Km62 - Km76+700	14.7	Mountainous area scale III
4	Km79+800 - Km98	18.2	Mountainous area scale III
5	Km108+458 - Km118+900	10.442	Mountainous area scale III
6	Km118+900 - Km123+100 (section through Bao Loc City)	4.2	Retain the existing urban roads (B_n = 27m, B_m = 2 x 7,5 = 15m, B_{vh} = 6 x 2 = 12m), only pavement improvement
7	Km123+100 - Km154+400	31.3	Mountainous area scale III
8	Km159+500 - Km172	12.5	Mountainous area scale III
9	Km176+500 - Km199	22.5	Mountainous area scale III
10	Km210 - Km222+800	12.8	Mountainous area scale III
11	Km222+800 - Km230+300	7.5	Mountainous area scale IV
12	Km230+300 - Km232 (section	1.7	Retain the existing urban roads (B_n =

No	Chainage	Length (km)	Design scale
	through Bao Loc City)		23m, B_m = 2 x 7,5 = 15m, B_{vh} = 4 x 2 = 8m), only pavement improvement
13	Km232 - Km234 (section through Bao Loc City)	2	Retain the existing urban roads (B_n = 17m, B_m = 2 x 6 = 12m, B_{vh} = 2 x 2,5 = 5m), only pavement improvement
14	Km240 - Km268	28	Mountainous area scale IV

1.5.1.1.6.Drainage works

a. Cross drainage:

- On-road culvert is planned to be permanent, load H30-XB80, having the same width as that of pavement;
- Design frequency P = 4%;
- Old culverts could be continually used or lengthened, provided that it is considered as under good condition or joint;
- Broken culverts or iron-pipe culverts shall be replaced by new ones;
- Culverts could be added for drainage performance, if necessary;
- Total culvert: 298 pieces/3923,1 m

b. Vertical drainage:

Top gutter: At any section which is featured by thick mantle and easy sliding, gutter is arranged on the top of the embankment to reduce the water volume from the slope in order to prevent water from overflowing the slope surface. Steps located at the end of the top gutter are created for water energy removal.

Vertical gutter: is arranged in the low excavated or embankment to let the drainage happen within the pavement scale. Gutter is reinforced by sectional concrete to apply at sections whose slope is more than 3%.

Vertical culvert: The design of the drainage vertical culvert system located at resident-intensive areas is featured by pipe culvert system Φ1.0m below the sidewalk; drainage is limited to water on pavement and sidewalk through the BTCT boot system which is put 28 m from one to another, averagely.

1.5.1.1.7.Other auxiliary works

a. Slope revement:

At small filled sections with high cross slope, the section expansion is just land strip or hard strip, the old pavement has been stabilized through durable operation and was designed as 1:1 or 1:0.75 fill slope method. Rubble stone is tightly arranged inside while the cut-off dike is built by rubble stone outside, mortar XM 10 MPa. Slope reinforcement is mainly done in section Km210+00 - Km234+00 (457,07 m) and section Km240+00 - Km268+00 (914,14 m).

b. Retaining wall:

The retaining wall is design for the purpose of embankment stabilization at positions of natural high cross sloping areas, of unstable and easy sliding embankment during operation phase. The design of 86-06X shaped method is applied to the retaining wall. It is built by concrete 16 MPa, on-site casting. The length of retaining wall along the road is 2.486,37 m

1.5.1.1.8.Safe traffic works

a. *Safe traffic works along the road*:

Pegs, safety fences, corrugated irons, sign boards shall be in compliance with the Land Road Signals Regulation No. 22TCN-237-01. The workload of safe traffic works includes: Sign board (2.153 pieces); pillar Km (220 pillars); Peg (9.910 pegs); Curved safety fence (5.018 m); Paint marking (58.560 m^2); Convex spherical mirror (15 pieces).

b. Escape ramp:

Escape ramp is built at 2 gap-crossing sections which are featured by unfavorable terrain, curved and sloping sections with small semi-diameter. Escape ramps are designed following the document 22TCN 218-94, published in conjunction with the Decision No. 1412/QĐ/KHKT dated 31/8/1994 of the Ministry of Transport. Escape ramp are built at: Km223+252.09 (right); Km228+102.28 (left); Km255+151.38 (left); Km260+816.83 (right); Km264+355.29 (left).

1.5.1.1.9.Intersection, cross-road

a. Intersection:

There are 5 intersection points in the project: (i) Intersection NR1 at Dau Giay T-junction, Km0+000; (ii) Intersection NR55 at Bao Loc town, Km123+900; (iii) Intersection NR20B (Mimôsa road), Km222+350; (iv) Intersection NR20B (Mimôsa road), Km233+950; (v) Intersection NR27 at Dran T-junction, Km268+000.

b. Cross-road:

- **National/provincial cross-road:** Intersection QL1 at Km00; Intersection QL55 at Km122+310; Intersection QL28 at Km153+650 and Km154+400; Intersection QL27 at Km206+390 and Km268; Intersection PR 762 at Km6+900; Intersection PR 763 at Km22+535; Intersection PR Thanh Son–Xuan Bac at Km40+663; Intersection PR Cao Cang at Km47+520; Intersection PR 721at Km77+680; Intersection PR 713 at Km93+880.
- **Intersection at civil road:** There are 665 intersection points between civil roads and the project road.

2.4.1.2 Flow over bridge

16 new bridges are build in the project, including 2 large bridges, 4 medium bridges and 10 small bridges along the road. Features of those bridges are described as following:

No	Bridge name	Chainage	Width (m)	Length (m)	Map KCN	Navigation
1	Gia Duc	Km1 + 880	12	24.70	1 x 24	Unnavigable
2	La Nga	Km35+712	12	342.00	10x33	Unnavigable
3	Phuong Lam	Km65 + 056	12	15.90	1 x 15	Unnavigable
4	Darleu	Km86+700	12	45.00	1x33	Unnavigable
5	Dai Quay	Km88+850	12	111.00	3x33	Unnavigable
6	Damrhe	Km97+900	12	45.00	1x33	Unnavigable
7	Dai Nga	Km129 + 500	12	82.00	24+33+24	Unnavigable
8	Dinh Trang Hoa	Km139 + 300	12	24.9	1 x 24	Unnavigable
9	Lien Dam	Km149 + 303	12	24.9	1 x 24	Unnavigable
10	Darle	Km177 + 800	12	35.115	1 x 24	Unnavigable
11	Hiep Thuan	Km183 + 376	12	20.11	1 x 12	Unnavigable
12	Dai Ninh	Km189 + 200	12	145.30	5 x 33	Unnavigable
13	Xom Trung	Km194 + 771	12	17.05	1 x 9	Unnavigable
14	Dinh An I	Km217+810	12	17.10	1 x 9	Unnavigable
15	Cau Dat	Km254+254	9	28.11	1 x 18	Unnavigable
16	Cau Xeo	Km263+100	9	28.15	1 x 18	Unnavigable

1.5.1.6.3.Scale and main specification

- Permanent bridge built by normal BTCT and BTCT DƯL.
- Planned load: HL-93, walk-on-foot 0,003MPa.
- Bridge width: B_c = 12 m; section Km240 - Km268, B_c = 9 m.
- Mat foundation or cast-in-situ concrete pile, depending on each bridge geology.
- Design frequency for small bridge P = 4%, for medium and large medium P = 1%.

1.5.1.6.4.Work structure

(a). Superstructure:

- Span L < 18m: Plate beam span structure by BTCT DƯL.

- Span 18 < L < 33m: I-beam span structure I by BTCT DƯL.

