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LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

A & D	Alienable and disposable
ADT	Annual Average Daily Traffic
AAS	Atomic Absorption Spectrophotometry
AASHTO	American Association of State Highway and Transportation Officials
AC	Authority to Construct
ACI	American Concrete Institute
AH/s	Affected household/s
amsl	Above mean sea level

APCI	Ascott Pacific Consultants, Inc.
ASL	Above sea level
ASR/s	Area Sensitive Receptor/s
BDRRMC	Barangay Disaster Risk Reduction Management Committee
BOD	Biochemical oxygen demand
BRW	Bay River Watershed
BSI	Berkman Systems Inc.
C_6H_6	Benzene
°C	Degree Celsius
CALABARZON	Cavite, Laguna, Batangas, Rizal and Quezon
CALTRANS	California Department of Transportation
CARI	Contractors All-Risk Insurance
CBH	Circumference-at-Breast-Height
CCCW	Center-Cluster-Corridor-Wedge
CCM	Camp Coordination and Management
CCTV	Closed-circuit television
CFNR	College of Forestry and Natural Resources
CHR	Commission on Human Rights
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLOA	Certificate of Land Ownership Award
cm	centimeter
CMS	Convention of Migratory Species of Wild Animals
CSMS	Cellular Service Mobile Service
CO	Carbon Monoxide; Community Organizing
D	Density
DAO	DENR Administrative Order
DAR	Department of Agrarian Reform
dB re10^{-12}	Unweighted sound power
dBA	Sound or noise level at A-weighting
dBA re 10^{-12}	Weighted-A sound power
dbh	Diameter at breast height
DED	Detailed Engineering Design
DENR	Department of Environment and Natural Resources
DENR-EMB	Department of Environment and Natural Resources-Environmental Management Bureau
DIA	Direct Impact Area
DO	Dissolved oxygen
DOST	Department of Science and Technology
DPWH	Department of Public Works and Highways
ECC	Environmental Compliance Certificate
EGF	Environmental Guarantee Fund
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
EMF	Environmental Monitoring Fund
ENE	East Northeast
ERDB	Ecosystems Research and Development Bureau
ESCP	Erosion and Sediment Control Plan
F	Frequency
FS	Factor of Safety
ft	feet
GD/s	Group Discussion/s
GDP	Gross Domestic Product
GPS	Global Positioning System
GTZ	German Agency for Technical Cooperation
H'	Shannon Weiner Index
ICT	Information and Communications Technology
IEC	Information, Education and Communication

IIA	Indirect Impact Area
IRR	Implementing Rules and Regulations
ISC	Industrial Source Complex Model
IUCN	International Union for Conservation of Nature
IV	Importance Value
J	Pielou's Evenness Index
Km/KM	kilometer
kph	kilometer per hour
L_{10}	Noise exceeded 10% of the time
L_{90}	Noise exceeded 90% of the time
LAPRAP	Land Acquisition Plan and Resettlement Action Plan
LARP	Land Acquisition and Resettlement Plan
LARRIP	Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples
L_{eq}	Equivalent noise level
LGU	Local Government Unit
L_{max}	Highest sound level measured over a time interval
L_{min}	Lowest sound level measured over a time interval
LoS C	Level of Service C
L_p	Sound level from source/equipment
L_w	Sound power of the source/equipment
m	meters
m/s	Meters per second
m^3	Cubic meter
$\mu g/m^3$	Micrograms per cubic meter
µg/Ncm	Microgram per normal cubic meter
masl	meters above sea level
MC	Memorandum Circular
MCE	Maximum credible earthquake
MD	Modeling Domain
MFR	Makiling Forest Reserve
MGB	Mines and Geosciences Bureau
MGPP	MakBan Geothermal Power Plant
MIW	Malaking Ilog Watershed
mm	milimeters
MMT	Multi-Partite Monitoring Team
MOA	Memorandum of Agreement
MRIC	Municipal Resettlement Implementation Committee
NAAQG	National Ambient Air Quality Guidelines
NAAQS	National Ambient Air Quality Standards
NAAQV	National Ambient Air Quality Guideline Values
NAMRIA	National Mapping and Resource Information Authority
NCR	National Capital Region
NO_2	Nitrogen Dioxide
NOAH	Nationwide Operational Assessment of Hazards
NPAAAD	Network of Protected Areas for Agricultural and Agro-Industrial Development
NDRRDMC	National Disaster Risk Reduction and Management Council
NSCP	National Structural Code of the Philippines
O_3	Ozone
OSG	Office of the Solicitor General
PA	Public Address
PAFs	Project Affected Families
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAHs	Project Affected Households
PAPs/APs	Project Affected Persons/ Affected Persons
PAR	Philippine Area of Responsibility
PB	Parsons Brinckerhoff Philippines, Inc.
PCAA	Philippine Clean Air Act

PCUP	Presidential Commission for the Urban Poor
PDRRMC	Provincial Disaster Risk Reduction and Management Council
PFZ	Philippine Fault Zone
PGPCI	Philippine Geothermal Production Company, Inc.
PHGA	Peak Horizontal Ground Acceleration
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PhP	Philippine Peso
PM	Particulate Matter
PM_{10}	Particulate Matter less than 10 micron
PMO	Project Management Office
PNR	Philippine National Railway
PO	Permit to Operate; Peoples Organization
PPE	Personal Protective Equipment
ppm	Parts per million
PWDs	Persons with disability
Qal	Quaternary (Recent) Alluvium
Qtt	Quaternary Taal Tuff
Qv	Quaternary Volcanics
Qvp	Laguna Formation
r	distance from the source
R.A.	Republic Act
RAP	Resettlement Action Plan
RC	Relative Basal Coverage
RCNM	Roadway Construction Noise Model
RD	Relative Species Density
RDom	Relative Dominance
RevCom	Review Committee
RF	Relative Frequency
RHU	Rural Health Unit
ROW	Right of way
ROWA	Right of Way Acquisition
RPF	Resettlement Policy Framework
RROW	Road Right-of-Way
SCTEX	Subic-Clark-Tarlac Expressway
SDA	Spoil Disposal Area
SJWS	San Juan River Watershed
SLEX	South Luzon Expressway
SLTC	South Luzon Tollway Corporation
SO_2	Sulfur Dioxide
SRR	Search Rescue & Retrieval
STAR	Southern Tagalog Arterial Road
SVL	snout-vent length
SW	Southwest
TMP	Traffic Management Plan
TPLEX	Tarlac-Pangasinan-La Union Expressway
TR	Toll Road
TRB	Toll Regulatory Board
TSP	Total Suspended Particulates
TWG	Technical Working Group
UPLB	University of the Philippines Los Baños
USEPA	United States Environmental Protection Agency
USFHWA	United States Federal Highway Administration
USGS-NEIC	United States Geological Survey-National Earthquake Information Center
VMS	Variable Message Signages
VPD	Vehicles per day
VSU	Visayas State University
WB-IFC	World Bank-International Finance Corp.
WVF	West Valley Fault (WVF)

EXECUTIVE SUMMARY

ES-1 Project Fact Sheet

A. Project Information

Project Name	**South Luzon Expressway (SLEX) Phase II Toll Road 4 (TR4) Project**
Location & Area	Calamba City, Laguna Sto. Tomas, Batangas Alaminos, Laguna San Pablo City, Laguna Tiaong, Quezon Candelaria, Quezon Sariaya, Quezon Tayabas City, Quezon
Nature of Project	ROADS & BRIDGES: Group 3.4.1 Roads, new construction (National Road ≥ 20.0 km with no critical slope)
Project Size/Scale	Construction and operation of an expressway and associated facilities with total length of 56.862 kilometers
Project Life	35 years of concession period
Project Capital Cost	PhP 11.922 billion (indicative cost)
Project Proponent	South Luzon Tollway Corporation (SLTC)
Contact Person	Engr. Thelma D. Mahinay Technical and Engineering Manager
Contact Address and Numbers	Km 44 SLEX, Sitio Latian Brgy. Mapagong Calamba City, Laguna e-mail: thelma.mahinay@sltc.ph (63 2) 584-4608

B. Proposed Re-Alignment

An Environmental Compliance Certificate (ECC) has been issued for the project on July 11, 2014. However, the project is still at pre-construction phase particularly at the stage of finalizing the covered area for the negotiation and acquisition of the right-of-ways. This is due to the proposed TR4 re-alignment upon evaluation of the factors that surfaced during the parcellary survey and initial ECC application such as the existing land cover / land use, general topography or terrain, communities/people to be affected, accessibility, etc. In particular, the final design will include the re-alignment of Sections TR4-A and TR4-E as presented below.

TR4 Sections	Features of Realignment
TR4-A	To avoid the MakBan production well underneath the initially-designed TR4 alignment.
	Quite far from the foot slope of Mt. Makiling
	Less built-up area to be affected
	More accessible

TR4 Sections	Features of Realignment
TR4-B	*No proposed change in the alignment*
TR4-C	*No proposed change in the alignment*
TR4-D	*No proposed change in the alignment*
TR4-E	Request of the general public to transfer the road alignment to the northern side of the national road
	Less built-up areas to be affected
	Less disturbance to the traffic flow at the existing roads

Based from the above-mentioned considerations, TR4-A will be shifted on the southern part and will be located at 15 barangays instead of the initial 16 barangays in Calamba City and Sto. Tomas, Batangas. The final location will be traversing mostly agricultural lands or brushlands, and nearer to the highway but farther away from the buffer zone of Mt. Makiling. On the other hand, the TR4-E will be shifted at the northern side of Daang Maharlika which is nearer at the footslope of Mt. Banahaw. Just like TR4-A, the new location is comprised mostly of farms and brushlands with slight built-up areas in the vicinity.

The Project will be implemented in two (2) phases: Phase I covering TR4-A to TR4-C or from Sto. Tomas, Batangas to Tiaong, Quezon; and, Phase II at TR4-D to TR4-E from Tiaong, Quezon to Tayabas City. The major components of the TR4 project are the main carriageway, overpass, underpass, bridges, interchanges, and toll plaza. The locations and major components of the TR4 realignment as compared to the initial alignment are presented below.

ES-2 Process Documentation

A. EIA Team

The Ascott Pacific Consultants, Inc. (APCI) was commissioned by the SLTC to conduct the EIA study for the proposed TR4. The EIA Team who conducted the study is presented in the table below.

Component Specialist	Name	EIS Preparer Certificate No.
Hydrology and Water Quality/ Project Team Leader	Felixberto M. Centeno	C2FMC0029
Meteorology and Air Quality	Ronald S. Pahunang	IPCO-173
Geology and Pedology	Anacleto Q. Suelto	With pending application for accreditation in 2016
Terrestrial Ecology (Fauna & Flora)	Michael J. Edrial	IPCO-101
Socio-Economic and Land Use	Dindi Tisha M. Samsuya	With pending application for accreditation in 2016

The Accountability Statement of EIA Preparers and the Proponent are presented in **Annex A** and **Annex B**, respectively.

B. Study Schedule and Area

The Environmental Impact Assessment (EIA) study was conducted for the amendments of the ECC for the TR4 project issued on July 11, 2014. According to the Environmental Management Bureau (EMB) Memorandum Circular 2014-005 (*MC 2014-005*) *Revised Guidelines for Coverage Screening and Standardized Requirements*, ECC amendments is required for the proposed TR4 re-alignment since it will cover some areas not included in the initial EIS.

Location and Major Components of TR4

TR4 Segment	Package A		Package B		Package C		Package D		Package E		Total	
Location	No. of Barangays											
	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment
Calamba City	2	2									**2**	**2**
Sto. Tomas, Batangas	12	11									**12**	**11**
Alaminos, Laguna	2	2	5[a]	5[a]							**6**	**6**
San Pablo City			2	3	6[a]	7[a]					**7**	**9**
Tiaong Quezon					1	1	4	3			**5**	**4**
Candelaria, Quezon							2	3	4	1	**6**	**4**
Sariaya, Quezon									7	7	**7**	**7**
Tayabas City									2	2	**2**	**2**
Grand Total											**47**	**45**
Major Components	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment
a) Length (km)	10.05	11.318	19.663[b]	12.117	19.663[b]	7.497	27.612[b]	15.00	27.612[b]	10.93	**57.325**	**56.862**
b) Bridges	2	3	2	5	-	2	2	3	2	3	**8**	**16**
c) Underpasses	-	8	5	6	3	7	2	4	1	2	**11**	**27**
d) Overpasses	4	2	3	4	4	-	10	13	6	7	**27**	**26**
e) Inteerchanges	1	2	1	1	1	1	1	1	1	2	**5**	**7**
f) Toll Plaza	1	1	1	1	1	1	1	1	1	2	**5**	**6**

Notes: [a] - indicates 1 barangay also included in the previous TR4 Segment

[b] - Total length of two TR4 Segments

The current assessment for the EIA study is confined at the TR4-A from Calamba City to MakBan, Sto. Tomas, Batangas and TR4-E from Candelaria to Tayabas City, Quezon which are the TR4 sections for the re-alignment. The EIA study was conducted from November 2015 to August 2016. The TR4-B to TR4-D are not included in the current assessment since no changes have been proposed in these TR-4 sections. Since the project is still for implementation, this EIS will cover the entire TR4 alignment or TR4-A to TR4-E which is the scope of the project as covered in the ECC issued in 2014.

C. EIA Process

The study was conducted in accordance with the requirements of the Environmental Management Bureau (EMB) Memorandum Circular 2007-002 (*MC 2007-002*), *Revised Procedural Manual of DAO 2003-30, and DENR (MC 2010-14), "Standardization of Requirements and Enhancement of Public Participation in the Streamlined Implementation of the Philippine EIS System*". The outline of this report followed the prescription of DENR MC 2010-14.

This EIS is an integration of the 2013 EIS based on the initial TR4 alignment and the current EIA study along the proposed re-alignment. Considering that the project has not yet commenced since the ECC issuance in 2014 vis-à-vis the incorporation of the elements of 2013 EIS which are not covered in the present study, this EIS will serve as the final EIS of the Project.

The representatives of SLTC and its commissioned preparers conducted the Technical Scoping with the DENR-EMB Central Office on May 24, 2016. The agreed scope of the EIA for the project is attached as **Annex C** (Screening Form/EIA Checklist).

1. Public Participation

SLTC and the EIS Preparer (social team) conducted social preparation activities ensuring public participation to elicit and document the views, concerns and issues of the stakeholders. In activities involving public participation, such as Information Education Communication (IEC)/pre-scoping, public scoping, Group Discussions (GDs) and perception survey, documentation of issues and concerns raised as well as responses from the proponent were documented. In all the activities, the identified stakeholders were invited through the assistance of barangay officers. Letters of invitation including the Program of Activities were sent to Local Government Units (LGUs) / barangay officials. Documentation of proceedings included accomplishing the attendance sheets; taking note of the issues and concerns and the proponent's reply; and, photos.

a) Pre-Scoping / IEC Activities

Prior to the commencement of the EIA for the TR4 Project, the SLTC and/or EIA Preparers conducted project orientation activities among the potentially affected communities that include the LGUs, barangay officials, and local residents. Between the period of November 25 – 27, 2015 to February 17, 2016 various pre-scoping/IEC meetings were held with LGU officials, barangay officials, their representatives, and other stakeholders within the proposed re-alignment in the following areas: Calamba City in Laguna; Sto. Tomas in Batangas; and Candelaria, Sariaya and Tayabas City in Quezon.

b) Public Scoping

Five (5) public scoping meetings were conducted to present and disseminate information about the proposed TR4 re-alignment consequently, to elicit issues and concerns on project implementation. These scoping meetings were held from February to March 2016 and attended by stakeholders from the following areas:

Stakeholders	Venue	Date & Time
Sto. Tomas, Batangas	Sto. Tomas Elementary School, Sto. Tomas, Batangas	February 17, 2016 / 1:00PM
Calamba City, Laguna	Brgy Putting Lupa Hall, Calamba City, Laguna	March 7, 2016 / 8:00AM

Stakeholders	Venue	Date & Time
Candelaria, Quezon	Brgy. Mangilag Norte Hall, Candelaria, Quezon	March 8, 2016 / 8:00 AM
Sariaya, Quezon	St. Francis Parish Hall, Sariaya, Quezon	February 18, 2016 / 8AM
Tayabas City, Quezon	Calumpang Elementary School, Tayabas City, Quezon	February 18, 2016 / 2 PM

In all the meetings, the issues and concerns of the stakeholders were identified and the corresponding responses from the Proponent, if any, were documented.

c) Perception Survey

A socio-economic/ perception survey, representing 5% of the household population of the affected areas, was conducted to gather information on basic demographic data, socio-economic and health profiles, access to basic social services, gender roles, social community networks, and project perception about the TR4 project. A standard EIA Questionnaire was used in the conduct of the survey. Survey teams included residents from barangays who were hired and trained to conduct the surveys under the supervision of a survey supervisor.

A 2013 perception survey was conducted in the 8 cities/municipalities according to the initial TR4 alignment. A 2nd perception survey was done in 2015 for the 5 cities/municipalities to be covered by the proposed TR4 re-alignment. Furthermore, a 2018 perception survey was conducted in 1 city and 2 municipalities that are not covered in the 2015 survey for updating due to the 5 year validity of the gathered information. The 3 perception surveys covered a total of 1501 sample households in 45 barangays.

d) IEC / Group Discussions

Group Discussions (GDs) were conducted from May 23, 2013 to June 4, 2013 in the 43 barangays to be affected by the Project. No interviews and GDs were conducted in two (2) barangays due to unavailability of local officials and the residents and/or ongoing activities in the area during that period.

The objective of the GDs was to further allow the stakeholders to surface various sectors' issues and concerns, perceived project benefits as well as their recommendations to facilitate project implementation. Contact persons in the barangays, usually the barangay captains and council men, were requested to invite residents and ensured these following sectors were represented in the discussions: youth, women, the elderly, and the farmers, landowners, businessmen and barangay officials. A total of 1,693 participants attended the 43 GDs with an average attendance of 40 persons per GD.

A consultation meeting with UPLB Chancellor and one UPLB professor on the impact of TR4 project on the buffer zone of Mount Makiling was also conducted on May 9, 2013.

ES-3 EIA Summary

A. Summary of Alternatives

Initially, the alignment will be affecting approx. 5.0 hectares (has.) of a golf course in Calamba City. The final design has shifted the alignment to the existing concrete road and its adjacent creek to avoid the impacts on the golf course. The creek is very wide and very deep wherein the alternative will be constrained by the required design standards. The length of girders and column (posts) will prohibit safe and sound construction of the bridge which entails high additional cost. Thus, this would necessitate the construction of a 640 meter long viaduct crossing the creek.

The initial design did not include the San Pablo Interchange but the result of *2012 Traffic Demand and Revenue Forecast* shows a better traffic flow in case that it will be included in the alignment of TR4.

The project will provide better and extensive services if the San Pablo interchange will be provided since San Pablo City is a major destination point. Thus, the proposed re-alignment will have the San Pablo Interchange as one of its major components.

During operation, the project will not require extensive resources such as food, water, electricity, fuel and other amenities since its requirements is minimal and will be distributed at the tollways and interchanges. The resource requirements at the tollways and interchanges could be easily provided or sourced from the local suppliers.

The supplies and materials, water, fuel and power requirements during construction are quite extensive. The contractors will be responsible in providing the manpower and their required amenities, construction supplies and materials, water, power, fuel, etc. The contractors could prioritize the local dealers and/or service providers to supply their requirements. This will minimize the project impacts since the local service providers have already existing environmental measures as part of their operation.