- Span 33 < L < 40m: Super T beam span structure by BTCT DƯL.

- Pre-stressed cable, beam by using type Φ12.7mm and Φ15.2mm which has low sag rate, following the standard ASTM A416 Grade 270.

- Cross-beam, bridge deck by BTCT, 30Mpa, on-site casting.

- Galvanized steel handrail.

- Pavement has 3 layers: Asphalt concrete is 7cm in thickness; Spread tack coat asphalt 0.5kg/m^2; Waterproof layer Radcon7.

- Bearing shoe by steel-core elastomeric pad.

(b). Substructure:

- Bridge abutment, pier by BTCT, on-site casting, 30MPa.

- Abutment, pier foundation: Depending on the actual geology condition, a bridge could be handled with mat foundation, BTCT pile or cast-in-situ concrete pile.

2.5 ENVIRONMENTAL IMPACT

2.5.1.1 In preparation phase

The preparation phase produces following impact:

- Permanent appropriation of 288.652 m^2 of residential land (Dong Nai: 157.891 m^2; Lam Dong: 130.761 m^2); the livelihood of those households would be affected due to the clearance of 12.228 m^2 house of all types (Dong Nai: 1.098 m^2; Lam Dong: 11.130 m^2);
- The livelihood of 64 households would be affected due to site clearance, removal and resettlement (Dong Nai: 32 households; Lam Dong: 32 households);
- Economic and income losses of localities and households due to the permanent appropriation of 1.627.661 m^2 of agriculture land (Dong Nai: 9.612 m^2; Lam Dong: 1.618.049 m^2);
- Economic and income losses of localities and households due to temporary appropriation of 5.900 m^2 of agriculture land in 3 years (Dong Nai: 1.200 m^2; Lam Dong: 4.700 m^2);
- The quality of air environment and the quality of life of people who live near the work sites are affected by dust generation caused by housing demolition within the site clearance area, site subgrading.
- Construction wastes generation (80 m^3 for Dong Nai and 780 m^3 for Lam dong, approximately) due to the demolition of old constructions; wastes generation due to the felling of 15.370 trees of all kinds in Dong Nai and 26.890 tree in Lam Dong;
- Wastes generation at 16 work sites during the site preparation;
- The quality of life of people who live near the work sites within the area of 120m is affected by the noise pollution due to the operation of equipments for the demolition of old constructions, equipments for site subgrading.

2.5.1.2 In construction phase

1.3.2.1 Effects sources relating to wastes

Wastes generated from the construction phase include non-reusable soil, dust and poisonous gas, solid waste, wastewater and waste lubricant.

a) Wastesoil

- The total amount of wastesoil is 652.613 m^3 for the whole project, in which:
  + Road works: 597.078 m^3
  + Bridge works: 55.535 m^3, in which:
    - Abutment, pier, end road: 49.600 m^3
    - Cast-in-situ concrete pile work with bentonite: 5.935 m^3
- The soil and water environment should be negatively affected by wastesoil if it is not properly treated:

+ Agricultural land is buried, physical characteristics of surface soil located in the near-by area along both road sides, in area nearby the work sites and in waste disposal sites, is unexpectedly changed;
+ River and spring system is invaded, turbidity of surface water is increased; rivers, springs and reservoirs are under accretion.

b) Dust and poisonous gas

- Along the road, dust and poisonous gas are generated by following sources in the construction process:
  + Dust generation due to the excavation of 1.775.075 m^3 soil (road part: 1.609.741 m^3; bridge part: 165.334 m^3) and the backfilling of 1.311.334 m^3 soil (road part: 1.047.365 m^3; bridge part: 263.969 m^3);
  + Dust and poisonous gas generation due to the delivery of 3.855.589 tone materials for project construction (coming from road surface and vehicle engines);
  + Dust and poisonous gas generation due to compensation equipment engines (discharge amount varies within a large range, from 19 g/shift for air compressor 240 m^3/hour to 3.303 g/shift for batching plant of 60 tone/hour).
- The amount of dust and emission emitted during the 36 months along the road is as following:

No.	Polluted substance	Discharge amount (*kg*)	Discharge intensity (*mg/m/s*)
1	Dust	5.672.655	0,7611
2	SO_2	12,78	0,000002
3	NO_x	177.391	0,0238
4	CO	35.725	0,0048
5	HC	9.855	0,0013

Upon the average wind speed of the project area , at the end of the wind direction and at the height of 1.5m, dust and poisonous gas concentration in the air is assessed by modifying model of as following: (i) There is a considerate increase of dust concentration during the road construction phase in comparison with the concentration before the construction (dust concentration is ranged between 0,012 - 0,106 mg/m^3 with the average value of 0,038 mg/m^3); (ii) At the distance > 5m from the sideway, dust concentration is 0,20 mg/m^3 lower than the allowable limit within 24 hours according to QCVN 05:2009/BTNMT; (iii) Dust coming from the road surface due to the traffic of material-carrying vehicles contributed to 85% of the total dust amount that comes from 3 main discharge sources; (iv) Emission concentration in the air due to the traffic of material-carrying vehicles are much lower than the allowable value stipulated by QCVN 05:2009/BTNMT.

Upon the average wind speed of the project area, the dissemination of dust and emission from compensation equipment is assessed by Gauss model as following:

(i) The hot asphalt batching plant is the equipment that caused the most serious pollution among working equipments required by the project. With 5m-height chimney, within the area of 20 m far from the source along with wind direction, dust concentration in the air exceeds the allowable value 0,30 mg/m^3 according to QCVN 05:2009/BTNMT; dust concentration is 1,8 times higher than the allowable limit at a distance of 10 m. Within the area of 300 m far from the discharge source along with wind direction, NO_x concentration in the air exceeds the allowable value 0,20 mg/m^3 according to QCVN 05:2009/BTNMT; NO_x concentration is more than 15 times higher than the allowable limit at a distance of 10 m.

(ii) The NO_x concentration at the distance of 120 m from the equipment which is ranked at 2nd position of largest pollution discharge among working equipments is girder crane K33-60, is 0,211 mg/m^3.

(iii) Although remaining equipments own dust concentration which is lower than the limitation value of Vietnam Standard QCVN 05:2009/BTNMT, most of them own the NO_x concentration which exceeds the allowable value 0,20 mg/m^3 according to QCVN 05:2009/BTNMT, within a radius area of 30 m to 50 m far from the discharge source.

(iv) Except the hot asphalt batching plant, although working equipments emit CO and PM10 dust to the air environment, their concentration does not exceed the allowable value according to QCVN 05:2009/BTNMT.

c) Solid wastes

Work solid wastes (concrete, broken bricks, discharged mortar, junk, package and domestic wastes) and hazardous solid wastes (machine wipers oil-containing wastes) could be generated in the work phase (machine wipers and oil-containing wastes).

- It is difficult to estimate the amount of work solid wastes since the work phase depends on many factors. In reality, previous traffic road constructions shows that the amount of this kind of waste is much lower than the discharged soil, stone. The average amount of domestic wastes emitted by all workers of the project is approximately 562 kg/day, i.e. 35 kg/day at each work site.
- During the work phase, hazardous solid wastes are mainly oil-containing ones such as machine wipers, lubricant-containing wastes due to leakage, v.v... Although it is unable to have the exact amount of this type of waste, actual experience shows that that amount is not large.

d) Wastewater

During the work phase, generated wastewaters are work wastewater, domestic wastewater and hazardous wastewater.

- Work wastewater is mainly emitted from batching plants at 16 work sites along the project road. The average daily amount is 19,2 m^3 for all work sites, i.e. 1,2 m^3 for each site, approximately. This type of wastewater is featured by suspended sediment, which is 4-6 times higher than the allowable value according to QCVN 24:2009/BTNMT (in comparison with B column) and by pH rate which is usually higher than the allowable value.
- The average consumption of domestic water is 100 liter/person/day, approximately. With a daily concentration of 70 persons in a work site, the amount of wastewater is about 7 m^3/day. Concentration of polluted substances (BOD_5, COD, total dissolved solid, suspended solid, non-mineral lubricant, Coliform) from the domestic wastewater is much higher than the allowable limit (QCVN 14:2008/BTNMT). The release of untreated domestic wastewater could cause local pollution for the surface water source in the area.
- Hazardous wastewater comes from the periodically replaced lubricant for machines and lubricant-containing wastewater due to vehicle and machine maintenance. By running 2.885.227 machine shifts during the construction phase, the monthly average amount of discharged lubricant is estimated to 3.506 liter, approximately.

1.3.2.2 Effect sources not relating to waste

a) Noise, vibration from work activities

a1. Noise

Following is the list of equipments that produce large noise which affects people who live near the work sites:

- *Batching site:* The value of the highest noise at a distance of 15 m is 90 dB A and noise at a further distance could be calculated by decreasing 6 dB A when distance is double. As a result, batching site shall be at least 120 m far from the residential area.
- *Delivery of soil:* Trucks for soil excavation and delivery (bulldozer, tow-truck, tractor grader and other trucks) could cause a noise of 90 dB A at a distance of 15 m; the highest noise at a distance of 120 m is about 70 dB A. As a result, for normal areas, outside the radius area of 120 m, noise should be lower than the limited value stipulated by QCVN 26:2010. For health facilities, libraries, kinder gardens, schools, churches, temples, pagodas, the noise should be

lower than the standard value 55 dB A, if working machines or delivery road shall be 750 m far from such facilities, in minimum.

- *Electricity generator:* They create noise of 82 dB A at a distance of 15 m, i.e. the generator shall be put 60 m far away from the residential area (highest noise is about 70 dB A) and 340 m far away from schools, hospitals or kinder gardens.
- *Pile-driving machine:* They create an average noise of 97 dB A at a distance of 15 m. Noise at a distance of 320 m and 1900 m is about 70 dB A and 50 dB A, respectively. In order to meet the requirements of QCVN 26:2010, the machine shall be put 300m far away from residential area and 1900 m far away from health resorts, hospitals, kinder gardens.
- *Assessment on noise effect level:* Along the project road, there are 24 residential areas and 55 sensitive facilities such as schools, hospitals, temples that are 40 - 80m far from the road. Hence, the quality of life of people who live along both sides of the road would be affected due to larger value of noise than the allowable limit during the working phase.

a2. Vibration

The highest vibration is generated from machine hammer in the bridge work; within a semi-diameter of 15m, vibration could exceed the allowable limitation. At this vibration level, vibration caused by work activities would give no harm to existing surrounding constructions since the project route tends to go further the residential areas and important constructions.

b) Soil erosion and sediment deposit

b1. Soil erosion

Erosion is likely to happen due to subgrading, embankment, bridge abutment work, bridge pier work and abutment road work.

- *Subgrading, embankment:* The project features an amount of 2.657.106 m^3 of excavated soil and embankment expansion. In rainy season, a part of soil will goes with the flow stream that leads to accretion of drainage system within the area. In the mountainous area where project is implemented, an approximate average rate of 0,1% amount of excavated and filled soil is washed away due to permanent rain during the operation time. Therefore, the amount of eroded and washed soil could reach a value of 2.660 m^3, i.e. around 11,7 m^3 for 1 km road. The hazard of soil erosion and outwash could happen along the entire route of 227,9 km and happen any time during the pavement work; the hazard is likely to grow at high slope section such as: Km62 – Km76+700; Km79+800 - Km98; Km240 - Km268.
- *Bridge abutment work, bridge pier work and abutment road work:* The implementation of 16 bridges approximately features an amount of 429.300 m^3 of excavated and filled soil for abutments, piers and roads at 2 bridge ends. In average, a rate of 0,1% amount of excavated and filled soil is washed away by rain, that could lead to a possible loss of 429 m^3 at all positions of bridge work. Depending on each position, the potential amount of outwash soil in each bridge is ranged from 20 to 39 m^3.

b2. Sediment deposit

The obvious effect of soil erosion is the deposit of the drainage system of Dong Nai and La Nga river basin by sediment. Based on the typical structure of soil grain in the project area and the typical flow stream in the region, it is learned that around 21% amount of eroded soil (equivalent to 650 m^3, approximately) will contribute to the deposit in the area which is 1000 m - 3000 m far away from the work site; the remainder will deposit in river, spring which is more than 3000 m far away from the erosion position toward the lower section. The drainage of Dong Nai and La Nga river, the duration of regional hydropower, irrigation lakes (10 important hydropower and irrigation lakes) would be threatened by sediment deposit.

c) Bank, end road base erosion

The appearance of bridge piers due to new bridge work would change the status of flow stream (flow stream allocation, speed v.v...) at the position of bridge work. Due to the high flow discharge in rainy and flood season at the project bridge position, the river banks and roads at 2 bridge ends could be eroded and slided. That hazard is inevitable for every project bridge during the construction as well as operation phase.

d) Local inundation

Local inundation could be caused by the division of and obstacles for drainage surface during the bridge work. Along the route, some bridges whose cross-section is not large have remarked a small flow discharge in dry season but huge discharge in rainy season. Therefore, when the flow stream is narrowed or obstructed due to bridge work, local inundation disappears in dry season or in sprinkles but does appear in heavy rains. Potential hazard could be found in: Gia Duc (Km1+880), Phuong Lam (Km65+056), Dinh Trang Hoa (Km139+300), Lien Dam (Km149+303), Dar le (Km177+800), Hiep Thuan (Km183+376), Xom Trung (Km194+771), Dinh An I (Km217+810), Cau Dat (Km254+254), Cau Xeo (Km263+100).

In rainy season, the implementation of cross culvert could be a reason of local inundation due to following reasons: (i) cross-section of flow stream is narrowed or flow stream is blocked; (ii) flow stream is temporarily blocked for the implementation of some item work; (iii) high rainfall in the project area (the highest rainfall in a day within the last 10 years Da Lat: 98mm, Duc Trong: 122mm, Di Linh: 162mm, Bao Loc: 153mm); (iv) high basin slope, high rate of runoff. Any position of construction, repairing or cross culvert lengthening have to face the hazard of local inundation during 7-month rainy season.

e) Underground water pollution

- *Pollution by additive due to cast-in-situ concrete pile work:* A part of the body of the cast-in-situ concrete pile with additive-containing bentonite should be located in the water-bearing complex when the pile goes through water-bearing bed. Some additives may cause pollution to the underground water. The spatial scope and the pollution level of the polluted water area depend on the time of setting which normally requires 24 hours for completion. Measures for pollution reduction shall be available since underground water in the main source of domestic water for people who is living within the project area.
- *Pollution by dirty surface water through the drilling tube wall:* Dirty water from work sites may flows down through a slit before penetrating the underground spring. Since the drilling hole wall does not harden, this hazard is available during the time of one drilling hole implementation. Therefore, the pollution scope will be larger in terms of space and time than the case of pollution by additive if dirty water goes through the drilling hole. Cast-in-situ concrete pile technology is used for the construction of 8 bridges in the project, in which La Nga bridge has the depth of drilling of 60m while other bridges has that of 8 - 29 m.