On the other hand, the contractors could also opt to utilize the river/s for the water requirements during construction activities. They could apply for *Water Permit* from NWRB for the use of the streamflow at the river/s adjacent to their construction sites. Considering the current usage of the rivers along and/or crossing the TR4 alignment, its possible use for the project will have minimal impact. In addition, the contractors could prioritize the services of the local power supplier. The use of standby generators could be limited during emergency such as brownouts and in areas not accessible by the existing electric transmission lines. This will minimize the air emission due to the burning of fuels.

B. Potential Impacts and Prevention/Mitigation or Enhancement Measures

The key physical environmental aspects, potential impacts, and applicable measures are identified and tabulated by project phases, as follows:

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
I. PRE-CONSTRUCTION PHASE		
Primary Activities with no Inherent Impact to the Environment • *Preliminary Design Phase* • *Surveys and Stakeout* • *Parcellary Mapping* • *Securing Clearances and Permits* • *Consultations with Stakeholders* • *Land or Right of Way Acquisition* • *Securing Notice to Proceed Construction*		
II. CONSTRUCTION PHASE		
A. The Land		
Land use	Change/Inconsistency in land use	Amending zoning plan along the RROW
Geology *Change in Surface Landform/ Topography/ Terrain/ Slope*	Induce mass movement (landslide, creeps, etc.)	• Confine land excavation and disturbance to the RROW • Incorporate results of geotechnical studies on unstable slopes and embankments to appropriate design and slope stabilization measures

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
Geohazards (*Effect of geohazards such as ground acceleration, settlement, lateral spread, and liquefaction to the Project*)	Structure failure with potential risk to people and property	• Design of structures to include seismic loading • Slope stability analysis • Embankment settlement assessment
Pedology	Soil erosion	• Minimize exposed work areas and clearing of vegetation • Immediate re-vegetation in areas where construction activities are completed • Implement a soil erosion and sediment control plan (ESCP) • Install silt ponds at bridges and other areas in the alignment adjacent to water bodies • Use slope stabilization measures along exposed slopes
Terrestrial biology	Vegetation removal and loss of habitat	• Initiate reforestation of potential impact areas prior to ground preparation • Implement properly designed reforestation after work completion
B. The Water		
Hydrology/ Hydrogeology	Change in drainage morphology	• Progressive rehabilitation and tree plantation at the break of slopes and water channel banks • Construction and regular de-silting of silt ponds
	Change in stream depth	Apply slope stability measures to prevent erosion and siltation
	Reduction in stream volumetric flow	• Construction and regular de-silting of silt ponds • No backfilling along the creeks or provide retaining walls if it could not be avoided
	Inducement of flooding	• Schedule earthworks during summer, if possible • Improvement and maintenance of existing road / drainage canals. • Proper waste and garbage disposals • Construction and regular de-silting of silt ponds • Application of slope stabilization measures • The drainage system design should consider the topography, maximum flood level, existing structures, etc. • Possible reduction of flow in the waterways traversing flood-prone areas

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
Water Quality	Water pollution	• Training of concerned personnel on oil spill response plan • Provision of drainage leading to an oil-water separator at the motor pool • Designation of paved used oil storage area for the storage of used oil and oil-contaminated materials • Provision of silt traps, sediment control dams, and siltation ponds at stockpiles, staging areas, and active construction sites • Location of labor camps at least 500m away from a waterbody • Collection and treatment of hazardous wastes prior to final disposal • Provision of temporary sanitary facilities at the labor camps • Stockpiling of collected silt/sediment for possible reuse • Disposal of solid wastes according to environmental regulations • Prohibit parking, cleaning and repair of vehicle or heavy equipment near the water body
Freshwater ecology	Siltation of freshwater bodies reducing the growth and development of aquatic organisms	Properly constructed drainage system along strategic areas to minimize siltation during a heavy downpour supplemented with silt curtains, geotextiles or coconets
	High volume of organic materials in freshwater bodies may result in eutrophication	Regular removal of accumulated silts and proper disposal or storage to minimize further mobilization.
C. The Air		
Meteorology *Change in local micro-climate*	Increase in local temperature due to vegetation removal	• Immediate planting of trees in open areas to minimize the exposed areas and the possible increase in temperature along the RROW • Implement properly designed reforestation on both sides of the road
Ambient air quality	Increase in fugitive dust during construction	• Conduct of water spraying at dry and exposed areas • Provide wheel washing facilities at the construction site to remove muds at the tires of heavy equipment • Impose speed limit • Re-routing of construction vehicles at considerable distance from Area Sensitive Receptors (ASRs), if possible • Possible suspension of construction works during very dry weather and/or windy conditions when dusts are apparently to be dispersed at nearby ASRs • Regular visual inspection at the project site and conduct of mitigation measures to control high fugitive emissions, if necessary

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
	Gaseous emission from fuel-burning equipment	• Implement properly designed reforestation on both sides of the road • Monthly monitoring of TSP, PM_{10}, NO_2 and CO at ASRs during the 1st year of operation; and, reduce frequency of monitoring thereafter as necessary
	Air pollution due to SO_2, NO_2, CO, and TSP emissions from vehicles and heavy equipment	• Regular maintenance of heavy equipment and motor vehicles • Installation of off-site ambient air quality monitors
Ambient sound levels	Increase in ambient noise level	• Enclosure of the project area during construction • Minimize, if not totally avoid, construction works during nighttime • Operation of heavy equipment only during daytime • Provision of noise barriers such as walls or earth embankment particularly adjacent to schools, churches, and residential areas • Planting of trees along the edge of RROW or adjacent to the road fence for blocking the line-of-sight between the noise source and the receptors.
D. The People		
Acquisition of RROW	Possible tenurial/ land issue	• Completion of the parcellary survey • Implementation of a Compensation Plan for affected properties based on ROWA guidelines
	Displacement of settlers, properties, conflict with land ownership	Implementation of a Compensation Plan for affected properties based on ROWA guidelines
	Cultural / Lifestyle Change due to relocation	• Provision of adequate financial compensation coupled with sound financial management for the affected households • The plan should include availability of access to basic services for both relocatees and remaining communities adjacent to the project
Site Selection	Change in Physical Resources	SLTC may assist in the improvement of Mt. Makiling watershed to enhance its environmental condition and resources
Relocation of Affected Households	Threat on food security from loss of economic opportunities and assets	Provision of livelihood and skills training to affected households
Manpower Requirement for the Project Construction	In-migration	• Prioritize hiring of qualified local residents • Provision of temporary housing, amenities, and sanitary services to the workers
	Resource competition	• Prioritize hiring of local residents • Resources / Assistance to host communities of relocatees for the delivery of basic services

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
Health and Safety	Threat to Public Health and Safety	• Coordination with RHUs for possible regular monitoring of residents' health conditions and in the implementation of health care interventions • Resettlement Plan should provide strategy for livelihood / income restoration among the affected households
Expected Local Benefits	*Opportunities for employment*	Prioritize hiring of qualified local residents
	Income generation opportunities	Flourishing of entrepreneurial establishments to cater to the needs of project workers and users
		Prioritize purchase of construction materials from local suppliers
	Increase revenue to host LGUs	Prompt payment of taxes and business permits
Traffic Condition	Disturbance to travellers particularly at MakBan road and barangay roads that connect to Maharlika highway which will be used as access roads to the project	Implementation of Traffic Management Plan (TMP) which incorporates the following: 1. Installation of signages and warning systems at designated areas before, along and after the construction sites 2. Enclosure / Barricading of construction sites 3. Provision of lighting system adjacent and within the construction sites for the safety of road users and workers 4. Road widening in identified areas like MakBan road 5. Delivery of pre-cast super structure members during nighttime between 10:00PM to 5:00AM when traffic is expected to be lowest.
III. OPERATION AND MAINTENANCE PHASE		
A. The Land		
Terrestrial biology	Effects of air emissions and noise on terrestrial fauna	• Planting of appropriate plant species or sound barriers at the road perimeter to attenuate noise • Prohibit vehicles without exhaust mufflers • Impose speed restriction in sensitive areas
B. The Water		
Hydrology	Change in drainage morphology	Progressive rehabilitation and tree plantation at the break of slopes and water channel banks.
	Change in stream depth	Monitoring and maintenance of slope stabilization measures along the alignment
	Reduction in stream volumetric flow	

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
	Flooding	• Regular cleaning and maintenance of drainage system • Monitoring and maintenance of slope stabilization measures along the alignment • Proper waste and garbage disposal • Possible reduction of flow in the waterways traversing flood-prone areas
Water quality	Sedimentation of water bodies	• Maintenance of embankment slope ratio • Maintenance of retaining structures or stone pitching along the alignment, if necessary • Maintenance of vegetation along embankment slopes particularly near bridge location
	Water pollution	• Training of concerned personnel on oil spill response plan • Disposal of solid wastes according to environmental regulations • Collection and treatment of hazardous wastes prior to final disposal • Designation of paved area for the storage of used oil and oil-contaminated materials • Provision of sanitary facilities in the toll plazas
C. The Air		
Change in the local micro-climate	Increase in local temperature due to presence of road and its operation	Maintenance of properly designed reforestation on both sides of the road
Air quality	Gaseous emission from fuel-burning equipment	• Maintenance of properly designed reforestation on both sides of the road • Monthly monitoring of TSP, PM10, NO2 and CO at ASRs during the 1st year of operation; and, reduce frequency of monitoring thereafter, as necessary • Prohibit entry to the expressway of vehicles emitting excessive smoke (visual observation)
	Noise generation from vehicular movement along the TR4 alignment	• Provision of noise barriers such as walls or earth embankment particularly adjacent to schools, churches, and residential areas • Planting of trees along the edge of RROW or adjacent to the road fence for blocking the line-of-sight between the noise source and the receptors
D. The People		
Project Operation	Change in Physical Resources	SLTC may assist in the improvement of Mt. Makiling watershed to enhance its environmental condition and resources
Manpower Requirement	In-migration	Prioritize hiring of qualified local residents
	Resource Competition	Prioritize hiring of local residents
		Resources / Assistance to host communities of relocatees for the delivery of basic services

Project Phase / Environmental Aspect	Key Environmental Aspects / Potential Impacts	Measures for Prevention/Mitigation or Enhancement
Health and Safety	Threat to Public Health and Safety	Coordination with RHUs for possible regular monitoring of residents' health conditions and in the implementation of health care interventions
Safety	Traffic accidents	• Provision of proper and adequate signages • Impose speed restrictions • Provide emergency response medical team • Implementation of Social Development Plan and IEC
IV. ABANDONMENT PHASE (Details of the Abandonment Plan will be submitted to EMB at least 1-year prior to abandonment)		

C. Summary of Risks and Uncertainties

The project is not expected to present significant impacts or risks to the land, air and water components. The MGB identified geologic hazards such as fault lines, volcanic eruptions and landslides are quite far and are not expected to significantly affect the alignment. The result of geotechnical investigations will be considered in the detailed engineering design for the proposed alignment. The vegetation in the area consists of common species of plants and trees. Although 14 species are listed in the *IUCN Redlist of Threatened Species*, none is cited in DAO 2007-01 or *National List of Threatened Plants and Wildlife Species*.

The project location is not a flood-prone area except for a few sections experiencing localized flooding. The flood-prone areas will be considered like incorporating the maximum flood level of the rivers along San Pablo City to Tiaong, Quezon in the parameters for the road design. In general, the project operation will have minimal impact on the air quality in the area. During construction, the contractors will be regularly monitored regarding its compliance and implementation of environmental measures to minimize negative impacts on the air quality.

The major concern of the project is the acquisition of RROW resulting to dislocation of affected persons/ families; loss of livelihood, structures and properties; and, threat or uncertainty of resulting economic well-being. However, the acquisition of the RROW is the responsibility of the DPWH since this public utility is a project of the national government which is only being contracted to SLTC. In this regard, the SLTC has just completed the Resettlement Action Plan (RAP) that will be used by DPWH in the RROW acquisition for the project. The RAP presents the Resettlement Policy Framework (RPF) that defines the objectives, principles and eligibility criteria for Project-Affected- Persons (PAPs), entitlements, legal and institutional framework, and modes of compensation. It also specifies the participation and consultation procedures and grievance redress mechanisms that will be employed to compensate, resettle and rehabilitate the living standards of PAPs.

1.0 PROJECT DESCRIPTION

The South Luzon Expressway (SLEX) Phase II Toll Road 4 Project started when it was presented to the Toll Regulatory Board (TRB) for evaluation and approval at the beginning of 2012. The conduct of parcellary survey together with the road design materialized after the TRB approval of the project in the following year. An Environmental Compliance Certificate (ECC) was issued to the project in July 2014 based on the environmental study using the initial design of the TR4.

The project did not commence after the ECC issuance due to the revision in some sections of the alignment to minimize, if not totally eliminate, the potential problems during its implementation. The 56.862 km length of TR4 exhibits different characteristics such as type of ownership, land classification, topography, land use, land cover, etc. which should be considered in the road design and RROW acquisition. A re-alignment was determined based on one or combination of the following factors; (1) initial environmental study; (2) site verification or parcellary survey; and, (3) coordination with the concerned government agencies and/or private entities.

The final design shows a major re-alignment at the start and end sections of the TR4 or at TR4-A and TR4-E. Thus, an ECC amendment will be required to include the areas in the re-alignment which are not covered in the initial TR4 alignment. This is also a factor for the project delay since the workplan is in chronological order starting with the construction of the TR4-A progressing towards TR4-E.

1.1 Project Location and Area

The proposed South Luzon Expressway (SLEX) Phase II Toll Road 4 Project (the “Project” or TR4) will interface with the existing SLEX Phase I in Calamba City, Laguna, and ends in Tayabas, Quezon. The Project with a total length of 56.862 km is subdivided into five (5) sections (**Table 1-1** and **Figures 1-1 to 1-3**). It traverses 45 barangays located within the following cities/municipalities:

- Calamba City, Laguna;
- Sto. Tomas, Batangas;
- Alaminos, Laguna;
- San Pablo City, Laguna;
- Tiaong, Quezon;
- Candelaria, Quezon;
- Sariaya, Quezon, and
- Tayabas, Quezon.

Table 1-1: Project Alignment

Sections	Km. Station		LENGTH (km)	Interchange
	FROM	TO		
TR4-A (Sto. Tomas-Makban)	KM 56+518.116 14° 09' 15.44" N 121° 08' 43.47" E	KM 67+835.980 14° 04' 48.84" N 121° 12' 11.07" E	11.318	Sto. Tomas Interchange Makban Interchange
TR4-B (Makban-San Pablo City)	KM 67+835.980 14° 04' 48.84" N 121° 12' 11.07" E	KM 79+953.320 14° 02' 23.55" N 121° 18' 36.17" E	12.117	San Pablo Interchange
TR4-C (San Pablo City-Tiaong)	KM 79+953.320 14° 02' 23.55" N 121° 18' 36.17" E	KM 87+450.000 13° 58' 52.01" N 121° 20' 00.62" E	7.497	Tiaong Interchange
TR4-D (Tiaong-Candelaria)	87+450.000 13° 58' 52.01" N 121° 20' 00.62" E	102+450.000 13° 56' 18.00" N 121° 27' 47.33" E	15.000	Candelaria Interchange
TR4-E (Candelaria-Tayabas City)	KM 102+450.000 13° 56' 18.00" N 121° 27' 47.33" E	KM 113+550.000 13° 59' 04.20" N 121° 33' 39.60" E	10.930	Sariaya Interrchange Tayabas Interchange
TOTAL			**56.862**	

The project will start by connecting to the Toll Road 3 (TR3) at KM 56 + 518.116 in Calamba City. From this point, it will be traversing mostly brushlands and agricultural lands along the footslope of Mt. Makiling before crossing the MakBan road. The road alignment will be passing coconut and fruit plantations after the MakBan Interchange and agricultural lands towards the San Pablo Interchange. The TR4-B will be traversing a topography with slope ranging from 90 meter above sea level (masl) to 270 masl. The TR4-C is in a vicinity with the same land use as in TR4-B. This road section is generally flat to undulating with major portion traversing coconut plantation and farmlands as it approaches the Tiaong Interchange.

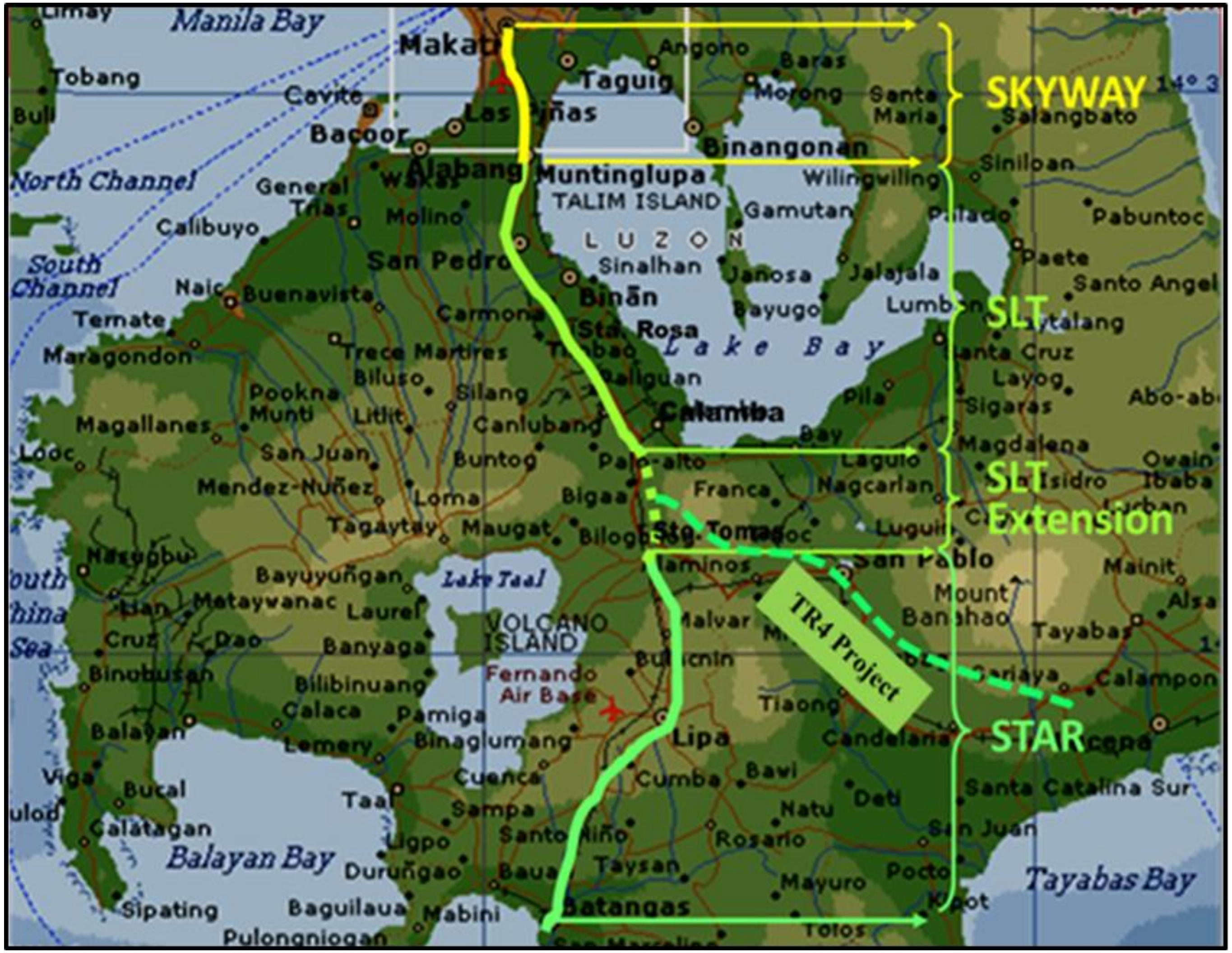
TR4-D also traverses agricultural lands with flattish to broadly undulating terrain. The TR4-D will be crossing several streams wherein the major river channels are deeply incised with almost vertical banks. In general, the TR4-D will be sloping upward from an elevation of 50 masl near Tiaong Interchange to 110 masl as the road segment approaches Candelaria Interchange. TR4-E follows the mid-slope of Mt. Banahaw with elevation of 110 masl to an average elevation of about 250 masl from the Sariaya Interchange to Tayabas Interchange. The area is mostly open grasslands to patches of cultivated lands with built-up areas near the national road.