f) Loss of local income

During the operation phase, the income of 2.250 small household businesses which live along the project road will be affected, especially for those which are in eating and drinking service. The daily number of customers is likely to reduce due to the higher dust concentration and its affection on food hygiene.

g) Traffic jam and accident

Featured by high traffic volume, the national road no. 20 is the only route that directly connects Da Lat and Bao Loc city to Ho Chi Minh City. During the rehabilitation and improvement of NR20, the traffic volume is not likely to decrease due to the unavailability of a bypass road. Therefore, traffic jam is much likely to happen during construction time. Traffic jam and accident may happens at:

- Intersection: Intersection NR1 at Dau Giay T-junction, Km0+000; Intersection NR55 at Bao Loc town, Km123+900; Intersection QL20B (Mimôsa road), Km222+350; Intersection QL20B (Mimôsa road), Km233+950; Intersection QL27 at Dran T-junction, Km268+000.
- Intersection of NR20 with national and provincial roads: with NR28 at Km153+650 and Km154+400; with NR27 at Km206+390; with PR762 at Km6+900; with PR763 at

Km22+535; with PR Thanh Son–Xuan Bac at Km40+663; with PR Cao Cang at Km47+520; with PR721 at Km77+680; with PR713 at Km93+880.
- Sections that cross resident-intensive areas (24 residential areas) and schools, churches, markets (55 facilities).

h) High number of workers

The number of workers which are employed to daily work in the project route might reach 1.124 persons. However, the highly crowded concentration within 16 camps is likely to raise troubles: (i) Internal conflicts between workers and conflicts with local people; (ii) Possibility of social evils such as gambling, drug, ebriety; (iii) Dispute in sales, daily life; (iv) Social disease spread such as HIV, v.v...

i) Soil compaction

Activities on work sites and the vehicle traffic outside the road scale are two reasons for land compaction and change of physical characteristics in temporarily appropriated areas.

j) Effects on ecosystems

Effects on terrestrial ecosystem

The terrestrial ecosystem could be affected on following aspects:

- Terrestrial ecosystem within the near-by areas along the project road could be affected since the dust concentration in the air is higher than normal value. Dust threatens the life of green trees, insects and animals within the area. On each side, the area which is within 50m far from the road should be affected.
- The air environment and the surrounding terrestrial ecosystem should be affected by the emission from work vehicles.
- The terrestrial ecosystem that surrounds the material warehouse should be negatively affected by leak, fire or explosion at the fuel storage yards within the site.
- Noise caused by work vehicle and mine explosion could affect the species which are living in the area near the road and cause them to migrate to further area. The most highly affected area is near section Km79+800 - Km98.

Due to the current biological diversity and the availability of natural forest, the terrestrial ecosystem which is near the section Km79+800 – Km98 is mostly affected while other remaining parts are less affected since there have been human activities in those areas many years ago.

Effects on subaqueous ecosystem

The project area shows a diversity of subaqueous ecosystem featured by a serie of reservoirs and flow streams in Dong Nai and La Nga river basins. Under different aspects, following factors could affect the subaqueous ecosystem:

- *Water polluted by suspended solid:* The high turbidity of water will limit the photosynthesis of species of phytoplankton – primary biological product, a food source for other species in the next food chain. However, favourable circulation of flow streams of rivers within the project area could render a possibility for food source restoration. Fine grains of bentonite could easily kill the breath of species living at the bottom.
- *Water and sediment polluted by oil:* Species living in the water and above the sediment are very sensitive to pollution caused by oil. Oil is an poisonous object that might reduce the biological productivity, even kill creature. Almost 2/3 area of Dong Nai river basin almost 1/2 area of La Nga river basin lie under the project construction and hence, such rivers could be affected by oil.
- *Water and sediment polluted by organic substances and microorganism:* Due to annually high flow discharge of the rivers (especially high in rainy season) and good possibility of curing cutback, the area of pollution should be rather small and happens only in the area of wastes receipt. The possibility of eutrophication of water source on large scale is rather

difficult to happen. Effect on subaqueous species is not considerable along the space and time.

– *Water and sediment polluted by solid wastes:* Solid wastes in the surface water could be floating or sinked into bottom. Floating parts might lessen the photosynthesis of weed; sinking parts could damage the benthos due to impact or negative coverage on their living areas. On the other hand, solid objects in the water could create a favorable environment for the development of harmful species which could threaten the survival of other species. Hence, eco-balance could be put in negative condition.

2.5.1.3 In operation phase

1.3.3.1 Effect sources relating to waste

In operation phase, wastes are mainly dusts and hazardous air from traffic vehicles. In addition, some heavy metals are also available on the road due to vehicle flow.

- *Dust and emission:* According to the forecast of traffic volume in the future, dust and emission concentration in the air environment are assessed based on the modifying model of Sutton to the road source. The forecast result shows that: NO_x concentration exceeds the allowable value of 0,20 mg/m^3 in the area from the road to a distance of 50 m and 80 m in 2020 and 2025, respectively according to QCVN 05:2009/BTNMT. Other remaining gas and dust concentration are all lower than the allowable maximum value.
- *Heavy metal:* The overflowing of rain water across the road has taken dirty substances and heavy metals into the surface water. However, without a comprehensive study on this matter in Vietnam, the level of pollution caused by heavy metals are still unknown. In the world, there are some research on the content of Cr, Cu, Fe, Pb, Ni, Zn in the rain water that overflows across the road.

1.3.3.2 Effect sources not relating to waste

- *Noise:* According to the forecast of traffic volume in the future, noise level should exceed 70 dB within 140m far from the road after 2020 and within 160 m after 2025.
- *The appearance of bridge piers in flow stream:* Newly built bridge piers may affect the flow stream in following aspects: (i) Change of flow stream speed at the area that is near the bridge pier towards 2 sides that leads to change of deposit/erosion of watercourse; (ii) Possibility of the increased bank stabilization due to flow stream change.

2.6 MEASURES FOR MINIMIZING NEGATIVE EFFECT

2.6.1.1 Preparation phase

1.4.1.1 Minimizing effects in design works

The environmental impact reduction has been taken into account in the design works such as selection of road scale, sectional expansion of the existing road, bridge scale, intersection, slope retaining wall, v.v...

1.4.1.2 Minimizing effects in site clearance and site subgrading

a. Measures for minimizing effects due to site clearance and resettlement

- Strictly implement the content of site clearance plan approved by competent authorities.
- On-site scattered resettlement plan is on priority due to low workload of resettlement in the project.
- Provincial-level People’s Committee monitors the implementation of site clearance compensation through an organization which is independent with another organization which is in charge of the implementation of site clearance policy.
- Take the maximum compensation of agriculture land for farmers in return for the recovered land; replacement of agriculture land is limited during the site clearance process.
- Propagation should be properly done to achieve the support, cooperation, favourable condition from the influenced parties during the site clearance process.

- The transparency, disclosure in every activity of land recovery and damage compensation shall be assured.
- The application of on-site personnel is enabled, priority is assigned to influenced parties to take part some works during the operation process.
- Destroyed civil constructions due to site clearance on both roads sides shall be promptly restored to stabilize the livelihood of residential community within the project area.

b. Minimizing effects in agri-households whose land is temporarily appropriated

- Negotiate expense for land lease with the land owner according to the price unit replaced to apply at the province.
- According to previous commitment, temporarily borrowed land shall be cleaned before fully returning the land to the land owner (stated in the land lease contract).

c. Minimizing dusts generated by old construction demolition

- Dust monitoring during the demolition process shall be fulfilled at demolition locations which are featured by high population density or near-by sensitive organizations.
- The demolished object shall be humidified if the dust concentration exceeds the allowable maximum limit according to QCVN 05:2009/BTNMT. Humidification is done by water pump or tank truck.
- Release wastes due to demolition: Cleaning shall be done at partial demolition instead of entire demolition. Reusable objects are stored in the site clearance area and are humidified to prevent dusts from spreading. Non-reusable objects shall be promptly delivered to side subgrading location following related regulations under supervision of monitoring consultant.
- Burning wastes from demolition in the area of the project is strictly forbidden.

d. Minimizing dusts in site subgrading

- In dry and sunshine days, dust monitoring shall be fulfilled during the site subgrading process at 6 sites which are near high population density areas stated in the EIA report.
- Site subgrading shall be humidified by sprinkle if the dust concentration at the nearest residential area exceeds the allowable maximum limit according to QCVN 05:2009/BTNMT (at least 3 times/day in dry and sunshine days).

e. Minimizing effects due to noise

- Demolition is not allowed at night from 10 pm to 6 am.
- Equipments to be used in demolition or site subgrading process shall own the feature of low noise;
- People living around the work site shall be notified of the implementation plan to enable them positively arrange their daily lives and achieve their support.

f. Wastes treatment in the preparation phase

- Wastes due to site clearance are collected and classified for reusable purpose. Any non-reusable objects are also collected and daily treated through contracts with urban environment companies in Dong Nai and Lam Dong provinces.
- Plant wastes such as branches, leaves cut in the site clearance process are collected to utilize for different purposes. Nylon and domestic wastes are also collected and daily treated through contracts with urban environment companies in Dong Nai and Lam Dong provinces.

2.6.1.2 Construction phase

1.1.1.1. Measures for minimizing dusts and emissions

a. Minimizing dusts and emission due to material delivery on road

Dusts from road surface due to the operation of material-carrying trucks take 80% of the total dust volume generated from emitting sources. Therefore, following reduction measures would be applied simultaneously:

- Vehicles that meet the requirement of emission standard Decision No. 249/2005/QĐ-TTg dated 10/10/2005 of the Prime Minister is on priority.

- In a bidding package, working plan on road sections shall be properly made; the entire route is divided into different work segments to successively and fully complete each work segment instead of implementing the whole route at once to a prevent a high number of material-carrying trucks operating on NR20.
- During the delivery, material that might disseminate dust shall be humidified over the its surface. Capped trucks to carry soil, sand are on priority; For uncapped trucks, truck body shall be tightly covered by canvas to prevent the material from wind affection.
- The maximum speed for material-carrying trucks is 35km/h to reduce the dusts from road surface.
- Mud, soil-containing tires of trucks moving out from the project area or material pit area shall be cleaned by water before entering national, provincial or inter-commune roads. Water used for cleaning is directed to an on-site storage tank for reuse purpose.
- An intermediate area of 300 - 500 m shall be created for vehicle to pass through from the project or material pit area before entering a road. This area shall be periodically humidified by water twice/day or humidification shall be done when the surface becomes dry in sunshine days. Falling soil, sand over the intermediate area shall be recollected. The surface of the intermediate area shall be cleaned twice/day or at any time if there are too much falling soil, sand that may spread to other areas.
- Sections along NR20 that cross 24 residential areas and 55 sensitive facilities shall be humidified by water twice/days or humidification shall be done when the surface becomes dry in sunshine days.
- Material delivery is limited when peak traffic happens (7-8am, 11 – 12am, 5-6pm).
- Allocation of material-carrying vehicle flow on different roads shall be done properly to prevent too many trucks from sharing the same road at the same time.
- Dusts and emission at the intermediate area shall be monitored; the humidification frequency shall be timely adjusted if the dust concentration exceeds the acceptable limit.
- Dust and emission concentration shall be monitored at sensitive locations. If the dust concentration is more than 0,3 mg/m^3, additional measures shall be fulfilled: (i) sweeping the falling soil, sand over the road surface that cross such location; (ii) Humidifying the road surface that cross such sensitive facilities by water; (iii) roads for material delivery may be redirected if necessary. The above-stated measures are applied in order to remove any reason that leads to over-dust for sensitive facilities until the dust concentration is lower than the acceptable limit.

b. Minimizing dust dissemination in excavation and backfilling

- Humidifying the excavated area which may disseminate dust by water at least once /day in lasting sunshine period in rainy season and at least twice/day in dry season. Road surface humidification is a compulsory technical requirement for pavement compaction.
- At the temporary areas to store wastesoils and materials, dust dissemination shall be prevented by making a surrounding fence in geotextile; fence shall be higher than the surface of storage yard at least 0,3 m to prevent dust dissemination.

c. Minimizing dust dissemination in work sites

- Material storage (sand, soil, rock powder, v.v...) and temporary wastesoil storage yards, that might disseminate dust, shall be located in windless areas, far away from residential areas; Such areas shall be fully covered by canvas or geotextile, except a suitable gap for comfortable achievement of material. Materials shall be humidified if dusts are disseminated when materials are achieved, provided that material quality is not degraded by humidification.
- Temporary areas to store wastesoils shall be equipped with surrounding fence in geotextile; fence shall be higher than the surface of storage yard at least 0,3 m to prevent dust dissemination.

- On-site stone grinding is not allowed; stone for concrete production would be bought in the nearest licensed organizations.
- Dust concentration coming from some activities such as the release of materials from tip-cars, the in- and out-movement of material-carrying trucks shall be monitored at 16 in work sites. If dust concentration is bigger than the acceptable value, reduction measures shall be promptly conducted: (i) Material surface shall be humidified by water before releasing them; (ii) Road section that causes dust shall be humidified at least twice/day.

d. Minimizing the emission of working vehicles

- Working vehicles shall be assured of its emission according to Decision No. 249/2005/QĐ-TTg dated 10/10/2005 of the Prime Minister on setting the roadmap for application of emission standards to road motor vehicles.
- Working vehicles in each area are allowed to move just within the assigned working area.

e. Minimizing the dusts and emission in batching plants

- In priority, hot asphalt concrete should be supplied by regional manufacturing factories: Batching plant of 95 tone/h in Binh An ward – Bien Hoa - Dong Nai of Cuong Thuan Idico Development Investment Corporation; batching plant of 360 tone/h in Long Thanh - Dong Nai of Dai Hung Transport Joint Stock Company; batching plant in Tam Bo - Duc Trong – Lam Dong of Hung Vuong Construction Transport Co.; batching plant in Cam Ly – Da Lat.

1.1.1.2. Measures for minimizing noise impact

- Noise equipments whose location could be movable such as batching plant, electric generator shall be 120m at least far from residential areas. If noise reduction is unable to realize through distance, there shall be a noise screen that surrounds the noise equipment.
- Following measures shall be applied to highly movable vehicles (noise reduction through distance is disabled): (i) Frequent maintenance, check on vehicles shall be done to assure the nominal value of noise; sound damper shall be used to be in compliance with technical standard for each vehicle; (ii) Limit the operational time for any vehicle that cause big noise near residential area: high-power grade builder is permitted to operate from 6am to 8pm; for pile driving plant, from 6am to 11:30am and from 1pm to 8pm within a day.
- The disclosure of construction activities shall be done; complaints shall be received and handled.