The start of the TR4-A is accessible from the existing South Luzon Expressway (TR3) and its end along the MakBan Road. The other road sections from TR4-B to TR4-E are mostly accessible thru the Maharlika highways at the proposed interchange locations and local roads along Batangas, Laguna, and Quezon. Access to the project is also possible thru some local provincial, municipal and barangay roads that it will be crossing particularly from TR4-B to TR4-E.

The proposed re-alignment will be traversing most of the identified barangays in the initial TR4 alignment. The realignment will be traversing 45 barangays as compared to the 47 barangays from the initial design of TR4 (**Table 1-2).**

The proposed alignment will enclose an easement or road right-of-way (RROW) limits of 60 meters across. The alignment, however, may be adjusted during the detailed engineering design to account for minor geometric re-alignment. The project involves only the main alignment of the TR4 since all its access roads will be provided and/or under the responsibility of the Department of Public Works and Highways (DPWH).

The direct and indirect impact areas of the project are determined based on *Annex 2-2* of the Revised Procedural Manual of DENR AO 2003-30. The direct impact area refers to the area covered by the road alignment and its road right-of-way limits of 60 meters. It also covers all related support facilities that includes areas to be utilized during construction, such as contractor’s field/site facility areas, concrete batching plants and other temporary facilities. The direct impact area (DIA) is represented primarily by the road alignment (***Figure 1-3***). The indirect impact area (IIA) during construction phase will cover the barangays and the city / town center wherein the TR4 project will be located (***Figure 1-3***). During operation, a wider coverage of impact area is projected emanating from the National Capital Region (NCR) down south to Mindanao that will be utilizing the project as a transport route.



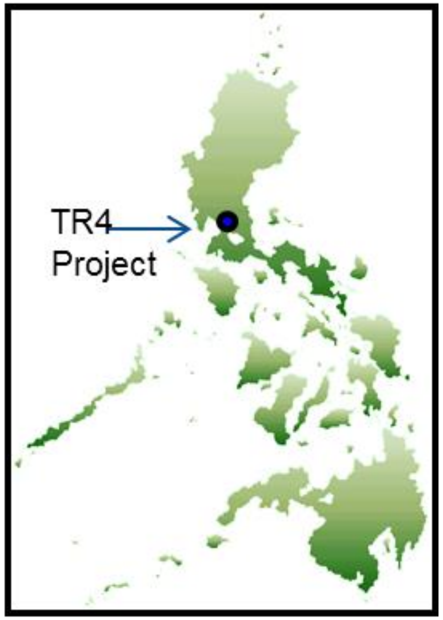
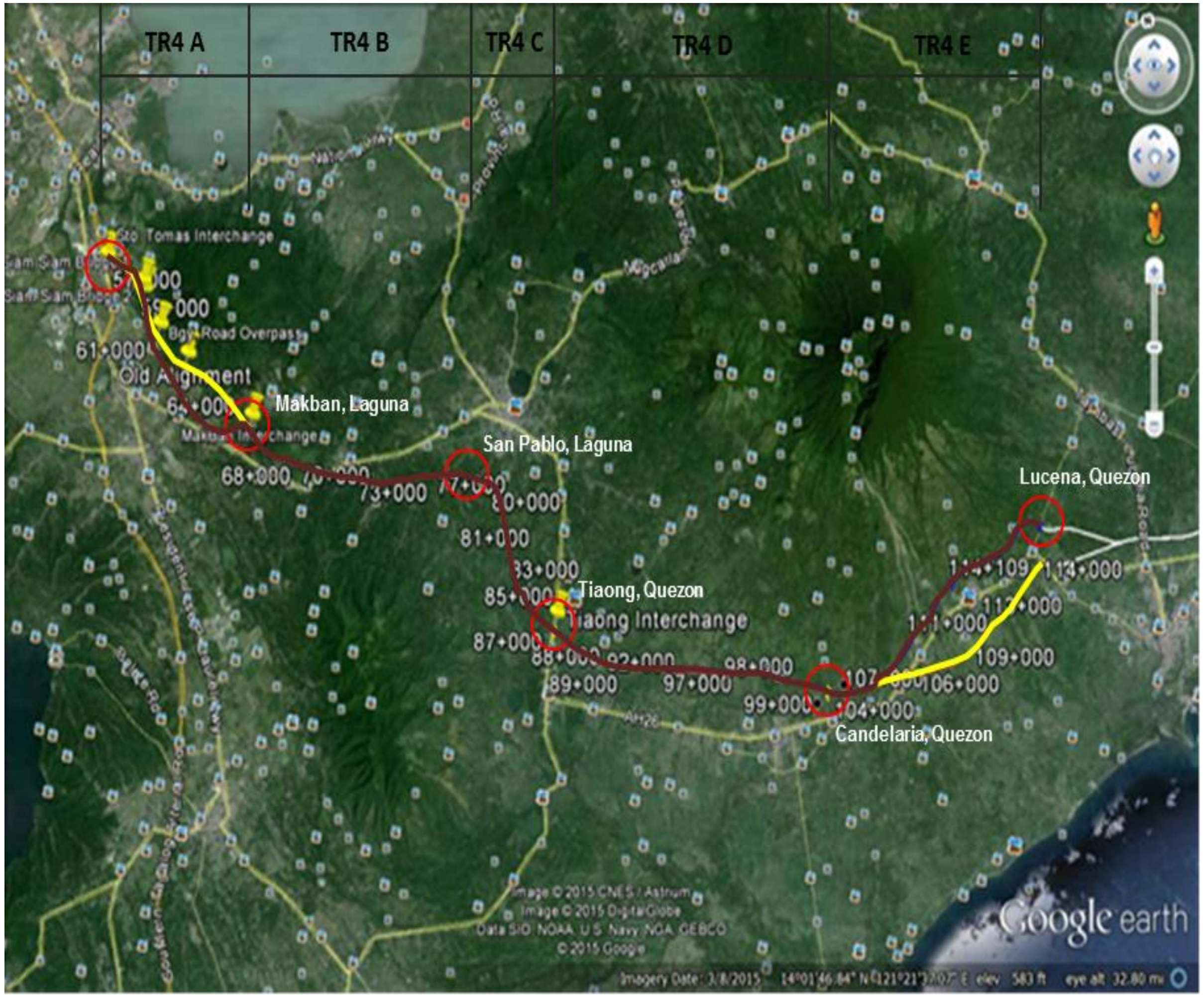


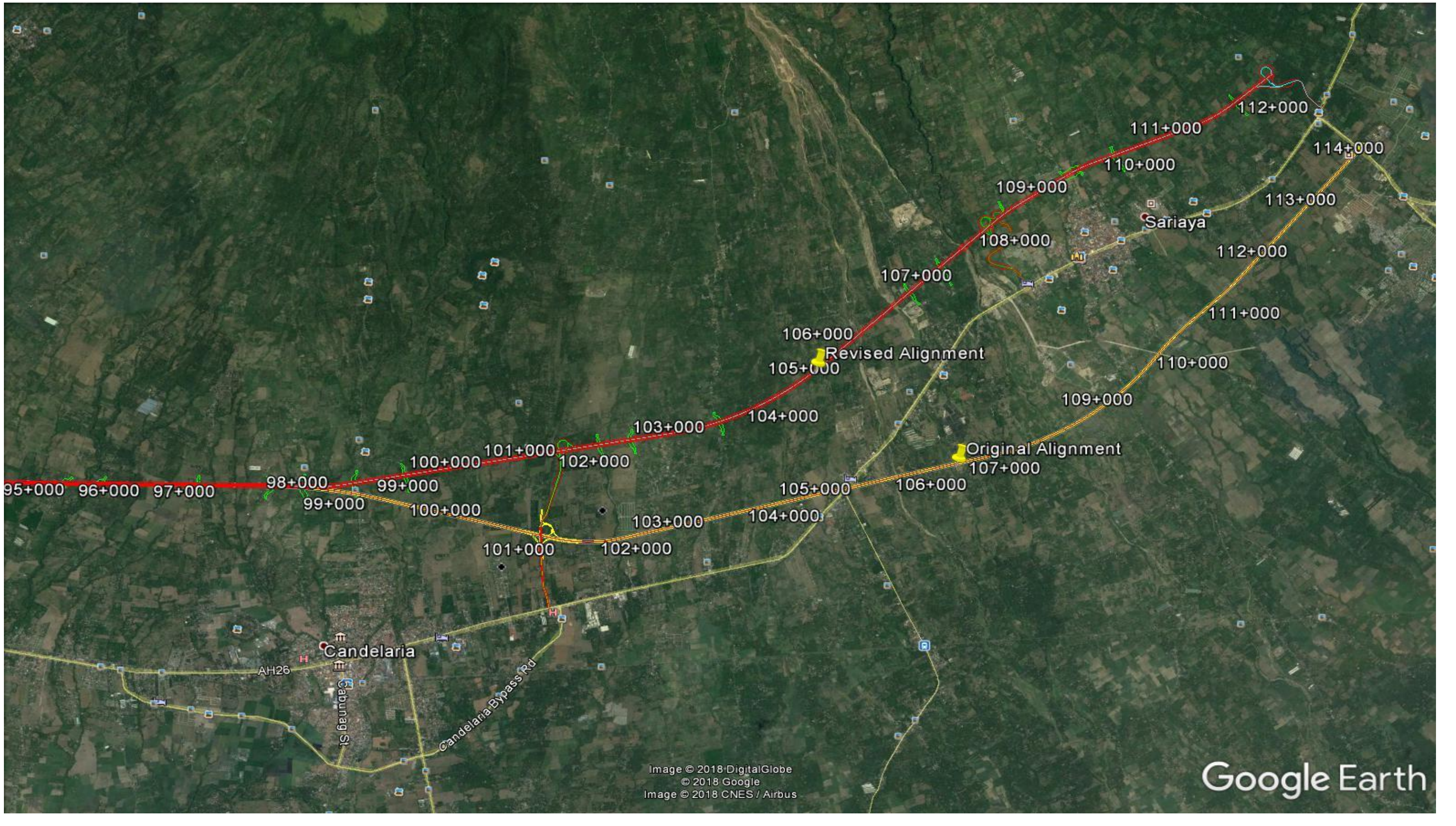
Figure 1-1: Location Map



LEGEND:

New & Final Alignment
Old Alignment

Figure 1-2: TR4 Alignment as depicted in Google Earth Map



(–) – Revised Alignment
(–) – Original Alignment

Figure 1-3: Topographic Map showing the TR4 Alignment

Table 1-2: List of Barangays and Impact Areas

NO.	LOCATION		Initial Design	Re-Alignment	Secondary Impact Area
	Barangay	City / Municipality		Primary Impact Area	
1	Makiling	Calamba City	-	√	
2	Puting Lupa		-	√	
3	Saimsim		√	-	
4	Camaligan		√	-	
5	San Rafael	Sto. Tomas	√	√	Sta. Anastacia
6	San Tiago		√	√	Sta. Elena
7	San Antonio		√	√	San Agustin
8	San Bartolome		√	√	
9	San Miguel		√	√	
10	San Vicente		√	√	
11	San Pedro		-	√	
12	Santa Elena		√	-	
13	Santa Anastacia		√	-	
14	San Agustin		√	-	
15	San Pablo		-	√	
16	San Felix		√	√	
17	San Jose		√	√	
18	San Juan		√	√	
19	San Andres	Alaminos	√	√	
20	San Juan		√	√	
21	Palma I		-	√	
22	San Miguel		√	√	
23	San Agustin		√	√	
24	San Benito		√	√	
25	San Roque		√	-	
26	Sta. Monica	San Pablo City	√	√	San Roque
27	San Miguel		√	√	San Rafael
28	San Gabriel		-	√	Sta. Ana
29	Soledad		√	√	
30	*Sta. Veronica*		-	√	
31	Sta. Maria		√	√	
32	Santissimo Rosario		√	√	
33	San Isidro		√	-	
34	San Antonio		√	√	
35	Bulakin	Tiaong	√	√	Anastacia
36	Cabatang		√	√	Lusacan
37	Lagalag		√	√	Talisay

NO.	LOCATION		Initial Design	Re-Alignment	Secondary Impact Area
	Barangay	City / Municipality		Primary Impact Area	
38	Lalig		√	√	
39	Anastacia		√	-	
40	Bukal Norte	Candelaria	√	√	Bukal Sur
41	Masin		-	√	Masalukot II
42	Masalukot I		√	√	Mangilag Norte
43	Mangilag Norte		√	√	
44	Mangilag Sur		√	√	
45	Masalukot II		√	-	
46	Malabanban Norte		√	-	
47	Concepcion I	Sariaya	√	√	
48	Sampaloc Sto. Cristo		√	√	
49	Pili		√	√	
50	Mamala II		-	√	
51	Balubal		-	√	
52	Gibanga		√	√	
53	Sampaloc I		-	√	
54	Sampaloc II		-	√	
55	Janagdong I		√	-	
56	Tumbaga II		√	-	
57	Tumbaga I		√	-	
58	Calumpang	Tayabas City	-	√	
59	Gibanga		√		
60	Isabang		√	-	
Total			47	45	12

Notes: Fonts

Black	*Barangays to be traversed at the TR4 initial design and re-alignment*
Blue	*Barangays to be traversed only at the proposed TR4 re-alignment*
Red	*Barangays to be traversed only at the initial design of TR4*

1.2 Project Rationale

The Philippine Government through the Toll Regulatory Board (TRB) has entered into a contract with South Luzon Tollway Corporation (SLTC) to improve the existing condition of SLEX and to extend the expressway from Calamba City to Tayabas City in Quezon. This is one of the priority projects of the Philippine Government to date, and part of the study on High Standard Highway Network Development and the Metro Manila Urban Expressway System Study in 1993.

An Environmental Compliance Certificate (ECC) has been issued for the project on July 11, 2014 (***Annex D***). A re-alignment of the TR4 has materialized in consideration of the concerns of some stakeholders and based from the results of parcellary survey. The primary factors considered for the proposed realignment include the following: existing land use, general topography or terrain, communities/people to be affected, and accessibility. Based on these criteria, a re-alignment of Section TR4-A will be implemented to avoid the existing geothermal injection wells and pipes of the MAKBAN Geothermal Power Plant and to move the alignment farther away from the buffer zone of Mt. Makiling. In addition, a realignment of Section TR4-E will be done to avoid the existing developed subdivision at the proposed endpoint of TR4 in Lucena City; to minimize possible problems on the cost for the right of way and crossing the structures from the existing and future major and minor roads such as eco-tourism road; and, to be more economical for the Philippine Government since most of the lots along the realignment's ROW are agricultural land.

Based from the above-mentioned considerations, TR4-A will be shifted on the southern part and will be located at 15 barangays instead of the initial 16 barangays in Calamba City and Sto. Tomas, Batangas. The final location will be traversing mostly agricultural lands or brushlands, and nearer to the highway but farther away from the buffer zone of Mt. Makiling. On the other hand, the TR4-E will be shifted at the northern side of Daang Maharlika which is nearer at the footslope of Mt. Banahaw. Just like TR4-A, the new location is comprised mostly of farms and brushlands with slight built-up areas in the vicinity. Since the changes are primarily along the internal route and not on the identified destinations / locations of toll plazas, the realignment is not expected to affect the traffic demand or cause a demand shift. The summary of the proposed realignment is presented in **Table 1-3.**

Table 1-3: Features of the Proposed Realignment

TR4 SECTIONS	FEATURES OF REALIGNMENT
TR4-A	Will avoid the MakBan injection well underneath the initially-designed TR4 alignment.
	Quite far from the footslope of Mt. Makiling
	Less built-up area to be affected
	More accessible
TR4-B	*No proposed change in the alignment*
TR4-C	*No proposed change in the alignment*
TR4-D	*No proposed change in the alignment*
TR4-E	Request of the general public to transfer the road alignment to the northern side of the national road
	Less built-up areas to be affected
	Less disturbance to the traffic flow at the existing roads

1.2.1 Specific Objectives

The Project has been proposed for the following reasons:

a) To contribute to the economic development of the growth centers in Region IV, Region V and other nearby regions.

The role of the three provinces (Laguna, Batangas, and Quezon) in the regional and national context stems from their being part of the CALABARZON development corridor. Endowed with beautiful land and seascapes, the three provinces can maximize their income through tourism activities while developing its agricultural, fishing and agro-industrial and manufacturing products that cater to the domestic and international markets. Thus, it is important to ensure that these provinces are able to perform and maintain their roles within the Region's framework. The development of additional gateway to these provinces such as the implementation of planned major transport projects like the TR4 will complete the missing link for the extension of the SLEX to Metro Lucena.

The TR4 scheme is intended to serve the main population centers in Quezon Province and San Pablo City in Laguna and spur further economic development and access to the National Capital Region. The Province of Quezon is the country's leading producer of coconut products, with fishing forming a large part of the province's economy.

Laguna, which is directly south of Metro Manila, is the third largest province in Region IVA. Laguna's proximity to NCR makes it a strategic site for domestic and international business. Since SLEX Phase 1 was completed, numerous industrial/ economic zones have been developed in the area. San Pablo City, which has the fifth largest population in Laguna, is expected to develop into the Information and Communications Technology hub of Southern Luzon upon the completion of the TR4 project.

b) To provide faster and safer access to Regions IV and V, and alleviate the worsening traffic congestions in the area.

There is only one (1) existing national highway (i.e., Daang Maharlika) that runs parallel with the proposed Project route. At Daang Maharlika, a two-lane highway, traffic congestions are occurring along several areas most especially within the town/city proper. With the construction of TR4, travel time will be significantly reduced.

A 2007 time-and-motion survey showed that the average travel speed along Daang Maharlika was 40 kilometers per hour (kph). In addition, a significant increase in traffic volume up to year 2036 is forecasted (**Table 1-4**). Thus, the extension of SLEX will ease existing and future traffic congestion in the area.

Table 1-4: Projected traffic Volume Up to 2036 (Source: SLTC 2012)

SECTION	ALL VEHICLE CLASSES				
	2011	2016	2021	2026	2036
Calamba to Sto. Tomas IC	59,487	69,234	78,216	85,492	97,962
Sto. Tomas IC – Sto. Tomas	46,501	54,588	62,336	67,210	76,070
Sto. Tomas IC – Alaminos	13,946	17,522	19,901	23,375	30,009
Alaminos – Tiaong	10,962	13,579	16,466	20,075	24,957
Tiaong – Candelaria	12,048	14,992	18,322	22,828	27,903
Candelaria – Tayabas	12,732	17,102	20,545	24,830	29,923
Total (TR4 full)	**49,687**	**63,195**	**75,235**	**90,909**	**112,792**

The SLTC will strictly implement the speed limit to ensure absolute safety for all motorists. Legally, the maximum allowable speed along the tollway is 80 kilometers per hour; but given certain conditions, especially when on a flat terrain, vehicles are allowed to travel up to 100 kilometers per hour.