1.1.1.3. Minimizing of effects to soil environment

a. Minimize material and wastesoil overflowing in temporary storage yards

- Selection of storage yard location: Storage yards are located within the work site or the site clearance area; yards should be rather flat; the further the surrounding agri-soil areas are; yards should be far from stream flow to prevent from erosion and washing-out in rainy season.
- Prevention of erosion, washing-out at storage yards: A large amount of material shall not be stored in the same storage yards (each yard is not more than 25 m^2 and not more than 1,5m in height) for the purpose of easy coverage, erosion prevention under rainy condition and dust dissemination removal by wind. Temporary soil storage yards shall be surrounded by geotextile to prevent from falling.
- Delivery organization: Wastesoil would be gradually delivered to locations of site subgrading or disposal sites upon the consent of local authorities.
- Treatment for overflowing, falling: The removal of overflowed, falling soil and the cleaning of overflowed areas shall be promptly implemented when agri-soil areas, specialized or residential land are overflowed. Overflowed soils in the irrigation ditch shall be also promptly recollected to prevent from accretion of channel flow.
- Damage compensation commitment: Damages caused by overflowing, falling shall be considered by the project owner for compensation under negotiation with damaged parties.

b. Minimize erosion, sliding in excavated areas

- *Work progress assurance:* In rainy season, cutting and filling shall be fully completed on divided sections and highly compacted before each squall of rain.
- *For cutting sections:* While working on cutting sections, the flora outside the site clearance area would be not removed if not necessary. Any section with high slope shall only be done in dry season; Preventive constructions shall be promptly done to remove slope erosion and sliding before the peak rainy season.
- *For filling section:* Filling shall be fully completed on divided sections and highly compacted before the peak rainy season, grass planting at slope.
- *Drainage system:* The completion of gutters along both sides of the road and cross culverts at worked sections shall be fulfilled to direct the water on surface to previously designed intention without the overflowing water over the in-work road surface. Drainage system shall be completed in schedule.
- *Retaining plate for mud recollection:* In rainy season, mud retaining plates by geotextile are temporarily used at the area of working sections, material or wastes storage yards. After fully completing each section, retaining plate would be taken off, cleaned and reused for next sections. Mud should be frequently recollected and treated like wastesoils. Retaining plates would be removed at the completion of each work.
- *Foundation excavation:* In rainy season, mud retaining plates are temporarily put around the location of foundation excavation during working time. Mud collected from the retaining plates would be daily recollected and treated like wastesoils. Retaining plates would be removed at the completion of each work.
- *Sediment treatment:* The cleaning in areas like agri-soil, residential land and traffic land shall be promptly performed in case of rain sediment in such areas.
- *Damage compensation commitment:* Agri- and other damages caused by sediment shall be considered for compensation under negotiation with damaged parties.

c. Minimize local inundation

- *Properly implement the work order:* Filling is conducted under the condition that cross culverts are in good operation. The work of vertical drainage system shall be committed in planned schedule and progress, especially the intended completion before peak rainy season.
- *Continual check:* Along the work site, inundation shall be frequently checked. If happens, following tasks shall be conducted: ridding for drainage, directing the water to natural stream flow without letting mud enter the water source by using retaining plates for mud recollection.

d. Minimize pollution by lubricant

- *Prevent lubricant from penetrating soil:* Within work site, storage area for lubricant, waste-lubricant, lubricant-containing wastes to be delivered shall has roof and cement floor with retaining edge. Equipments for fire prevention and cure shall be equipped.
- *Collection and temporary storage:* All waste-lubricant and lubricant-containing wastes are collected and stored in separate barrels which are temporarily located in stipulated areas within the work site. 02 new barrels shall be available for back-up when necessary.
- *Delivery and treatment:* Waste-lubricant and lubricant-containing wastes shall be registered by project owner, assigned to organizations which are in charge of delivery and hazardous waste treatment in Dong Nai and Lam Dong province or near-by provinces in accordance with Circular No. 12/2011/TT-BTNMT dated 14/4/2011 of the Ministry of Natural Resources and Environment on stipulating hazardous waste management.

e. Minimize pollution by solid wastes

- *Collection:* Solid wastes coming from work process shall be frequently collected and temporarily stored at stipulated yards within the site clearance area before gradually delivering to site subgrading areas upon the written permission of local authorities.

- *Stipulation of storage yards:* Solid waste storage yards shall be surrounded by geotextile and tightly reinforced to prevent from falling in rainy season.

f. Minimize pollution by domestic solid wastes

- Contractors should have contracts with provincial Urban Construction Management Companies to deliver all domestic wastes to local disposal sites. However, domestic wastes are collected and temporarily stored at work sites by contractors to ensure the environmental hygiene.
- Regulation of site waste management shall be promulgated, in which the negative release of solid wastes at surrounding environment and into rivers is strictly forbidden..
- The project owner or assigned contractor is in charge of monitoring the actual waste management and periodically deals with the representative of local urban environment company to learn proposals and recommendations on waste management status.

g. Minimize effects on compacted agri-soil

- Setting-out shall be done along the site clearance area, roads for construction traffic and site boundary to clearly announce the allowed area of work.
- Workers shall be notified of the allowable work area; any movement outside that area is strictly forbidden.
- Compacted soil area caused by urgent requirement or careless during work process shall be treated by ploughing the affected soil area to a farming depth.
- Temporarily appropriated land area shall be treated after the completion of work by fully cleaning the surface, ploughing to a minimum depth of 0,5 m before returning it to land owner.

1.1.1.4. Minimize effects on surface water, sediment

a. Minimize the possibility of turbidity increase during working

- Measures for material and wastesoil overflowing reduction at temporarily storage yards and erosion, sliding caused by rain reduction at excavated and filled areas stated in previous section, shall be properly done.
- Prevention and treatment of bentonite-containing soil and overflowed, falling bentonite: (i) The release of benonite-containing mud, soil into river flow is forbidden; (ii) Benonite-containing mud, soil shall be collected and stored in temporary storage yards; Overflowed, falling bentonite shall be collected and stored in temporary storage yards with retaining edges to prevent from spreading into surrounding land; (iii) Mud, soil shall be collected and dried before treating like solid waste treatment.

b. Treat the wastewater caused by machine maintenance and wastes of batching plant

- The operational area of batching plants are built on a sand floor to preliminarily filter the wastewater before directing the wastewater along a gutter into a retention pond for reuse purpose.
- Water for material and vehicle cleaning shall be collected and directed to a settling pond. The deposited water could be reused; sediment is collected and treated like work wastes.

c. Minimize pollution on water sources by solid wastes during bridge work

- The release of solid wastes from work and domestic wastes into rivers is strictly forbidden.
- During bridge work, geotextile lattice shall be used under the bridge to retain falling wastes and ensure labour safety for workers under the bridge. Wastes shall be periodically collected, classified and treated like wastes at work sites.
- Recycle bins shall be put on the floating mounting to store wastes. Wastes shall be periodically moved to work sites and treated like wastes at work sites.

d. Minimize pollution from overflowing rain water

- Measures for erosion, sliding reduction as stated in the above part shall be properly done.

- The implementation of asphalt concrete road surface shall be conducted in dry days and when the road foundation is dry to prevent oil and solvent in mixed liquid resin used for road sprinkle from entering the water sources. When tack coat asphalt is sprinkled, work shall be immediately stopped and road surface shall be covered by dry sand in case of sudden rain.
- The implementation of environmental safety shall be heavily monitored at the sites of material supply; waste-lubricant from equipments shall be collected and delivered to treatment facility; scattered lubricant is collected by wiper and treated together with hazardous wastes.

e. Minimize pollution from domestic wastewater

- 02 mobile toilets are available at each work site to collect the domestic wastewater. Wastes from digestion tank is collected by functioning unit. At the end of the construction, those mobile toilets would be remove to recover the site for project area.

f. Minimize the possibility of pollution by lubricant-containing wastes and waste-lubricant

- Measures for lubricant pollution reduction on soil environment as stated shall be done properly.
- Waste-lubricant, lubricant wipers shall be collected and stored in separate barrels on barges, which are moved to work sites and stored in stipulated locations..
- The release of lubricant-containing solid wastes into water and river banks is strictly forbidden.

g. Clearance of river, spring watercourse

- At the completion of the bridge work, any temporary construction on the river bank and in the watercourse shall be removed.
- Remove temporary bridges (at 12 bridges: Gia Duc, Phuong Lam, Darleu, Dai Quay, Damrhe, Dinh Trang Hoa, Darle, Hiep Thuan, Xom Trung, Dinh An I, Cau Dat, Cau Xeo), restore the original status of flow cross-section, stabilize the watercourse, stabilize river banks as original status. After the clearance, wastes shall be collected and treated like solid wastes at work sites.
- Remove temporary roads; materials used for temporary roads are considered as waste like solid wastes; restore the site to its original status; the appropriated land for temporary roads shall be ploughed to a minimum depth of 0,5 m before returning to land owner.

1.1.1.5. Minimizing effects to underground water

a. Prevent the possibility of pollution during the cast-in-situ concrete pile work with bentonite

- Standard bentonite shall be used in the cast-in-situ concrete pile work without having to use addition.

b. Prevent the possibility of infiltration of dirty surface water

- Casing abutment shall be surrounded by edges to strongly minimize the infiltration possibility of dirty surface water. This task is maintained until the end of hole drilling and is repeated by a new pile work.

1.1.1.6. Minimizing effects to creatures

a. Minimize damage to terrestrial eco-system

- Measures for air and soil environment impact reduction shall be applied.
- Workers shall be notified of documents on protection forest and special-use forest by the PMU.
- The site clearance shall be conducted right within the setting-out area. Tree cutting outside the setting-out area shall be strictly prohibited. The PMU compiles a regulation to monitor workers in this field.
- The site work shall be built within the area which is agreed by land owner and local authorities.

- Measures for fire prevention shall be built. Trial implementation of such measures shall be done before the arrival of dry season.
- Forest destruction, wild animals hunting is strictly forbidden for work personnel.
- If mine is required by road expansion, following measures shall be used: (i) use method “internal explosion” for stone destruction; (ii) Mine explosions are quickly done and not allowed to happen at the same time; (iii) The explosive volume is thoroughly calculated to create an exploded noise of 75 dB A at the distance of 150 m.

b. Minimize damage to subaqueous eco-system

- Measures for sediment and surface water environment impact reduction shall be applied.

1.1.1.7. Prevention of river bank bridge, end road base erosion

- The prevention of erosion, bridge abutment and end road base subside shall be fully and rightly fulfilled in progress, as estimated in the project (melaleuca leucadendra, grass planting, stonework, air brick tiling).
- Drainage system shall be combined properly.

1.1.1.8. Prevention of collapse, sliding for slope and road base

- The drainage system shall be properly built in terms of volume, technique, progress as stated in the project.
- The slope revetment shall be properly built in terms of volume, technique, progress as stated in the project.
- The soil retaining wall shall be properly built in terms of volume, technique, progress as stated in the project.

1.1.1.9. Measures for minimizing of effects from workers’ camps

- Local workforce should be utilized to reduce the camp density.
- Local authorities shall be notified of workers’ information to implement management of provisional stay.
- Site regulations shall be established, in which environmental hygiene and security, order are strongly taken into account.
- Social evils shall be limited among site workers by installing entertaining devices such as television, radio that could be used during non-working time.
- Investor shall be in line with local authorities to easily control the security within the project area;

1.1.1.10. Measures for minimizing of effects to traffic activities

a. Minimize the possibility of traffic jam along the road

- The entire route is divided into separate sections and sections are fully completed following the successive method.
- The road work shall be implemented on the new road expansion, prior to the old road that is saved for existing traffic. The road work on the old road section would be started after basically finishing the road expansion.
- Temporary roads and bridges shall be properly built for traffic in terms of appropriate load and width if the new and the old bridge share the same centerline. On-road vehicles shall be instructed by project personnel and sign board for by-pass road; In and out direction for material-carriage trucks shall be stipulated in a map.
- Material supply planning shall be done properly by the “Just-in-Time” rule to reduce the large number of on-road carriage vehicles as well as the large volume of material that might cause traffic obstacles.
- Sections that might easily cause accidents such as deeply excavated sections, highly filled sections or in-work underground culverts, … shall be equipped with strong lighting at night and sign boards that could be realized from far distance.

- At the site of bridge work, sign boards and signal lights shall be available at 2 ends of the bridge.

b. Minimize the possibility of traffic jam and accident at sensitive sections

There are 55 sensitive facilities along the project road; additional measures shall be applied beside above-stated ones:

- Sign boards shall be available at 2 ends of the in-work section; setting-out shall be available at sensitive areas; At 2 ends of the section that crosses school, there shall be personnel to control the traffic in peak times.
- For sections that cross school, the work plan shall be properly made such as holidays and weekends are on priority for work; no work is permitted at each closing time of school; sections for existing traffic should be wide enough while personnel who are in charge of traffic control shall be available at the 2 ends of the section that leads to school.

c. Minimize the possibility of traffic jam and accident at intersections

- Materials, vehicles shall not be put over the intersection of roads; they are located within the area of the project.
- Sign board to announce site work shall be available, speed limitation of 5km/h at 2 ends with the availability of personnel for traffic control.
- Dusts and muds shall be frequently removed from the road surface.
- Local traffic polices should be utilized to control the road traffic.

1.1.1.11. Measures for minimizing of effects to local traffic infrastructure system

- The use of local infrastructure shall be agreed by local authorities: written permission of temporary use of inter-district, inter-commune, inter-hamlet roads for traffic.
- Vehicles should be used rationally: Vehicle weight shall be matched to the actual intensity of the used road; actual load is set to nominal load and speed is not more than 30 km/h.
- Maintenance and return: Hygiene and traffic safety shall be committed during the operation; roads shall be periodically maintained, restored to the original state and returned to the local at the work completion.

1.1.1.12. Waste control during construction phase

a. Compilation and promulgation of waste management procedure

- The project owner is responsible for compiling procedures for wastes management generated during construction phase. Contractors shall be notified of this procedure. By using the promulgated form, contractors are in charge of reporting the waste management status to the project owner. Normal wastes and hazardous wastes are controlled by the waste management procedure. During the construction phase, the procedure is used by working units to make expense sheet and report of actual wastes. The procedure itself is one of content that needs to be monitored according to the requirement written in the Environmental Monitoring Program.

b) Treatment of normal wastes

According to terms and conditions of the business contract, contractors are required by the project owner to treat the normal wastes (construction and domestic wastes) as following:

- Unhazardous construction wastes could be used for site subgrading at civil constructions. They would be delivered to the subgrading location upon the written permission of local authorities.
- The domestic solid wastes shall be collected and classified (reused and removed one). The non-reusable wastes would be delivered to provincial disposal sites through business contracts with provincial urban environment companies.

c) Treatment of hazardous wastes

According to terms and conditions of the business contract, contractors are required by the project owner to treat the hazardous wastes (oil slick collected from wastewater, lubricant wipers due to machine maintenance, waste lubricants due to lubricant replacement in machines and oil-containing soil at construction site) as following:

- Register as waste generator with the Department of Natural Resources and Environment in Dong Nai and Lam Dong province before the project commencement.
- Oil-containing wastes shall be classified and temporarily stored in separated capped barrels and labeled following the TCVN 6707/2000 "Hazardous wastes – Warning signs, prevention".
- Oil-containing wastes shall be treated within the time stipulated by legal requirement. If the storage of oil-containing wastes is required for more than 6 months, the project owner shall register and periodically report (once per 06 months) to provincial-level Natural Resources and Environment Departments.
- Oil-containing waste management shall be assigned to a specialized officer or a person who has been trained on hazardous waste management.
- The delivery and treatment of oil-containing wastes are implemented through contracts with hazardous waste carriers and hazardous waste treatment facility owner licensed under Circular No. 12/2011/TT-BTNMT dated 14/4/2011 of the Ministry of Natural Resources and Environment on hazardous waste management.