For the same reason on safety, a minimum speed limit will be enforced along the TR4. Minimum speed is 60 km per hour; otherwise, a mobile patroller's assistance is necessary to protect slow moving vehicles from posing a hazard to other fast moving motorists.

1.2.2 Project Benefits

Upon completion, the TR4 will link the provinces of Batangas, Laguna, and Quezon including the Port in Lucena City to the key economic hubs in Manila. The linked highway is expected to convey more than 60% of the country's exports through SLEX from the industrial hubs not only in the CALABARZON corridor but as far south as Mindanao. Travel time from Lucena City to Sto. Tomas in Batangas until the Alabang Viaduct is estimated to take a little over 1 hour, compared to the present 3 hours.

The SLEX TR4 will offer a seamless nautical and land highway that will save both precious time and transport cost for individuals, passengers, businesses and freight movement. In addition, it is expected to decongest Metro Manila by opening up new centers of business and commerce further south via TR4.

1.2.2.1 Ease of Travel, Safety and Convenience

The good motoring experiences at SLEX Phase 1 after its rehabilitation will practically be duplicated when the TR4 becomes operational. With all these benefits already being enjoyed by CALABARZON motorists, the TR4 will provide travelers and the transport industry a public service that is at par with internationally-approved traffic and road maintenance standards and practices.

Better roads like TR4 yield benefits that are far beyond motoring. They become economic lifeline that helps the industries and businesses grow and generate more jobs. Likewise, a new road to be built called TR4 puts families closer to their loved ones. It raises the quality of life for Filipinos.

1.2.2.2 Meeting Motorists' Expectations

With wider lanes which will allow safer and shorter travel time, the new and well-lighted TR4 toll plazas will be installed. Considering the system compatibility with Skyway and/or STAR Tollway, the long queues of vehicles before and after the toll plazas would become thing of the past.

Street lamps will be installed along and near interchanges to extend visibility and reminders to all motorists that decelerating and accelerating vehicles are coming up ahead. Bigger and wider culverts are to be constructed in flood-prone areas while see-through fences are to be maintained to offer harmony with nature and neighboring residential/commercial developments.

1.2.2.3 New and Improved Road Safety Devices

A key to the TR4 toll ways traffic management system in responding quickly and in real-time are the CCTV cameras closely spaced at 1 kilometer apart. Any stalled vehicle, pedestrian, or strayed animal can be identified by the cameras so that traffic patrol teams can be alerted to respond immediately. This pro-active monitoring system ensures safer and secure SLEX for the motorists.

Huge electronic message boards called *Variable Message Signages (VMS)* will also be installed both on the north and south bound lanes. These VMS provides real-time advisory to motorists on traffic situations, exact location of accidents (*if any*), and other traffic advisories.

Also, TR4 will be equipped with motorist emergency lay-bys (emergency area) that will be strategically located kilometers apart; serving as emergency and parking stops for drivers who need them.

1.2.2.4 Lower Traffic Incidence

Traffic records in 2007 up to the present reveals lowering accident occurrences inside the newly-built SLEX. Now under the care of SLTC, the travel safety record in 2010 is seen to have improved by 70% compared to the 2007 record. Accidents have been reduced to 50% in 2009, and 30% for the first 3 months of 2010 as compared to the 2007 record.

To date, the average record of traffic accident from 2011 to 2014 has accounted 1.33% major injuries and 2.20% fatalities. More than 80% of these accidents were due to collision of 2 or more vehicles, with 70% caused by driver's or human error.

1.3 Project Design Considerations / Alternatives

1.3.1 Project Design Considerations

1.3.1.1 Siting of the Road Alignment

Considering that it is a government project, the re-alignment of TR4-A and TR4-E was concentrated on having the layout plan along public lands and open areas to minimize problems in the right-of-way acquisition. This is mostly attained at sloping areas or mountainous terrains. The alignment is set relatively close to the feasible access points particularly at the footslope or just downhill of the mountain for economic consideration, aside from avoiding possible intrusion to settlement of indigeneous people. However, this configuration increases the possibility of crossing the waterbodies that is draining the mountain. The construction of bridges against setting the alignment at higher elevation to avoid crossing the waterbodies is a major factor in finalizing the TR4 alignment.

Majority of the slightly sloping to level lands along the TR4 alignment are private properties. In this case, the main consideration is to minimize the negative impacts to property owners and/or users of the land. This is realized by placing the TR4 alignment in the following land use in order of priority:(i) idle or open areas;(ii) agricultural lands;(iii) fruit/tree plantations; and, (iv) small settlements. This will minimize the displacement of affected families, removal of structures and facilities, and the disruption of economic activities in the area.

The existing road/s in the area will be connected to the interchanges going to the toll gate as access to the TR4. No disruption on the driving pattern of the motorists is expected except for having an option to use the TR4 as the route to their destinations.

1.3.1.2 Technology Selection / Operation Processes

- Both horizontal and vertical alignments are designed to minimize the demolition of buildings and land acquisition. Overpass at the intersections with national roads, barangay roads and farm crossing have been based on the actual site conditions. TR4 is passing over and sometimes passing below these roads. The clearance above roadway is generally 5.20 m for uniformity with TR2 and TR3 and 6.80 m above railways.

- The center line of the TR4 alignment was established such that it minimizes the cut and fill works and the land acquisition by reducing the median similar to TR3.

- The alignment has been designed to avoid disturbance to industrial areas in the Municipality of Sto. Tomas by locating it in agricultural lands or brushlands. This will also avoid increasing air pollution in the industrial area due to the fuel combustion of vehicles using the TR4.

- TR4 starts at Sta. 54+393.48 of TR3. The alignment bends to the southeast through a buffer zone between the light industry area and the protected zone of Mount Makiling. The alignment continues up to Brgy. San Pablo, Sto. Tomas, Batangas then shifting slightly to the east due to the presence of industrial buildings and the road to Makban Geothermal. This will also minimize the increase of air pollution in the industrial areas and incompatibility with the land use or classification.

- The TR4 alignment at the intersection in Alaminos, Laguna and the national road is designed to avoid the double crossing on the barangay road and away from Malaking Tubig River. The TR4 alignment is set away from Malaking Tubig River so that it will not serve as obstruction in conducting activities in the area particularly during calamities and typhoons.

- TR4 alignment in Makban has the characteristics of a mountainous area with several valleys and steep slopes. Hence, the design standards used are those applicable to such terrain conditions. However, the alignment from San Pablo City, Laguna to Candelaria, Quezon follows the standards for rolling terrain while flat terrain from Sariaya to Tayabas City, Quezon. The design standards to be implemented will minimize the waste generation particularly during construction and positioned the TR4 alignment visually compatible with the vicinity.

- The alignment is modified to pass between an existing road and its adjacent creek to avoid the Ayala Greenfield Golf and Leisure Club located at Barangay Saimsim, Calamba, Laguna.

- The alignment at Makban, Sto. Tomas, Batangas passes through mountainous terrain. Vertical crest curves are designed to provide the required stopping sight distance rather than overtaking sight distance. This also allows minimum length of the curves, hence the volumes of earthworks. Allowing the sight distances to the barest minimum will result in cut earth materials during construction. However, this approach will require the carriageway lane marking to indicate a no overtaking signage and similar appropriate signages. This will entail an added cost but will ensure the safety of motorists during its operation.

- Alignment from San Pablo City to Tiaong is designed taking into consideration the maximum flood level of the rivers, the topography of the barangay, farm roads crossings, and the existing railways. This will prevent inducement of flooding due to the presence of the TR4 alignment.

The hazard maps from Philippine Institute of Volcanology and Seismology (PHIVOLCS) and Mines and Geo-Sciences Bureau (MGB) were used as reference to determine the natural hazards expected along the TR4 alignment. The Liquefaction Hazard Map of PHIVOLCS showed that the TR4 alignment is not susceptible to ground shaking, ground rupture and liquefaction since it is quite far from the nearest active fault. The TR4 alignment has low susceptibility to landslide except at the river crossing based on the MGB Landslide Susceptibility Map. However, the MGB Geohazard Map indicated low to moderate susceptibility to flooding. Together with the projected increase in rainfall due to climate change, the susceptibility to flooding of low-lying areas particularly in the San Pablo City to Tiaong section is incorporated in the design of the TR4 alignment.

In summary, the proposed location and design of the TR4 alignment will minimize the waste generation, particularly from the demolition of existing structures and ground excavation during construction. It will also prevent the potential increase in air pollution during operation by locating the TR4 alignment farther away from industrial areas. The project will be patronizing the local suppliers for the raw materials to be used during construction. Coordination with the local water and power suppliers will be prioritized for the provision of the project requirements. The operation of electric generators and usage of surface water/groundwater will be limited in the mountainous areas wherein there are no existing supply. **Table 1-5** below provides the key environmental considerations in choosing the final alignment for TR4 and the bases in the selection of alternatives.

Table 1-5: Matrix of Key Environmental Considerations

Particular Segment of the TR4 Alignment	Key Environmental Considerations	Remarks
Km 56 to 67	Minimize earthwork cut and fills	Entire alignment
Km 57	Avoid disturbance and increase of air pollution in the industrial areas	Calamba Section
Km 58	Avoid disturbance and increase of air pollution in the industrial areas, and compatibility with the land use	Calamba section
Km 67	Avoid disturbance and increase of air pollution in the industrial areas	Shifting to east; Makban Interchange
Km 62	Minimize waste generation during construction at the valleys and steep slopes	Sto. Tomas section
Km 79 to km 100	Minimize waste generation during construction at the rolling terrain	San Pablo to Candelaria
Km 103 to km 110	Minimize waste generation during construction at flat terrain	Sariaya to Lucena
Km 57+500	Original alignment will cross the golf course	Calamba section (realignment) final alignment will no longer cross the golf course
Km 57 to Km 58	Construct 640 meter viaduct	High in cost
	Stopping sight distance	
Alignment from San Pablo to Tiaong	Avoid possible inducement of flooding in the area	Barangay/farm roads and railroads crossings
Entire alignment	Minimize demolition of buildings, land acquisition costs, and increase in air pollution	Calamba - Alaminos - San Pablo

Particular Segment of the TR4 Alignment	Key Environmental Considerations	Remarks
	Traffic decongestion	Alaminos - San Pablo
	Main population, business and agricultural centers	San Pablo - Tiaong - Candelaria - Sariaya
	Industrial and economic zones	Sariaya - Tayabas - Lucena
	Daang Maharlika which is one directional highway	Laguna - Quezon
San Pablo Interchange	ICT hub	Promote employment
Tayabas Roundabout	Fish port	Easy access

1.3.1.3 Traffic Volume

The project will optimize the connection of the provinces of the CALABARZON (Cavite, Laguna, Batangas, Rizal and Quezon) with the Metro Manila thru the South Luzon Expressway. In addition, it will extend its operation to connect the southeast and southwest of Luzon with Quezon and Laguna.

1.3.1.4 Project Area

TR4 scheme intends to serve the main population, business and agriculture centers in Quezon and Laguna Provinces. Quezon is one of the country's leading producers of coconut products. Within Quezon, the bulk of population is centered at Lucena City and its adjacent city and municipalities. Lucena City also has a port with passenger and products terminal, in addition to a fishport.

Laguna is directly south of Metro Manila and its proximity to Metro Manila makes it a strategic site for domestic and international business. Since SLEX Phase 1 was completed, numerous industrial / economic zones, including high end housing and institutional/touristic establishments have been developed. San Pablo City is expected to develop into the Information and Communications Technology hub of Southern Luzon.

1.3.1.5 Existing Road Network

Currently, there is one national highway called Daang Maharlika, running parallel to the proposed TR4 alignment. The highway is mainly one-lane in each direction. A considerable amount of traffic congestion in the built-up areas is still a daily phenomenon along the highway even with its ongoing expansion.

1.3.1.6 2012 TR4 Traffic Demand and Revenue Forecast

A 2012 traffic study was conducted by Parsons Brinckerhoff Philippines, Inc. (PB) as commissioned by SLTC (**Annex E**). The highlights of the above-mentioned study are presented below.

The traffic volume was observed to be moderate to heavy in the roads near the vicinity of the proposed TR4 alignment during the morning peak of 8:00 AM – 9:00 AM. The volume gets heavier as traffic approaches the city or town proper. The link which has the heaviest volume is the Calamba City – Sto. Tomas link (**Figure 1-4**).

The traffic hourly variation showed that the peaks of traffic volume occur between 8:00 – 9:00 AM at 6.19% and 3:00 – 4:00 PM at 5.48% (**Figure 1-5**). There was an observed gradual decrease in the afternoon traffic from 6:00 PM to 4:00 AM as compared to the daytime volume. The majority of the vehicle volumes during morning and afternoon peak hours were cars with 50% followed by PUJs and trucks with 19% each.

The general trend of traffic along the study area decreases eastward from Calamba City. However, the traffic volume starts to increase towards Metro Lucena after passing the Municipality of Candelaria. It could be due to the road connecting the Lipa City and San Juan-Rosario in Batangas from its southern portion, which is a project of DPWH Region IV.

It was observed that most of the jeepney routes are much localized and mainly serve the demand between the larger urban centers. It could be presumed that jeepneys are unlikely to switch to the proposed expressway due to the local nature of their service.

In summary, the results indicated that the TR4 (Phase 2) corridor will have a lower level of traffic compared to SLEX Phase 1 and STAR corridors (**Figure 1-4**). The light vehicles such as cars, jeepneys, and FXs constitute the highest proportion of the road users accounting to about 75% of the total vehicles on the road. Other vehicles that have been observed are tricycles.

A travel time and delay survey was conducted considering the existing routes linking and/or along the proposed TR4 alignment as follows:

Table 1-6: List of Existing Routes

Route No.	Route Name
1	Calamba to Pagsanjan
2	Calamba to Candelaria
3	Calamba to Padre Garcia / Tiaong
4	Padre Garcia / San Juan to Lucena City

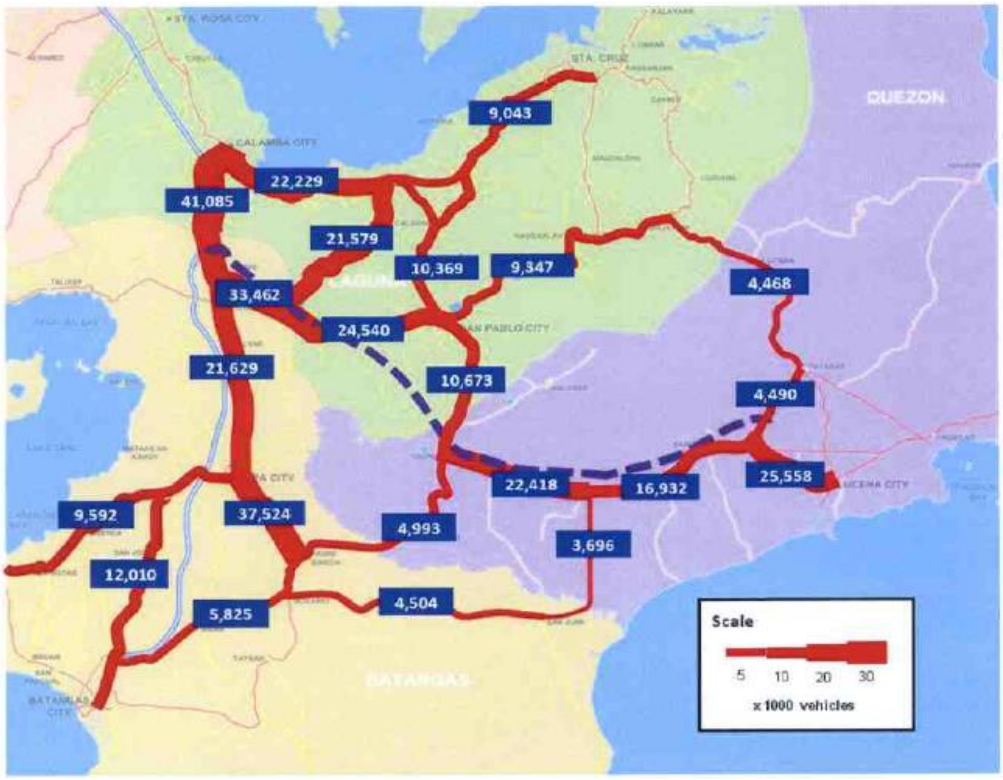


Figure 1-4: Traffic Volume during Peak Hour

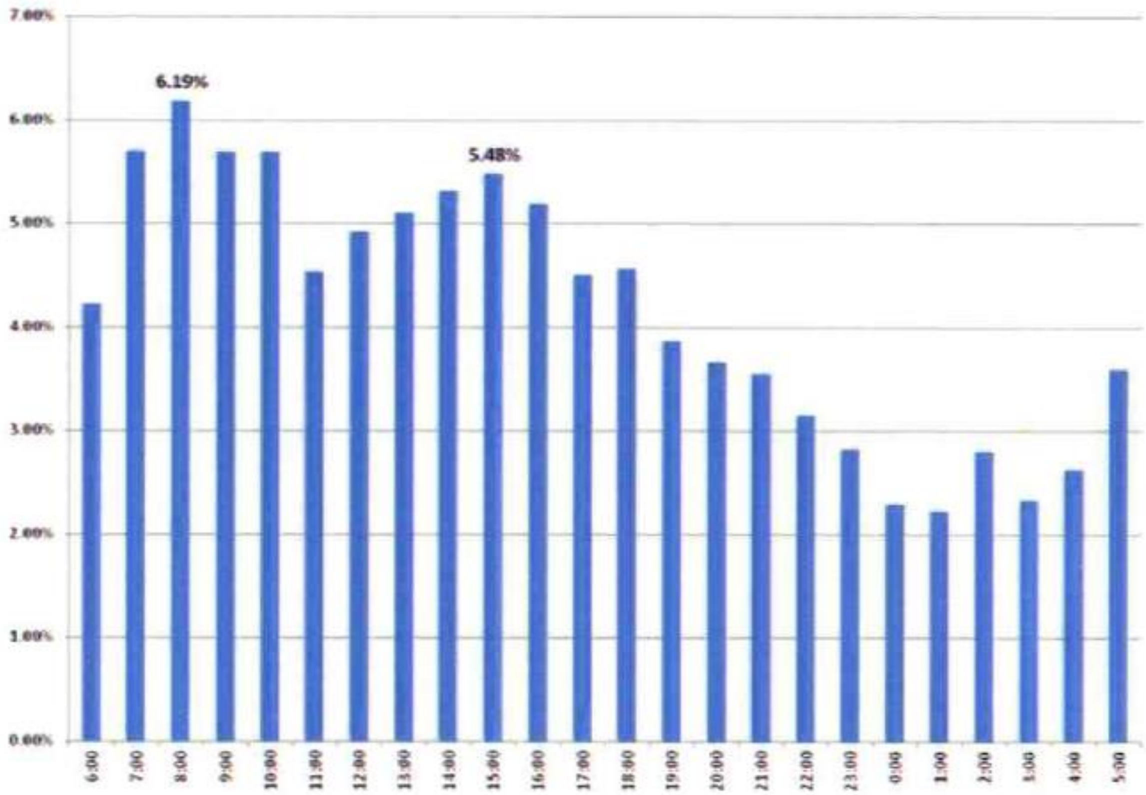


Figure 1-5: 24 Hour Traffic Distribution

Isochrones were constructed to represent actual travel time for each route. The routes were linked as per starting point in Calamba City and endpoint per respective route. Results indicated that the travel time for Route 2 (linking Routes 2 and 4) takes almost 3 hours to reach Lucena City with average speed of only 35 kilometers per hour (kph) (**Figures 1-6 to 1-7**).

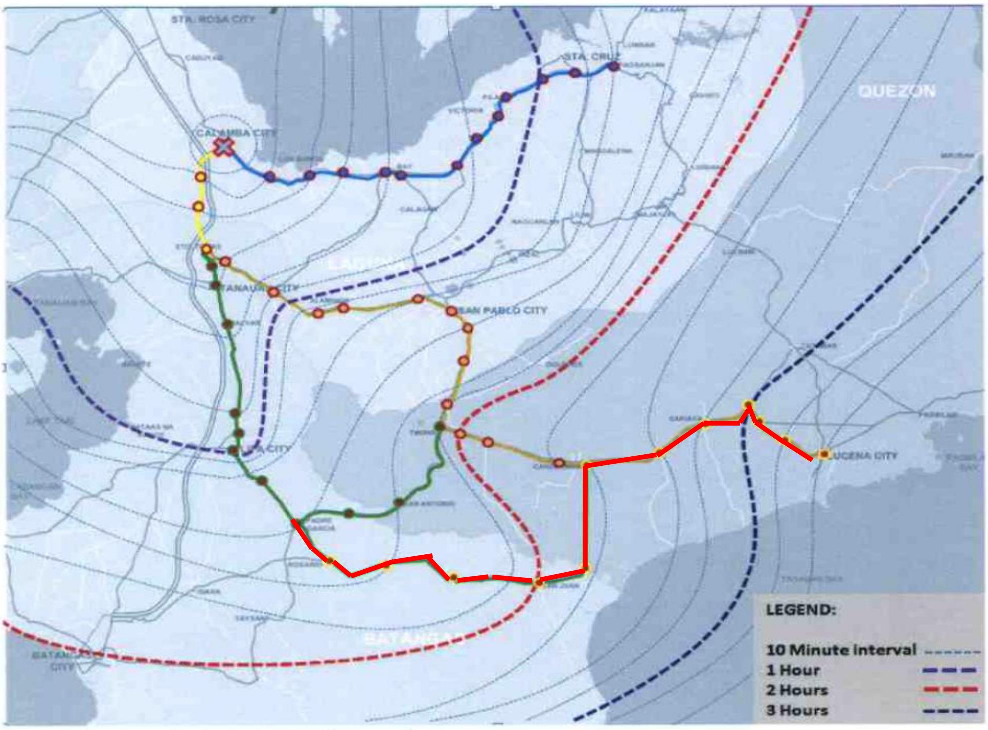


Figure 1-6: Isochrones of Travel Time

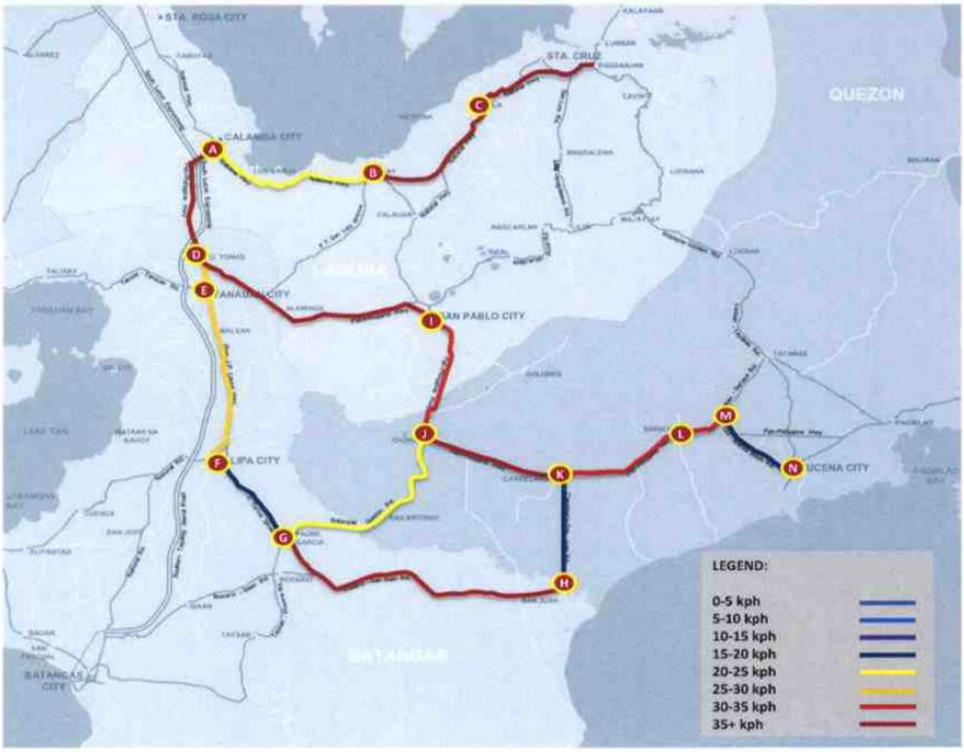


Figure 1-7: TTD Travel Speed *(Source: 2012 Traffic Study)*

The traffic study assumed a Level of Service C (LoS C) to determine the maximum capacity of TR4. LoS C is still in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to maneuver within the traffic stream. Based on this assumption and the results of traffic survey, the maximum capacity of 50,000 vehicles per lane per day is computed which was used in the traffic demand forecasting.

The traffic demand forecasts in annual average daily traffic (AADT) assuming an average scenario is presented in **Table 1-7**. In addition, the traffic forecast was based on the initial design which did not include a tollway in San Pablo City. The inclusion of the San Pablo City tollway in the final design cropped up from the result of the traffic study.

Table 1-7: Summary of Base Traffic Forecast for the Average Scenario (AADT, veh/day)

Segments	2015	2020	2025	2030	2035	2040	2045
Sto. Tomas - Alaminos	8,298	23,666	26,481	29,294	32,865	36,435	40,278
Alaminos – Tiaong	7,826	22,483	24,548	26,611	32,717	38,821	45,682
Tiaong – Candelaria	5,531	16,151	18,544	20,936	23,779	26,621	29,664
Candelaria – Sariaya	4,946	14,430	16,681	18,930	22,026	25,121	28,459
Sariaya – Lucena City	4,479	13,170	15,126	17,080	20,291	23,501	26,980

(Source: 2012 Traffic Study)

A minimum of 50% diversion to TR4 of the base traffic is projected at the initial stage of the project operation (**Table 1-8**). The peak of traffic diversion to TR4 is projected in 2020 and will gradually decrease thereafter.

Table 1-8: Base Traffic Diversion to TR4 (%)

Segments	2015		2020		2030		2040	
	AADT	%	AADT	%	AADT	%	AADT	%
Sto. Tomas - Alaminos	4232	51	11762	49.7	13446	45.9	14428	39.6
Alaminos – Tiaong	3960	50.6	11826	52.6	13412	50.4	16460	42.4
Tiaong – Candelaria	3009	54.4	9125	56.5	10656	50.9	11926	44.8
Candelaria – Sariaya	3170	64.1	9596	66.5	11642	61.5	12887	51.3
Sariaya – Lucena City	2737	61.1	8363	63.5	9975	58.4	11656	49.6

Note: AADT – Annual Average Daily Traffic (vehicles/day)
(Source: 2012 Traffic Study)

The corridor traffic growth will be higher when the TR4 is built at an average of 3.77% per year as compared to the status quo or without TR4 at 2.27% per year (**Figure 1-8**). The expected increase in the traffic growth could be attributed to the following:

- The project will attract traffic from other corridors (e.g., the Laguna de Bay corridor and the Sto. Tomas to Batangas City) which would be diverted to the TR4;
- TR4 will release latent traffic demand, which is not evident due to condition of the current roads;
- The project will also serve as catalyst to future enhanced land development within the corridor; and
- The project will enhance longer commuting from south-eastern part of Quezon province and the rest of Region V provinces.

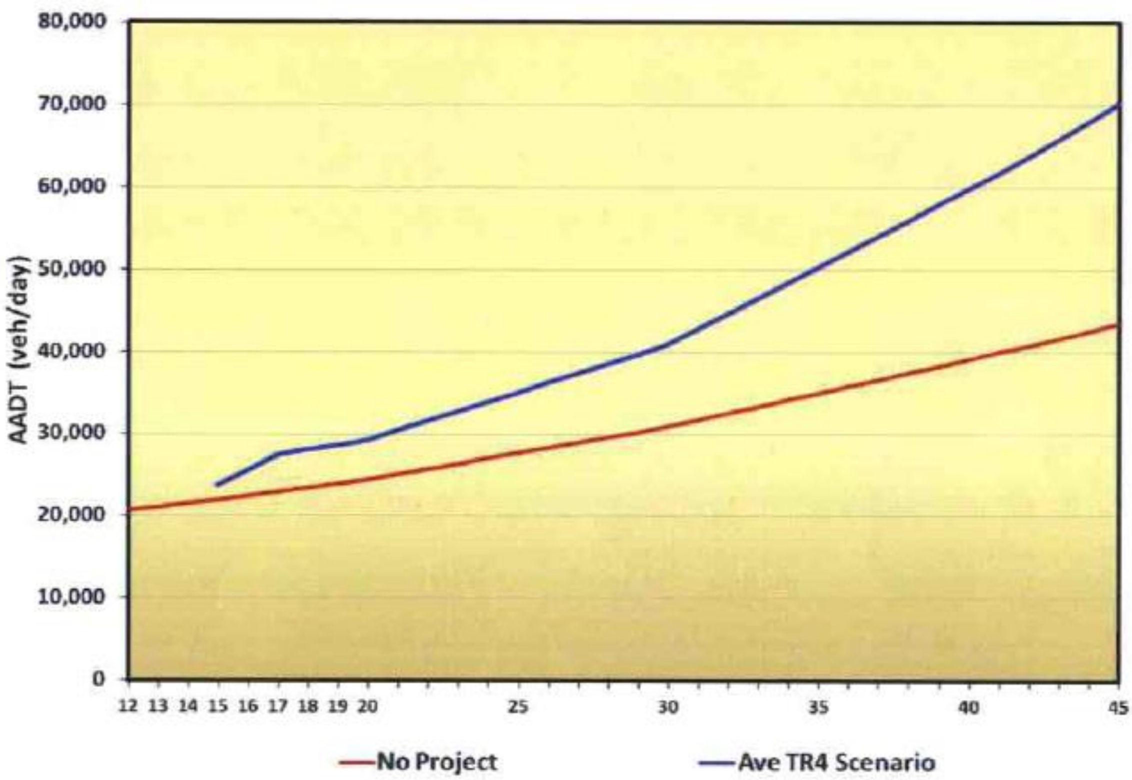


Figure 1-8: Corridor Traffic Growth

1.3.1.7 General Site Conditions

In general, the project area is not susceptible to any geologic and hydrologic hazards as per geohazard evaluation of the Mines and Geosciences Bureau (MGB). The possible occurrence of the geohazards such as volcanic eruption and seismic events are expected quite far from the project area.

The regional landscape reflects a strong volcanic imprint manifested by the presence of numerous active and inactive volcanoes. The Taal Volcano is the nearest active volcano which last erupted in 1977.

The active fault systems surrounding the project site are the West Valley Fault, the Philippine Fault, and the Lubang Fault. On the account of the movement of the tectonic features and fault systems, the project region experiences one earthquake per year of Magnitude 5 and above. The seismic events tend to cluster in the offshore region along Verde Island Passage between the southwest coast of Batangas and Mindoro Island.

Local geologic structures observed in the immediate vicinity of the proposed alignment are the nearly horizontal to low angle, thin- to medium- bedded and massive tuffaceous ignimbrite deposits. There were no geological lineaments or faults encountered at the project area.

The entire project alignment is located in low to moderate susceptibility to flooding. However, localized flooding in some sections are reported such as in San Vicente, Sto. Tomas, Batangas; San Pablo City to Tiaong, Quezon; and, Barangays Tumbaga I and II in Sariaya, Quezon.

Except during the construction phase, the project operation will not require significant power, water and materials. The proponent could coordinate with the local service providers for the water and electricity requirements at the tollways and interchanges during the project operation. The contractors will be responsible for the water and power requirements during construction, either by installing their sources or coordinating with the local service providers.

1.3.2 Summary and Comparison of Alternatives

Initially, the alignment will be affecting approx. 5.0 hectares (has.) of a golf course in Calamba City. The final design has shifted the alignment to the existing concrete road and its adjacent creek to avoid the impacts on the golf course. The creek is very wide and very deep wherein the alternative will be constrained by the required design standards. The length of girders and column (posts) will prohibit safe and sound construction of the bridge which entails high additional cost. Thus, this would necessitate the construction of a 640 meter long viaduct crossing the creek.

The initial design did not include the San Pablo Interchange but the result of traffic study shows a better traffic flow in case that it will be included in the alignment of TR4. The project will provide better and extensive services if the San Pablo interchange will be provided considering that the city is a major destination point. Thus, the proposed realignment will have the San Pablo Interchange as one of its major components.

The supplies and materials, water, fuel and power requirements during construction are quite extensive. The contractors will be responsible in providing the manpower and their required amenities, construction supplies and materials, water, power, fuel, etc. The contractors could prioritize the local dealers and/or service providers to supply their requirements. This will minimize the project impacts since the local service providers have already existing environmental measures as part of their operation.

On the other hand, the contractors could also opt to utilize the river/s for their water requirements during construction activities. They could apply for *Water Permit* from NWRB for the use of the streamflow at the river/s adjacent to their construction sites. Considering the current usage of the rivers along and/or crossing the TR4 alignment, its possible use for the project will have minimal impact. In addition, the contractors could prioritize the services of the local power supplier. The use of standby generators could be limited during emergency such as brownouts and in areas not accessible by the existing electric transmission lines. This will minimize the air emission due to the burning of fuels.

1.3.3 No Project Scenario

If the project will not be implemented, the traffic congestion along Daang Maharlika is expected to worsen. With the continuous increase in the number of vehicles plying the route, the current traffic congestion will not only be confined at the built-up areas but could even expand to remote areas. This will further increase the delay or travel time along this route. This will have a significant impact to the economy in terms of access and delivery of goods and services; mobility of commuters; development of the LGUs or land use plan implementation; loss or wastage of time and resources, among others

1.4 Project Components

The Project will be implemented in two (2) phases: Phase I covering TR4-A to TR4-C or from Sto. Tomas, Batangas to Tiaong, Quezon; and, Phase II at TR4-D to TR4-E from Tiaong, Quezon to Tayabas City. The major components of the TR4 project are the main carriageway, overpass, underpass, bridges, interchanges, and toll plaza. Other facilities will include drainage system, lightning system, offices, warehouse, and services area. The main components of the project based from the initial design and the proposed realignment are presented in **Table 1-9**.

1.4.1 Main Carriageway

The main carriageway of the TR4 will have 2 x 2 lanes or 2 lanes for each direction (**Figure 1-9**). It will consist of five sections but the initial total length of 57.325 km is slightly reduced to 56.862 km (**Table 1-9**) and to be designed based on standards for main carriageway (**Table 1-10**).

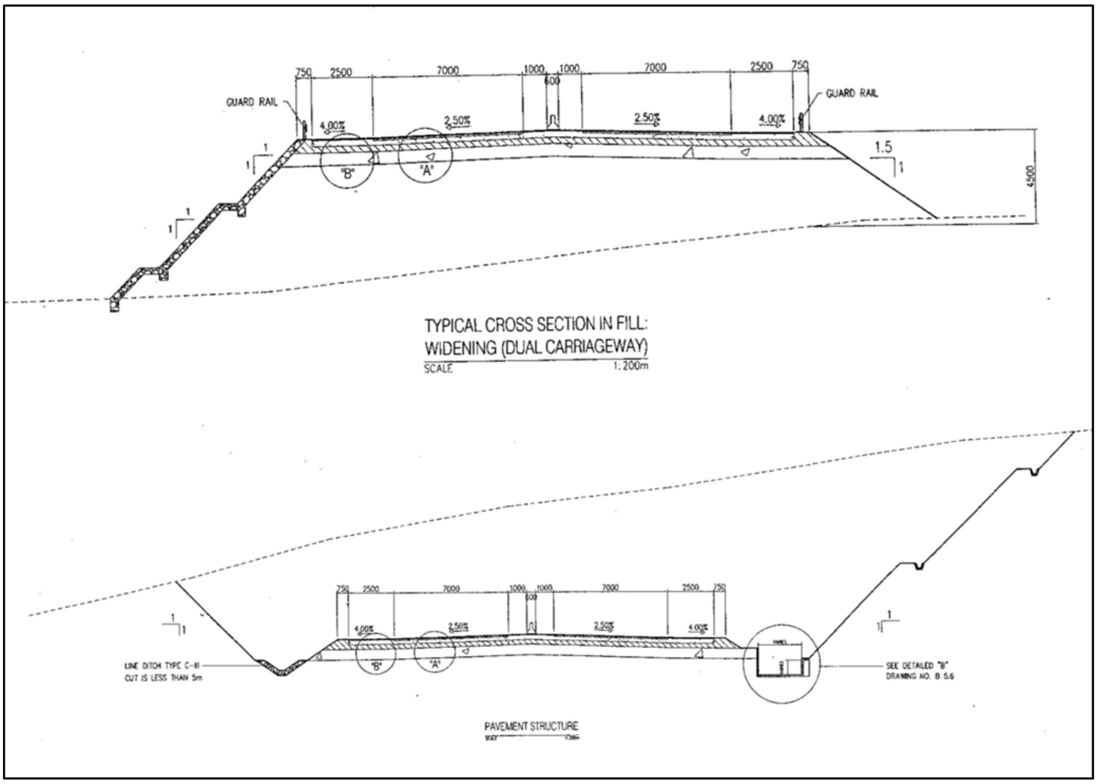


Figure 1-9: Typical Road Cross Section (4 Lanes) Project

Table 1-9: List of Major Project Components

Location and Major Components of TR4

TR4 Segment	**Package A**		**Package B**		**Package C**		**Package D**		**Package E**		**Total**	
Location	No. of Barangays											
	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment
Calamba City	2	2									**2**	**2**
Sto. Tomas, Batangas	12	11									**12**	**11**
Alaminos, Laguna	2	2	5[a]	5[a]							**6**	**6**
San Pablo City			2	3	6[a]	7[a]					**7**	**9**
Tiaong Quezon					1	1	4	3			**5**	**4**
Candelaria, Quezon							2	3	4	1	**6**	**4**
Sariaya, Quezon									7	7	**7**	**7**
Tayabas City									2	2	**2**	**2**
Grand Total											**47**	**45**
Major Components	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment	Initial	Realignment
a) Length (km)	10.05	11.318	19.663[b]	12.117	19.663[b]	7.497	27.612[b]	15.00	27.612[b]	10.93	**57.325**	**56.862**
b) Bridges	2	3	2	5	-	2	2	3	2	3	**8**	**16**
c) Underpasses	-	8	5	6	3	7	2	4	1	2	**11**	**27**
d) Overpasses	4	2	3	4	4	-	10	13	6	7	**27**	**26**
e) Inteerchanges	1	2	1	1	1	1	1	1	1	2	**5**	**7**
f) Toll Plaza	1	1	1	1	1	1	1	1	1	2	**5**	**6**

Notes: [a] - indicates 1 barangay also included in the previous TR4 Segment

[b] - Total length of two TR4 Segments

Table 1-10: Standards for the Main Carriageway

Design Elements	Recommended values for terrain types		
Terrain Condition	Flat	Rolling	Mountainous
Design Speed (KPH)	100	80	80
Number of Lanes	2	2	2
Lane Width (m)	3.65	3.65	3.65
Median Width (m) Dual Carriageway, Two-Traffic Lane	New Jersey 0.60 m	New Jersey 0.60 m	New Jersey 0.60 m
Inner Shoulder (m) Dual Carriageway Two-Traffic Lane	1.2	1.2	1.2
Outer Shoulder (m)			
Dual Carriageway, Two-Traffic Lane	3	3	3
Single Carriageway, Two-Traffic Lane	3 (each side)	3 (each side)	3 (each side)
Min Radius of Curvature (m)	550	550	550
Max. Gradient (%)	3	4	5
Super-elevation Rate (%)			
Desirable	3	3	3
Maximum	5	5	5
Crossfall of Carriageway (%)	2.5	2.5	2.5
Crossfall of Shoulder (%)			
At Grade	4	4	4
At Structure	2.5	2.5	2.5
Vertical Clearance (m)			
Above Roadway	5.08	5.08	5.08
Above Railway	6.8	6.8	6.8

(Source: SLTC)

1.4.2 Overpass and Underpass

Overpasses and underpasses are required at crossings of the TR4 alignment traversing roads, railways, rivers, creeks, interchanges, barangay roads, and farm crossings. The TR4 will have a total of 27 underpasses and 26 overpasses (**Table 1-9**).