2.6.1.3 Operation phase

- ***Measure for minimizing of noise***

- Old-style vehicles with high noise level is not permitted to run; new-generation vehicles with European's and advanced countries' low noise standards are encouraged to use, instead.
- Air horn is strictly forbidden in residential areas.
- The planning of residential areas should be rational; building construction is not allowed within the area of roads traffic safety corridor or the construction location shall be at least 15m far from the road.
- Within the scale of 160m from the road, it is not allowed to have any type of organization which is sensitive to noise such as health station, library, kinder garden or schools.

- ***Dust and emission pollution reduction measures***

- Old-style vehicles with high hazardous emission level is not permitted to run; new-generation vehicles with European's and advanced countries' low emission ratio are encouraged to use, instead.
- The planning of residential areas should be rational; building construction is not allowed within the area of roads traffic safety corridor; Within the scale of 60m from the road, it is not allowed to have any type of organization which is sensitive such as health station, library, kinder garden or schools.

- ***Prevention of river bank, bridge end road base erosion***

- The project owner shall run a period plan to check the bridge collapse, erosion and roads at 2 ends of the bridge (once per 3 months in dry season and once per month in rainy season during warranty period).
- As soon as damage is identified, reinforcement and restoration at the point of erosion and sliding shall be immediately conducted.
- In case of serious sliding, cause of sliding shall be properly identified before applying appropriate measures: combination of grass planting for surface reinforcement and drainage; combination of retaining wall construction, drainage and surface reinforcement; retaining wall construction, surface reinforcement and retaining wall construction for the protection of toe of slope.

- ***Prevention of collapse, sliding for slope***

- The project owner shall run a period plan to check collapse, sliding for slope (once per 3 months in dry season and once per month in rainy season during warranty period). In case of collapse, sliding, temporary reinforcement is done at the points of sliding by: falling soil, stone due to collapse, sliding shall be removed to ensure traffic; 3 - 4 lines of stone could be temporarily arranged, not higher than 2 - 4m; reinforcement is done by grass or tree planting. Next, implement the consolidation and stabilization by one of following ways: (i) Use anchor wall, anchor frame structure; BTCT retaining wall with mechanical cutting for loading-out, surface reinforcement and drainage; (ii) Retaining wall construction, surface reinforcement and drainage.

2.7 ENVIRONMENT CONTROL PROGRAM

1.5.1. Responsibilities on environmental protection of related parties

Environmental management program is one of important factors to assure a complete fulfillment and timely amendment of inappropriate issues of reduction measures stated in Chapter 4 to minimize negative impact on preparation, implementation and project operation. Project owner is the top organization which takes full responsibilities on environmental issues of the project. In order to create a clear connection between consultancy units and the project owner, the Project Management Unit shall establish an environmental unit to monitor the implementation of environmental protection of the project. From the environmental aspect, responsibilities of each party are basically defined as following:

a) Project owner – Directorate for Roads of Vietnam:

- Promulgate documents to assign roles for organizations/units which are under its management;
- Receive and handle environment-related issues of the project (environmental monitoring reports, environmental monitoring, environmental complaints, v.v...) sent by PMU no. 7.

b) Project Management Unit no. 7:

- Sign contracts with contractors and consultancy units;
- Organize, appoint specializing unit on environmental issues of the project;
- Estimate and submit competent authorities for the cost and expense approval regarding related activities on environmental protection;
- Receive and handle environmental monitoring reports of consultancy units, periodically report to project owner, Department of Natural Resources & Environment of Lam Dong province and Department of Natural Resources & Environment of Dong Nai province.

c) Environmental unit of the project

- Watch directly for the implementation of environmental constructions, previously assigned environmental impact reduction measures of work units;
- Watch for monitoring activities and environmental monitoring of consultancy units;
- Review, analyse the environmental monitoring reports;
- Report the status of implementation of work units and consultancy units to PMU no. 7 and propose handling measures if necessary.

d) Work units

- Subjected to full responsibilities on environmental protection measures written in the assignment documents of the project owner and the approved EIA report;
- Subjected to the supervision of supervising consultant;
- Implement additional measures upon the requirement of the project owner

e) Environmental monitoring consultancy

- Monitor the implementation of environmental impact reduction measures of work units;
- Working units shall be notified of potential environmental issues that might cause trouble for the project implementation;

- Periodically report to PMU no.7 and project environmental unit.

g) Environmental consultancy

- Environmental monitoring is subjected to the approved content and frequency;
- Report the monitoring results to project environmental unit and PMU no.7;
- Additional monitoring shall be done when required.

1.5.2. Content of environmental monitoring

a) Monitoring the preparation

Monitor the selection of location for workers' camp, location for asphalt mixing stations, batching plants to meet stated conditions in respective reduction solutions. Provision of domestic water for workers, wastewater treatment ability and prevention of fire and explosion shall be reviewed.

b) Monitoring the site clearance and resettlement

- Monitor the scale of site clearance by the approved documents.
- Monitor the implementation of compensation and resettlement policy; assess the satisfaction of influenced parties, propose amendment if necessary.

c) Monitoring the wastes

- Check, monitor the procedure for waste management of the project.
- Monitor the domestic solid wastes of workers, waste from construction material in the camp area for workers, temporary area for material storage, and work site.
- Monitor liquid waste (including domestic wastes, wastes at batching plants, motorbike maintenance stations)
- Monitor hazardous wastes (oil-containing waste, spent oil).
- Monitoring time: in preparation, work and after work completion.

d) Monitoring air quality, noise

- Monitoring criteria: Suspended dust concentration; SO_2; NO_2; CO; Noise (L_{eq}, L_{10}, L_{90}).
- Monitoring frequency: 3 times in dry season and once in rainy season during the construction period.
- Monitoring location: at 25 typical locations as stated in Chapter 5.
- Referred standards: QCVN 05:2009/BTNMT; QCVN 06:2009/BTNMT; QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT.

e) Monitoring water quality

- Monitoring criteria: pH, turbidity, suspended solids, BOD_5, COD, DO, Lubricant, NO_2^-, NO_3^-, PO_4^{3-}, hazardous heavy metals (As, Cu, Cd, Fe, Hg, Pb, Zn), Coliform.
- Monitoring frequency: once per 4 months during the construction time.
- Monitoring location: Obtain the analytic sample of surface water, 100m far from each bridge location toward the downstream of each river (for 15 bridges stated in the project).
- Referred standards: QCVN 08:2008/BTNMT; QCVN 14:2008/BTNMT.

f) Monitoring soil quality

- Monitoring criteria: pH, total organic subtances, acidity, total N (T-N), total P (T-P), Cl^-, SO_4^{2-}, hazardous heavy metals (As, Cu, Cd, Hg, Pb, Zn).
- Monitoring frequency: Obtain the analytic sample once in the last six months of the project.
- Monitoring location: at 25 communes và 7 locations of soil waste disposal as stated in Chapter 5.
- Referred standards: QCVN 03:2008/BTNMT; QCVN 07:2009/BTNMT; TCVN 6696:2000.