Depending on the topography in the area, an overpass or underpass will be constructed to connect the existing access road or farm-to-market road that will be crossed by the TR4 alignment. The access road will be designed in such a way that the regular type of vehicles and/or transport mechanisms in the area could be used to traverse the underpass or overpass.

The two typical underpasses included in the project are:

- Underpass at Barangay Roads and Interchanges; and,
- Underpass at Farm Crossings.

The four overpass types required for the project are:

- Overpass at interchanges;
- Overpass at river/creek crossings;
- Overpass at Philippine National Railway (PNR); and
- Overpass at local roads.

The overpass and underpass structures will be designed according to:

- DPWH Standard Specifications for Public Works and Highways, Volumes 2 & 3, 1995 Edition
- National Structural Code of the Philippines (NSCP) Volume I;
- NSCP Volume II for Bridges;
- AASHTO Standard Specifications for Highways Bridges 17th Edition - 2002 (which includes Division I-A Seismic Design);
- American Concrete Institute (ACI) Code 318-95;
- DPWH Retrofitting Guidelines for Highway Bridges in the Philippines, 1993;
- DPWH Department Order No. 75, Series of 1992, re: Advisory Seismic Design of Highway Bridges; and
- Seismic Retrofitting Manual for Highway Administration, US Department of Transportation.

1.4.3 Interchanges

Seven interchanges are planned for connecting the project with the national roads near the main town/city centers along its alignment. The interchanges will be located at:

1. Calamba City and Sto. Tomas, Batangas at KM 56+518 (*beginning of TR4, KM 54+393.48 of TR3*)
2. Makban in Alaminos at KM 66+705
3. San Pablo City at KM 79+053
4. Tiaong at KM 86+825
5. Candelaria at KM 101+210
6. Sariaya at KM 110+100
7. Tayabas in Quezon at KM 108+725

The local roads will be widened on the side connecting to the ramps of the interchanges to have a deceleration lane for the vehicles that must stop to enter the interchange and guarantee two free lanes for the vehicles which are still proceeding on both directions of the National Roads. The proposed design of the interchanges are shown in **Figures 1-10 to 1-16.**The interchanges are mostly located in agricultural lands but some are adjacent to light industrial area. . Majority of the residential patches to be traversed by the TR4 alignment is within the Quezon Province which are located adjacent to agricultural lands.

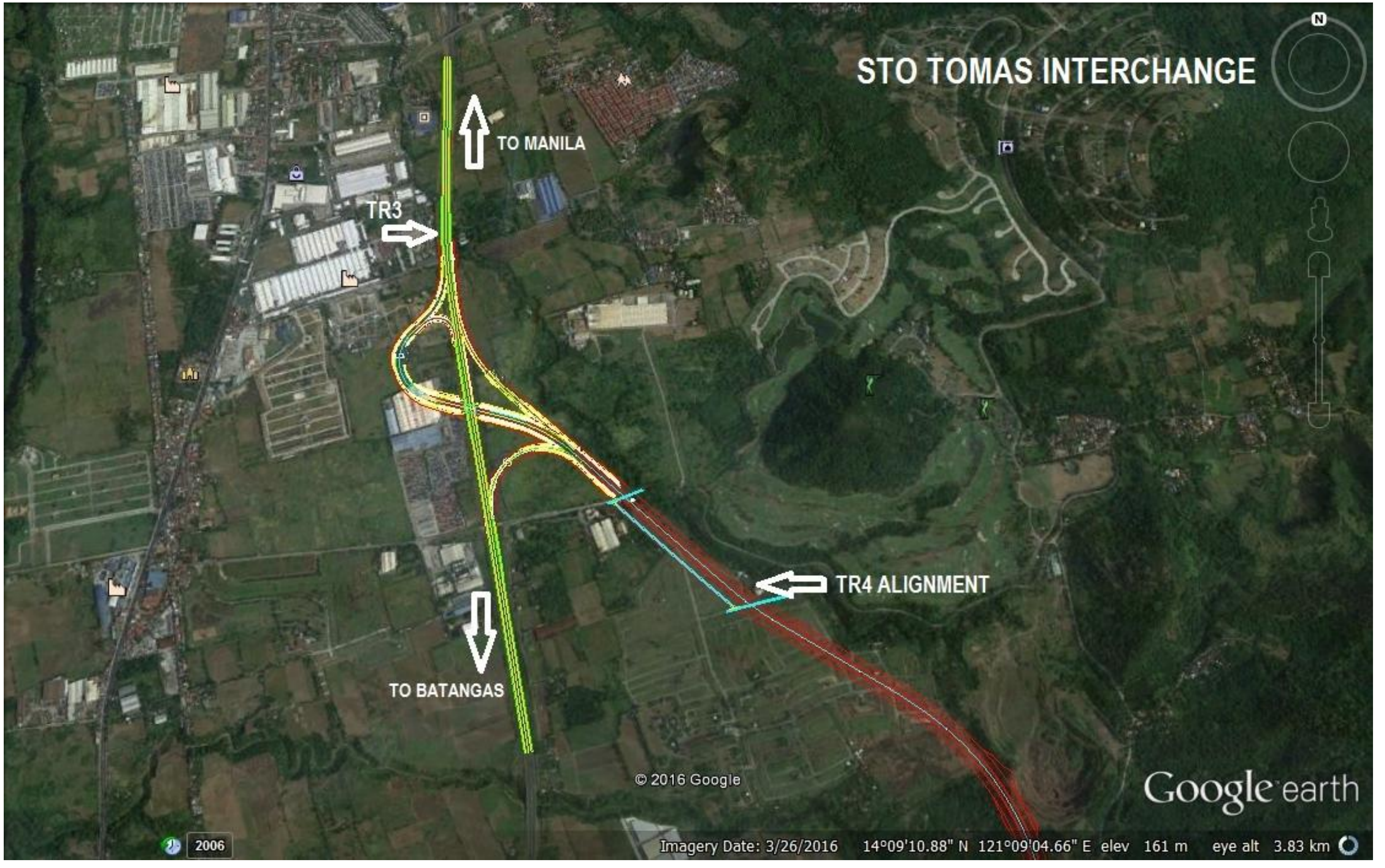


Figure 1-10: Sto. Tomas Interchange

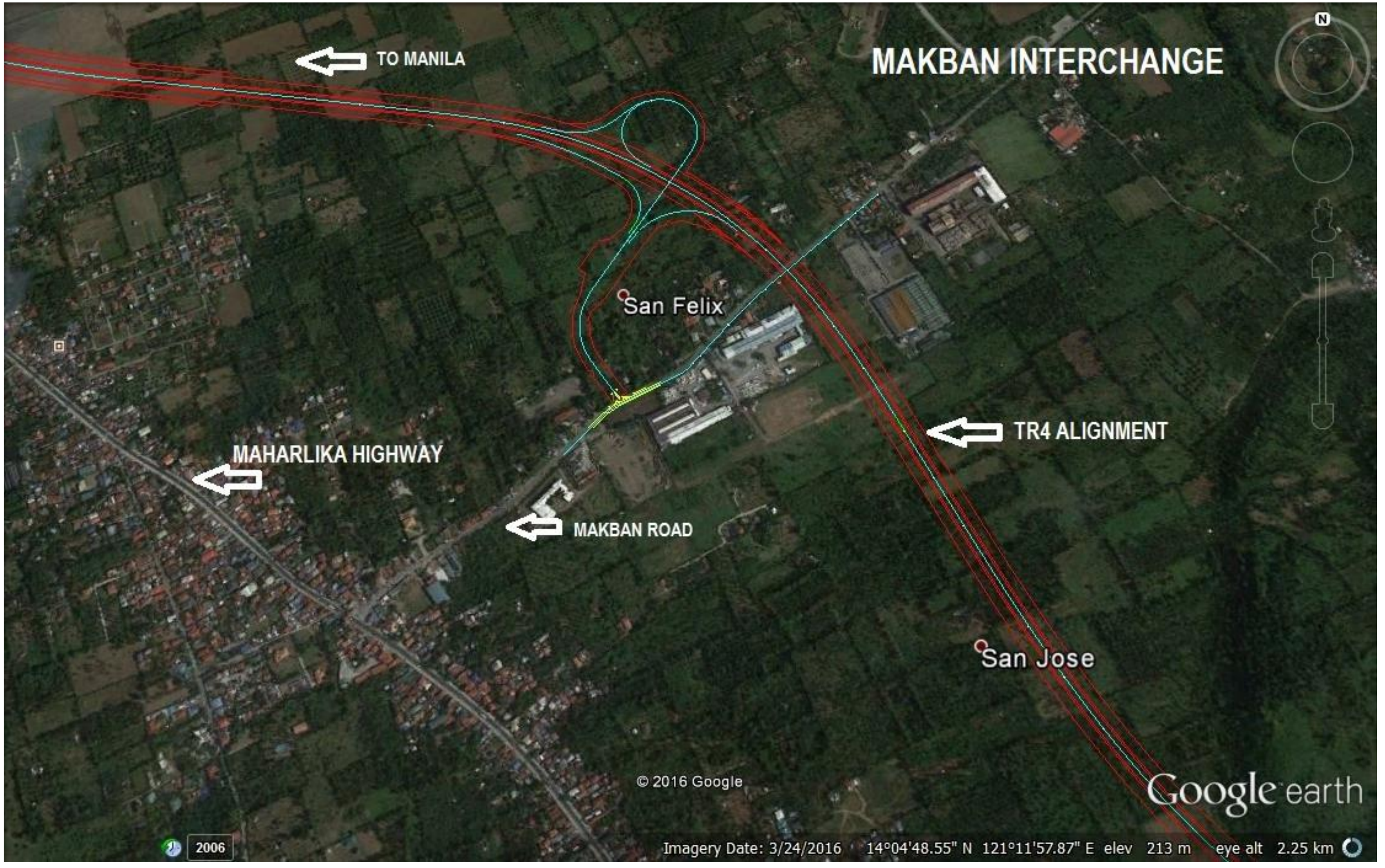


Figure 1-11: Makban Interchange

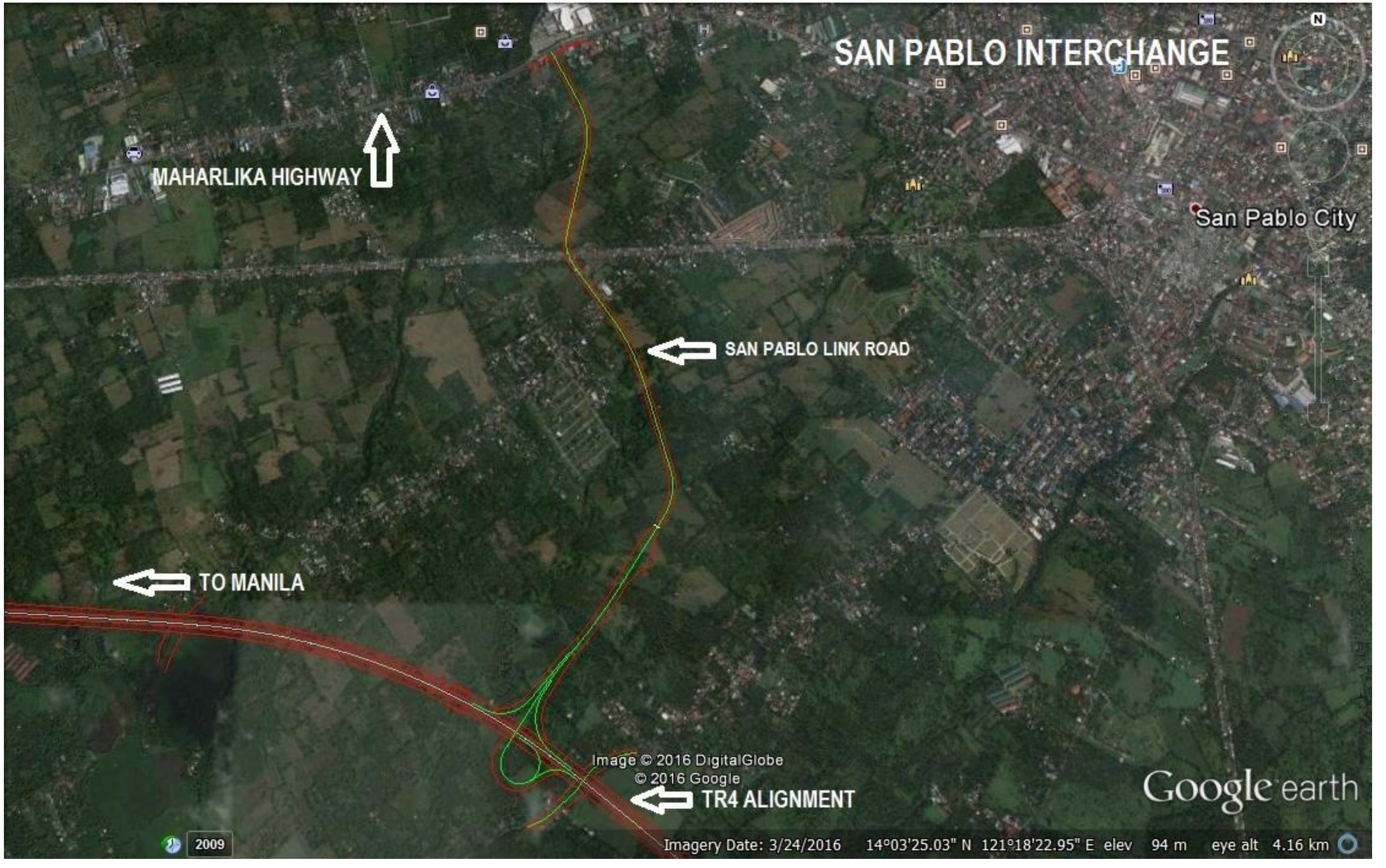


Figure 1-12: San Pablo Interchange

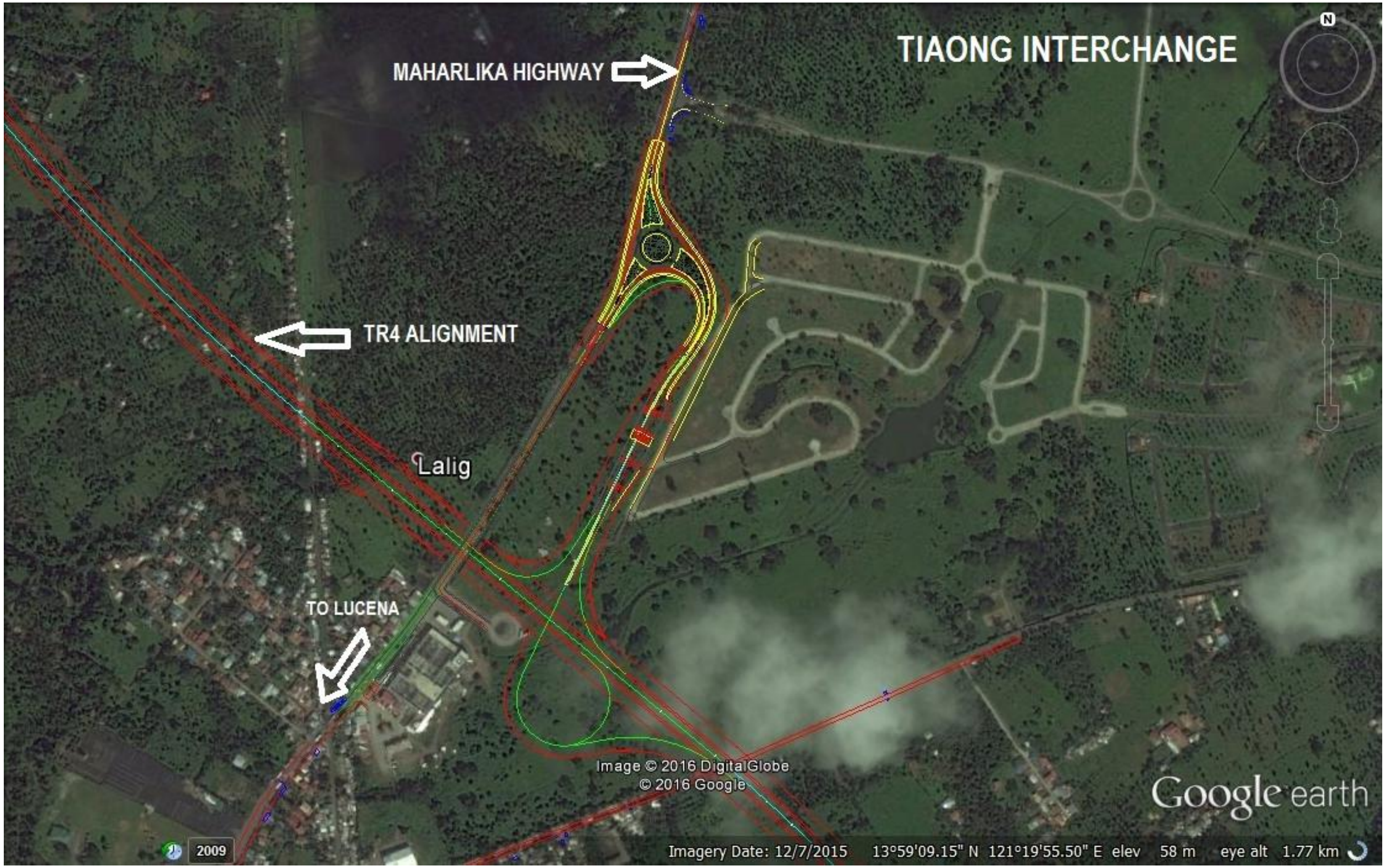


Figure 1-13: Tiaong Interchange

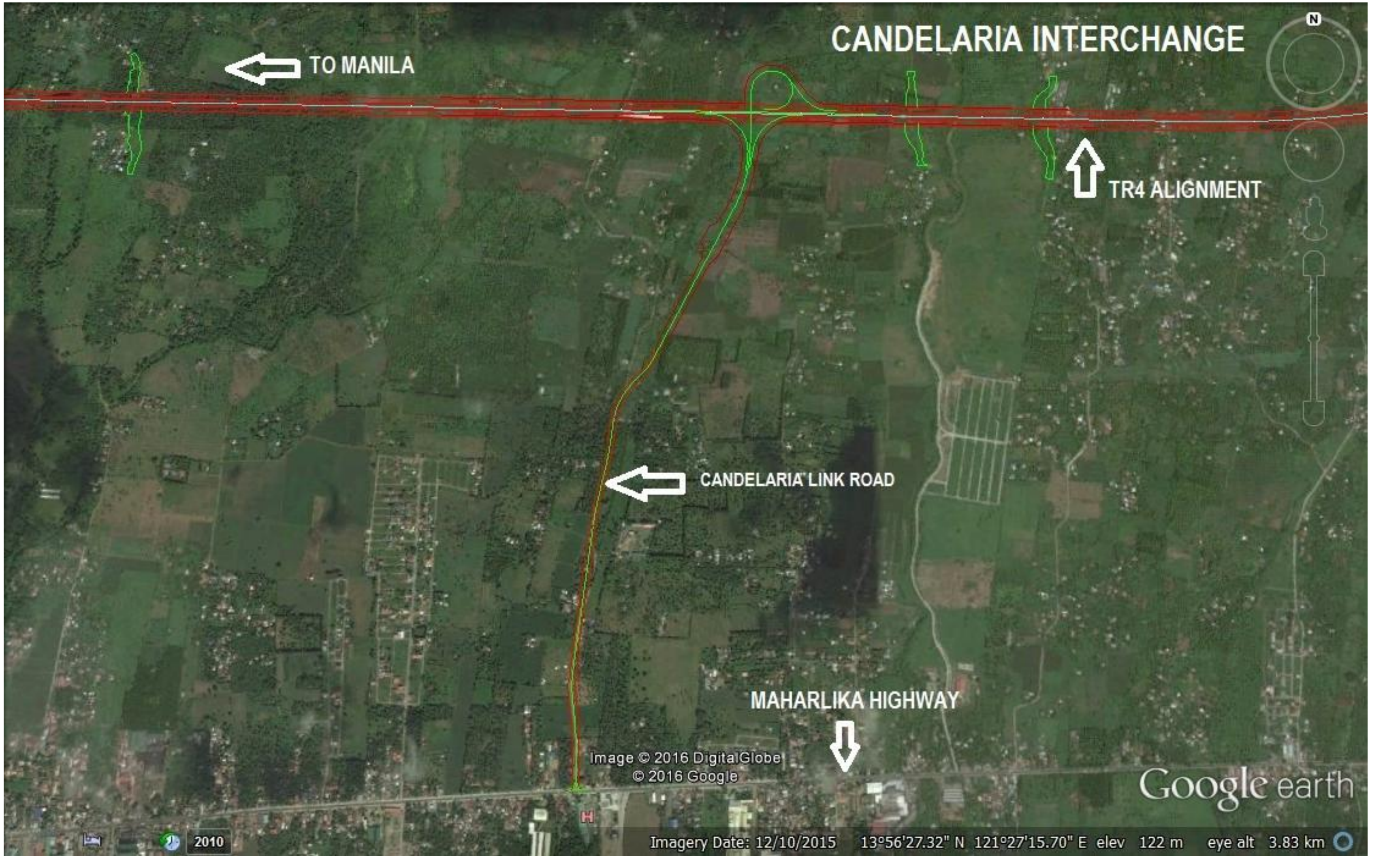


Figure 1-14: Candelaria Interchange

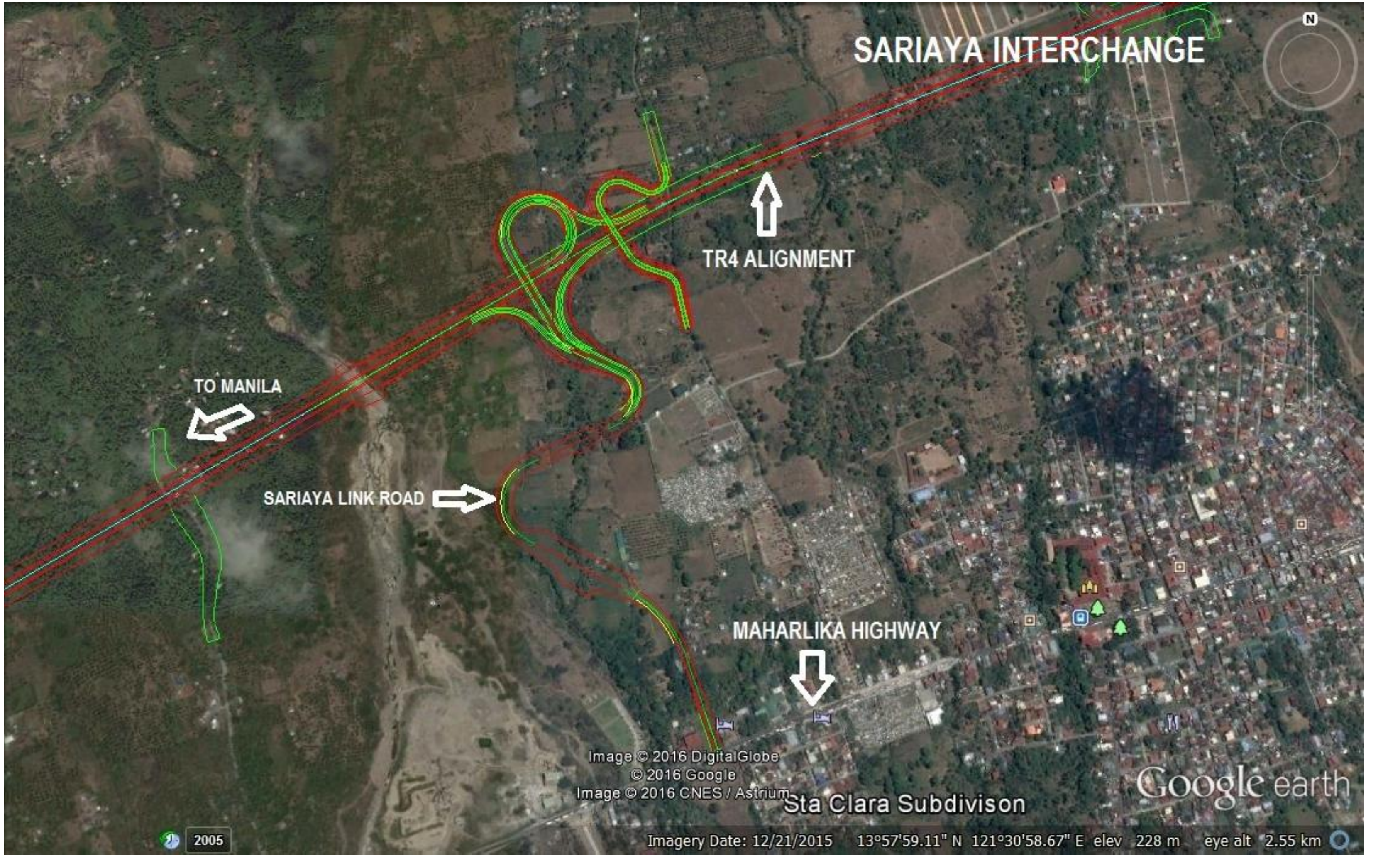


Figure 1-15: Sariaya Interchange

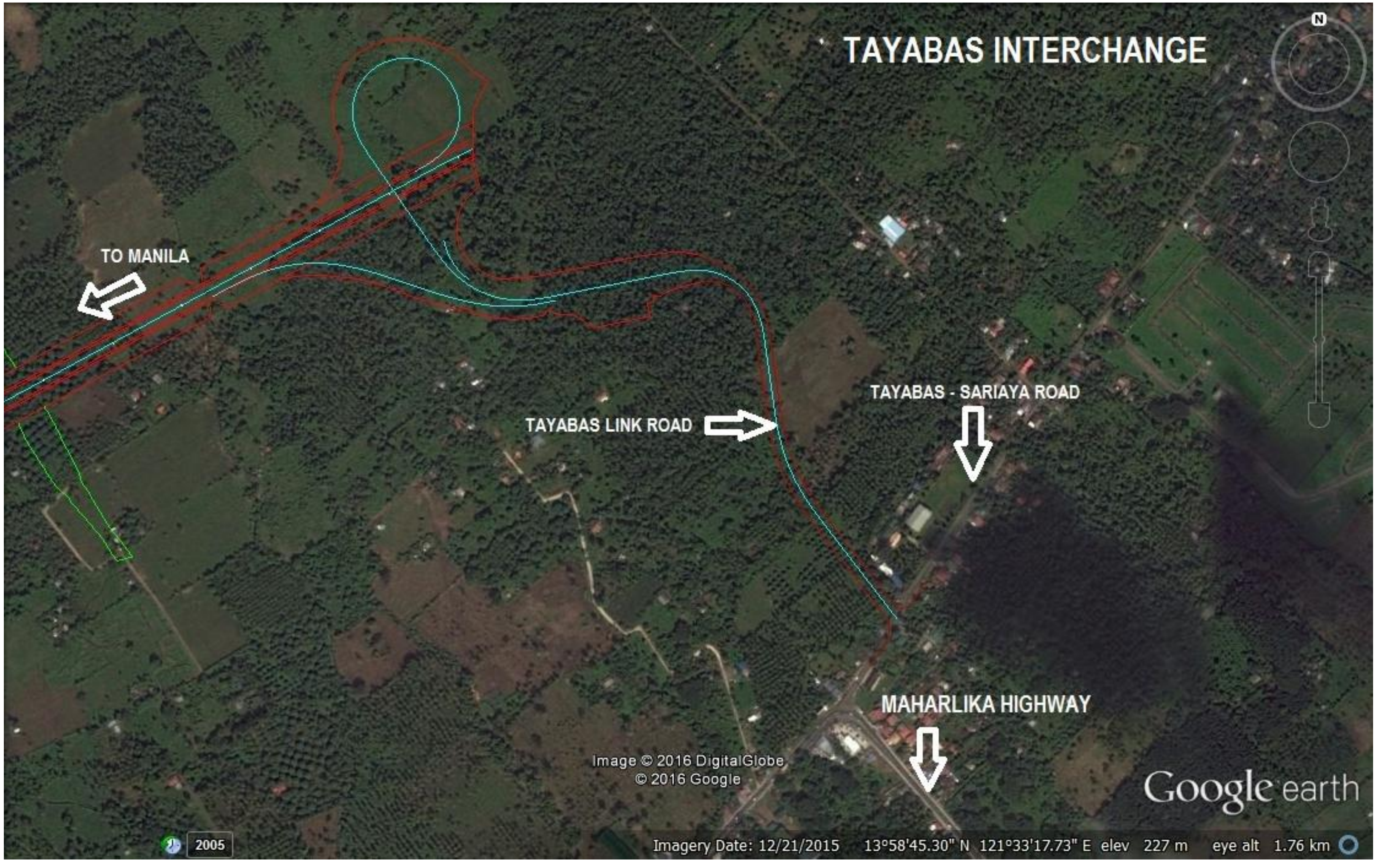


Figure 1-16: Tayabas Interchange

Majority of the alignment will be situated in open areas/brushlands or areas with agricultural crops. In few cases, the alignment will have to cut thru areas with structures, particularly housing of landowners or tillers of the land. The alignment will not be crossing highly urbanized area, heavy industrialized area, commercialized area and institutional zones. The TR4 will be linked to the above-mentioned land use zones by connecting the interchanges to the existing access roads to these areas, In general, the TR4 alignment could be considered compatible in the existing and proposed land use of the affected cities and municipalities.

1.4.4 Toll Facilities

A toll plaza is defined as the area where tolls are collected. The list of toll facilities and their locations to be provided or extended from the existing toll facilities of SLEX are as follows:

1. Toll Barrier: one (1) to be located in Calamba City;
2. Toll Plaza: two (2) entries and three (3) exits for both directions in six (6) interchanges excluding Sto Tomas or total of 30 toll booths; and
3. Toll Operations Building

The toll plaza starts where the approach roadway pavement widens, continues through the toll barrier or collection point, and ends where the pavement transitions exist. The physical limits of a toll plaza are defined by the beginning of the approach to the toll island, ending beyond the physical terminus of the toll island.

A toll plaza typically includes the approach (transition) zone, the queue area, the toll island or barrier, a recovery area, and the departure (transition) zone. In addition, the plaza encompasses all advance toll plaza-related signage and transitional lighting.

The TR4 will use the existing constructed toll plaza design for its toll plaza configurations. These are largely determined not by traffic demand, but by the type of toll system, methods of toll collection, the toll rate schedule, and the physical and environmental constraints of the site being almost all the toll plazas are elevated in form.

1.4.5 Bridges and Box Culverts

Bridge or box culvert will be constructed in the segment of the alignment that will be crossing a waterway. The construction of either a bridge or box culvert will depend on high traffic volume, large and variable water volume, high debris-potential, sensitive channel bottom and banks, significant fish resource, large elevation difference between channel and road grade, etc. The Project will include 16 bridges crossing the rivers and 18 box culverts for the connection of mostly intermittent creeks (**Table 1-9**).

1.4.6 Support Facilities

1.4.6.1 Drainage Systems

The proposed project will be provided with efficient drainage system for surface and subsurface water including slope groundwater and seepage. It will provide an all-weather road drainage system of adequate cross-drain, drain collection system, sufficient countermeasures for flooding of road and major drainage structures, surface water infiltration and drainage outfalls. The drainage system comprises of a network of pipe culverts, roadside ditches, and internal drainage systems for the road pavement structures.

The design of TR4 Project considerably prepares for the extreme conditions on rainfall and other meteorological/weather (PAGASA) criteria.

1.4.6.2 Lighting Systems

The proposed project will be provided with highway safety and expressway lightings. Highway safety lighting will serve as illumination of unusual permanent features or conditions that may require additional care and alertness for motorists to negotiate, such as the interchange and toll plazas. The expressway lighting will be used to illuminate areas of potential vehicle conflict and to delineate exit ramps, entrance ramps, and island noses and curbs. The locations of the lightings will be determined during the detailed engineering design.

1.4.6.3 Landscape

Landscaping will consist of three (3) types of plants, namely: drought-tolerant, perennials, and non-deciduous/semi-deciduous plants. Ground covers and tress will be placed along the mainline of the tollway for beautification and erosion control measures.

1.4.6.4 Temporary Structures

Temporary building structures will be provided during the construction phase that will serve as offices and accommodation for non-local personnel and workers. The facilities will be provided with portalets which will be contracted to accredited hazardous waste treater for the regular transport and treatment of the collected wastes.

1.4.6.5 Waste Management and Safety/Emergency Facilities

Waste management facilities will include sewerage and storm drain systems, oil-water separators at the contractors' service areas, spoils disposal area, and exhaust gas silencer for diesel-engine power generators.

Safety and emergency facilities will also be provided along strategic locations of construction sites of the project, especially in areas near the critical host communities and industrial/commercial zones.

1.4.6.6 Power and Water Supply

Power supply will be tapped from the local electric utility supplier. The demand for electricity is generated from temporary site facilities or site camps that the contractors will supply/provide as part of its contractual obligation. The site camp is comprised of temporary buildings, treatment systems, and other facilities needed to house its engineers and workers.

During construction, water use is minimal. Domestic water will be tapped from the local water district in the locality. The water consumption of the facilities and workers is considered low as the duration of construction is temporary for about 15 to 18 months.

Heavy water usage during construction happens during the production of concrete products and materials for road such as for bridges, drainage and other road furniture. These products will utilize water, however, the water supply will be provided by concrete batching plant suppliers for assigned contractors of the segment of the road. This means that the contractors to be commissioned would have its own concrete production/batching plant, and carries with it corresponding permits and clearances, i.e., ECC, water rights permit, LGU permit, etc.

1.5 Process/Construction Technology

1.5.1 Road Construction

1.5.1.1 Equipment

Typically, method and equipment used in road construction carries significant economic and design factors especially in road location and its final design. Common equipment used in construction include a bulldozer, hydraulic excavator, and scrapers, among others. These equipment and its suitability for different stages of construction are very important.

Initial stage of road construction starts from excavation and drainage installation to final grading. At present, the assumption is that there will be no blasting to clear or level any area for the project construction. However, in case blasting would have to be done, controlled blasting will be employed to prevent excessive noise or 'boom' sound. If ever blasting will be required, SLTC will require from the contractor the submission of permits and clearances from the concerned authorities on the use of explosives before any blasting activity.

The most common equipment in road construction is bulldozer equipped with straight or U-type blades. These are economical pieces when earth material needs to haul or push distance with a straight blade from 17 to 90 meters depending on grade.

The following road design considerations for bulldozers are used:

1. Earth is side cast and then wasted rather than used to build up side cast fills.
2. Earth is moved down-grade with the aid of gravity, not up-grade.
3. Fill material is borrowed rather than pushed or hauled farther than the economic limit of the bulldozer.
4. Unless substantial rock blasting is specified requiring drilling and blasting equipment, solid rock faces should be avoided.

Table 1-11 shows a typical list of road construction equipment characteristics (*as cited* from Oregon State University, Extension Service, 1983).

Table 1-11: Characteristics of Road Construction Equipment

Criteria	Bulldozer	Front-end Loader	Hydraulic excavator	Dump trucks or scrapers	Farm tractors
Excavation mode (level of control of excavated materials)	Digs and pushes; adequate control (depends on blade type)	Minor digging of soft material; lifts & carries; good control	Digs, swings, & deposits; excellent control; can avoid mixing materials long-distance material movement; excellent control	Scrapers can load themselves; 'top down' subgrade excavation; used for small quantities	Minor digging and carrying; good control because it handles
Operating distance for materials movement	91 m; pushing downhill preferred	91 m on good traction surfaces	23 m (limited to swing distance)	No limit except by economics; trucks must be loaded	31 m (approximately)
Suitability for fill construction	Adequate	Good	Limited to smaller fills	Good for larger fills	Not suitable
Clearing and grubbing (capacity to handle logs and debris	Good	Adequate	Excellent	Not suitable	Handles only small materials
Ability to install drainage features	Adequate	Digging limited to soft materials	Excellent	Not suitable	Adequate for small tasks
Operating cost per hour	Moderate, depending on machine size	Relatively low	Moderate to high, but productivity excellent	Very high	Low
Special limitations or advantages	Widely available; can match size to job;	Cannot dig hard material; may be	Good for roads on steep hillsides; can do all required	Limited to moving material long distances; can	Very dependent on site conditions and

Criteria	Bulldozer	Front-end Loader	Hydraulic excavator	Dump trucks or scrapers	Farm tractors
	can do all required with good operator	traction limited	except spread rock for rock surfacing	haul rock, rip rap, etc.	operator skill

1.5.1.2 Slope Stabilization

There are methods to avoid massive earth failures during road construction and they are categorized based on how it affects soil stability.

- Relocating the road on a more stable area
- Excavation of unacceptable materials, thus, reducing soil weight
- Provide retaining structures such as rock buttresses at the toe of fill slope, gravity retaining walls at toe of fill or cut, and piling walls, likewise at the toe of fills or cuts.

Engineering and structural methods for stabilizing slopes can be grouped into:

Excavation and filling. This includes the following: (i) excavating the toe of an earth flow until successive failures result in a stable slope; (ii) removing and replacing failed material with lighter, more stable material, or re-compact debris; (iii) excavating to unload upper portions of a mass failure; and, (iv) filling to load the lower portions of a mass failure (most likely in conjunction with other loading or restraining structures).

Draining. This includes removal of drainage of tension cracks to prevent upward migration of water into the road prism, insert perforated, horizontal drains, or drainage galleries to increase the drainage rate.

Restraining. This includes retaining walls, piles, buttresses, counterweight fills, cribs, bin walls, reinforced earth, and pre-stressed or post-tensioned soil or rock anchors. The earth pressures for the design of retaining walls require computation based on the Rankine formula which describes earth pressures as a function of unit weight and internal angle of friction of the backfill material.

Miscellaneous techniques. Grouting normally reduces soil permeability, thereby preventing the ingress of groundwater into a failure zone. Chemical stabilization, generally in the form of ion exchange methods, is accomplished by high pressure injection of specific solutions into failure zones or into closely spaced pre-drillled holes throughout the movement zone.

1.5.1.3 Sources of Construction Materials, Storage/Staging, Power and Water

All construction materials will be sourced from legitimate existing rock crushers, hot mix, and concrete batching plants located within the immediate vicinity that have valid environmental clearances and permits from DENR. Stockyard or material staging areas will be strategically located near the locations of interchanges due to its proximity to access road and relatively wide area.

Power and water sources will come from the grid of local power supplier and local water utilities, respectively.

1.5.2 Road Maintenance

Road surfaces are maintained as frequent as necessary to provide a smooth running surface and a good crown or slope for drainage. All good roads require monitoring the surface and subgrade wear or deterioration. Pavement rutting often occur during and after the rainy season.

A wide variety of practices is used to treat road surfaces in minimizing wear and tear or reduce dust. The quick deterioration of road is sometimes caused from contact of materials or chemicals not compatible with the road (asphalt).

1.5.3 Storm Management

During storm damage to roads and property, an emergency plan will be implemented wherein personnel and equipment are mobilized on short notice. This is similar with emergency measures during fire control.

More important during construction is collection of weather data including daily amount of precipitation, cumulative precipitation per storm, total per season, month, etc. All information on runoff amounts, temperature changes, wind and barometric pressure are noted.

1.6 Project Size/Capacity

The TR4 alignment is designed to carry an operational capacity of 50,000 vehicles per day (2 lanes per direction). Its right of way (ROW) is pegged at 60 meter width and extending 56.862 km long.

The configuration of the TR4 alignment is planned to be 2- 3.65 m wide lane with a 1.20 m wide hard shoulder in each direction. It is anticipated that if the traffic flows are near capacity, the hard shoulder will be used by drivers.

Though from the forecast traffic growth assumptions provided by DPWH up to year 2026, it reveals a reduction of 5% in the 2026 growth rate every 5 years. **Table 1-12** below shows the approximate area of the entire ROW.

Table 1-12: Project Size

Site	Approx. Area (has.)
Carriageway/ Alignment (60m W)	345.54
Sto. Tomas Interchange	10.32
Makban Interchange	5.81
San Pablo Interchange	7.17
Tiaong Interchange	5.28
Candelaria Interchange	7.48
Sariaya Slip Ramp	6.00
Tayabas Roundabout	0.36
TOTAL AREA	387.96

1.7 Development Plan, Description of Project Phases and Timeframes

This section describes the proposed physical activities, with brief identification of associated environmental aspects and mitigating measures. Detailed impacts and measures are discussed in **Section 2**.

The physical activities for the proposed project will consist of four (4) phases: the pre-construction phase, construction phase, operation phase, and abandonment phase, as follows:

- Pre-Construction Phase – involves survey, negotiation and acquisition of the right-of-way, acquisition of government permits;
- Construction Phase - land preparation, and actual construction works;
- Operation Phase - involves operation of the project; and
- Abandonment Phase – systematic decommissioning and removal of project facilities, and rehabilitation.

Table 1-13 shows the project implementation schedule. Acquisition of the right-of-way will start in the 1st quarter of 2017while construction works will follow during the 2nd half of the year. The construction of a road section will take a minimum of 12 months to a maximum of 18 months up to completion. The construction of adjacent road sections may overlap after at least 6 months of activities at the initial road section. The initial operation of the Project will start upon the completion of TR4-C before the end of 2019with the opening of TR4-A which is projected to commence by the end of 2017. The TR4 is targeted to be in full-operation within the 3rd quarter of 2021.

Table 1-13: Project Implementation Schedule

STAGES	DURATION	TIMELINE		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
		FROM	TO											
TRB Evaluation & Approval	5 mos.	01-Jan-12	01-Jun-13											
Detailed Design	14 mos.	01-Sep-13	31-Dec-14											
Parcellary Survey & Plan *(including revision of interchanges)*	18 mos.	01-Jul-13	30-Jun-16											
Issuance ECC	18 mos.		14-Jul-14											
Right of Way Acquisition														
TR4A (Sto Tomas-Makban)	12 mos.6 mos.	01-Jul-17	23-Dec-18											
TR4B (Makban-San Pablo)	12 mos.	28-Dec-17	23-Dec-18											
TR4C (San Pablo-Tiaong)	9 mos.	26-Jun-18	23-Mar-19											
TR4D (Tiaong-Candelaria)	9 mos.	25-Aug-18	22-May-19											
TR4E (Candelaria-Lucena)	9 mos.	23-Dec-18	19-Sep-19											
Construction														
TR4A (Sto Tomas-Makban)	15 mos.	01-Feb-19	26-Apr-20											
TR4B (Makban-San Pablo)	18 mos.	01-Sep-18	23-Feb-20											
TR4C (San Pablo-Tiaong)	12 mos.	29-Oct-19	23-Oct-20											
TR4D (Tiaong-Candelaria)	18 mos.	25-Jul-20	16-Jan-22											
TR4E (Candelaria-Lucena)	15 mos.	21-Apr-21	15-Jul-22											
Operation (*after completion of Section C)*		**24-Oct-20**	**onwards**											

1.7.1 Pre-Construction Phase

Typically, this phase involves all tollway pre-construction activities. It includes securing approval from the grantor (Republic of the Philippines through Toll Regulatory Board), conducting parcellary surveys to determine the exact alignment, acquisition of the road-right-of-way (RROW) limits also by the Philippine government through DPWH, and securing the ECC from DENR, among others.

The following are milestones of the TR4 Project to date:

- February 14, 2012: *TRB formed the Technical Working Group (TWG)* for TR4 project
- May 28, 2012: *TRB approved revised TR4 alignment*
- June 1 to July 23, 2012: *SLTC updated the Basic Design for TR4*
- August 28, 2012: *TRB approved the TR4 Basic Design*
- January 15, 2013*:* *TRB approved the TR4 Construction Cost*
- April 25, 2013*:* *TRB approved the TR4 Financial Model*
- July 11, 2014: *Issuance of Environmental Compliance Certificate*
- October, 2015: *Final Design of TR4 Realignment and secure revision of the ECC*
- *Final process of the Parcellary Plan for RROW*
- *Final Engineering Design*
- Mid-2016: *Target: Start of Construction*

1.7.1.1 Right of Way Acquisition (ROWA)

1.7.1.1.1 TR4 Project Impact

Considering the length of the TR4 alignment, a great number of property owners, tenants, and their families will be affected. With about 45 barangay units from 8 cities/municipalities and 3 provinces, an initial estimate of 388 hectares will be directly affected by the alignment.

1.7.1.1.2 LAPRAP –Framework for ROW Acquisition

DPWH D.O. No. 5 and DPWH D.O. No. 327 *series of* 2004 require the implementing agency (DPWH) to prepare a Land Acquisition Plan and Resettlement Action Plan (LAPRAP) or Land Acquisition and Resettlement Plan (LARP) in order to ensure the equitable provision of just compensation for land, structures and/or improvements, to be acquired for infrastructure Right of Way.

LAPRAP is also the basis for qualifying and compensating the Project Affected Persons (PAPs) who would be partially or fully to be affected by the project. DO No. 327 stipulates the entitlement for each type of Affected Persons (APs) or PAPs. In addition, the LAPRAP identifies potential social and environmental impacts of the project and offers guidance on their proper management.

1.7.1.1.3 ROW Acquisition by Negotiation

Donation is a mode of acquisition; for an owner to willingly give away property as donation to the Republic. Although it is not impossible, it has been used to expedite site acquisition in securing ROW. Key to applying the “mode of donation” is the identification of properties that may be donated.

Another mode of ROW acquisition is through negotiated sale. As in any negotiation, the law allows the implementing agency to make offers. More often, DPWH determines the classification of the property differently from that declared by the owner. DPWH resorts to this procedure when it is apparent that (i) the actual use/condition of the property is different from what was declared by the landowner; and, (ii) the declaration of the owner changed only within a period nearly before or after government has declared that its properties will be acquired.

This procedure is meant to ensure that government resources are efficiently used and to avoid fraud.

1.7.1.1.4 ROW Acquisition by Expropriation

APs and PAPs who refused the offer of government (DPWH) to enter into negotiation for their affected property and/or with incomplete documents will be endorsed to the Office of the Solicitor General (OSG) for filing of the necessary expropriation complaint.

The APs and PAPs subjected to expropriation proceedings include:

- APs/PAPs who refused Government's initial Offer;
- Unregistered Land Owners;
- CLOA Holders;
- APs/PAPs who are Heirs of the Registered Owners;
- Tenants;
- Right's Holders; and
- APs/PAPs unable to produce any government approved document evidencing ownership.

Expropriation proceedings would appear to have been the preferred way of DPWH in acquiring site possession pursuant to R.A. 8974. In this mode, DPWH needs only to file a complaint of expropriation and payment of: (i) 100% BIR Zonal Value; and, (ii) Replacement cost of improvements, as the Court will naturally issue a Writ of Possession in favor of the Republic.

1.7.1.1.5 Advance Payments by SLTC and SLEX Contractors

The participation of SLTC and its contractor is another mode to facilitate ROWA. In normal cases, proponent may advance the cost for ROW activities.

Contractors/Sub-Contractors of the project may also advance some cost to ensure that construction works continue unimpeded.

This mode is subject to a Reimbursement Agreement between the proponent and the government.

1.7.2 Construction Phase

The construction phase includes all developmental activities prior to commercial operation. It consists of physical construction of major structures, such as bridges, underpasses, overpasses, interchanges, and the main carriageways. It will also involve the installation and utilization of temporary facilities, such as the housing for workers, lay down areas, contractor's area, warehouses, and service areas.

The wastes generated during this phase will include the following:

- Spoils during earthworks and site clearing;
- Possible oil leaks and spills from fuel and oil storage areas;
- Gaseous and particulate emissions from vehicles and construction equipment;
- Noise generated by vehicles and construction equipment; and,
- Domestic and solid wastes generated at construction sites, contractors area, and temporary housing facilities for workers.

In general, this phase involves all civil, mechanical, structural, and electrical works, including installation of toll collection system facilities, and ancillary works and landscaping. All surface development will be confined within the right-of-way limits of the proposed project.

The main environmental aspects identified at the indicative site are generation of spoils, noise generation and dust emission. Excess excavated earth materials will be disposed at the Spoil Disposal Area (SDA) which is stabilized mechanically or by vegetative means. Noise levels will increase in surrounding areas at the construction site. Dust emission and increase in noise level will also occur.

1.7.3 Operation Phase

This phase involves the operation and maintenance of the toll road and its facilities. It generally involves monitoring of the condition of the road/expressway and its related facilities, and the routine and periodic maintenance works along the confines of the ROW.

Routine maintenance includes vegetation control, clearing ditches, cleaning and repairing of culverts and the cleaning and repair of traffic signs. Periodic maintenance normally covers the repair of road surface, resurfacing and road shoulder repair. Maintenance will include the plaza buildings, toll facilities, warehouse, signal and lightings, air-conditioning and ventilation systems and sewers.

The wastes to be generated during operation include the following:

- Possible oil leaks and spills from fuel and oil storage areas;
- Gaseous and particulate emissions from vehicles plying along the expressway;
- Noise generated by passing vehicles along the expressway; and
- Domestic and solid wastes generated at toll plazas, service areas, and other support facilities.

Prior to the initial operation from the opening of TR4-A, other segments of the proposed TR4 Project (B, C, D, & E) will be constructed successively one after completing the other, and will be operated eventually after securing approval or permit to operate from TRB.

1.8 Manpower Allocation

During its peak of construction, the proposed project will utilize about 1400 workers at a given time of construction. About 700 personnel are expected to be employed during operation, either as regular or contractual employees. The SLTC will include in the agreement with the contractors a provision of priority in hiring qualified local resident from host and neighboring LGUs. The contractors will coordinate with the concerned LGU offices in the dissemination of job openings for the TR4 project. The information will be allowed for general circulation when no qualified local residents are hired within an agreed period of time between the contractors and the LGUs.

Table 1-14 shows the indicative number of skilled and unskilled workers during construction and operation phases. During operation, most of the skilled workers to be required are for manning the toll booths in 8-hr shift for 24 hours/day; for road maintenance; for road patrols and emergency assistance, for administration and accounting; and, security personnel. The unskilled workers for the operation are mostly for janitorial works and maintenance of the buffer zones. On the other hand, **Table 1-15** shows the typical manpower composition during the construction.

Table 1-14: Estimated Number of Workers

Phase	Skilled	Unskilled
Construction period	700 70% male 30% female	700 90% male 10% female
Operation period	500 50% male 50% female	200 70% male 30% female

Table 1-15: Manpower during Construction

Engineers	100
Foreman	100
Drivers	200
Security	100
Welders	100
Steelmen	100
Surveys	100
Heavy Equip operators	200
Labour/utilities	300
Aides	100
Total (estimate)	1,400

1.9 Project Investment Cost

The construction of the TR4 project will cost about Twelve Billion Pesos. **Table 1-16** shows the estimated costs per segment of the proposed project.

Table 1-16: Project Cost per Section

Section	Cost (PhP)
TR4-A	3,275,945,493.79
TR4-B	2,221,051,893.06
TR4-C	1,516,088,576.45
TR4-D	2,606,845,541.99
TR4-E	2,301,910,899.87
Total	11,921,842,405.16

Source: SLTC, 2013

2.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

2.1 The Land

2.1.1 Land Use and Classification

2.1.1.1 Scope

This section covers the general land use and classification of the project area in provincial and municipal scales. It also includes the Environmentally Critical Areas (ECAs) adjacent to the location of the proposed project.

2.1.1.2 Methodology

Primary data gathering includes interview and consultation with key LGU personnel in the cities / municipalities that will be traversed by the TR4 alignment. This is supplemented by secondary information from published and unpublished reports by government agencies and from Google Earth maps.

This section is an updated summary of information presented in the May 2014 EIS for the SLEX Phase II TR4 Project.

2.1.1.3 Regional Land Use[1]

CALABARZON is a small region in the Philippines in terms of land area. However, the predominance of alienable and disposable (A&D) land as compared to forestlands is an indication of the demand for areas that accommodated built-up types of development in the region.

Until the 1980s, the CALABARZON landscape remained largely agricultural. However, as pressure was exerted on agricultural land for conversion to residential, commercial and industrial use, similar constraints were also being exerted on forestlands that became increasingly used for agricultural practices.

CALABARZON has used its land variedly throughout its provinces. Agriculture remains predominant in Quezon and Batangas while built-up areas dominate the Cavite, Laguna and Rizal landscapes. The built-up areas in Cavite, Laguna and Rizal comprised more than 50% of their total A&D land, with Rizal registering 76%. Moreover, industrial use as evidenced by the presence of economic zones is concentrated on these same provinces which are nearest to the National Capital Region (NCR). **Figure 2-1 to 2-7** presents the land use maps of Sto. Tomas, Calamba, San Pablo, Tiaong, Candelaria, Sariaya and Tayabas, respectively.

On the other hand, the region has a total forestland area of 574,320 hectares in 2003. However, less than 40%of the above-mentioned area has actual forest cover. This is interpreted to indicate the conversion of forestland for other uses, particularly agriculture.

2.1.1.3.1 Production Land Use in the Sub-Region

Land devoted or suitable for agricultural activities such as cultivation of the soil, planting of crops, growing of fruit trees, livestock, poultry raising, fisheries, and aquaculture development covers a total area of 700,582 hectares representing 51% of the total land area and 80% of the total A&D land. A&D land and Network of Protected Areas for Agricultural and Agro-Industrial Development (NPAAAD) coverage have been increasing at the rates of 0.02% and 4.96%, respectively. More than half of the NPAAD in the sub-region is located in Quezon. The increase in A&D land for cultivation is partly attributed to the programs of Department of Environment and Natural Resources (DENR) and Department of Agrarian Reform (DAR).

[1] *Region 4-A Regional Development Plan, 2011-2016*

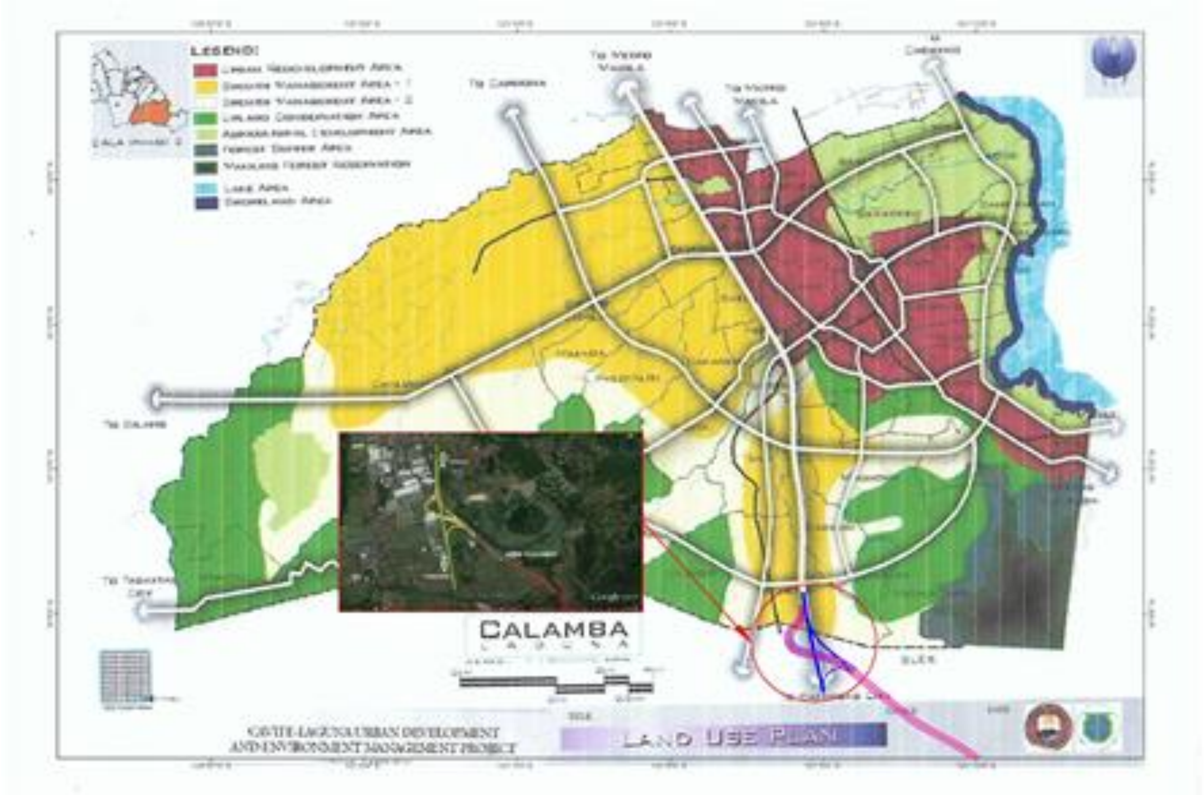


Figure 2-1: Calamba Land Use Map

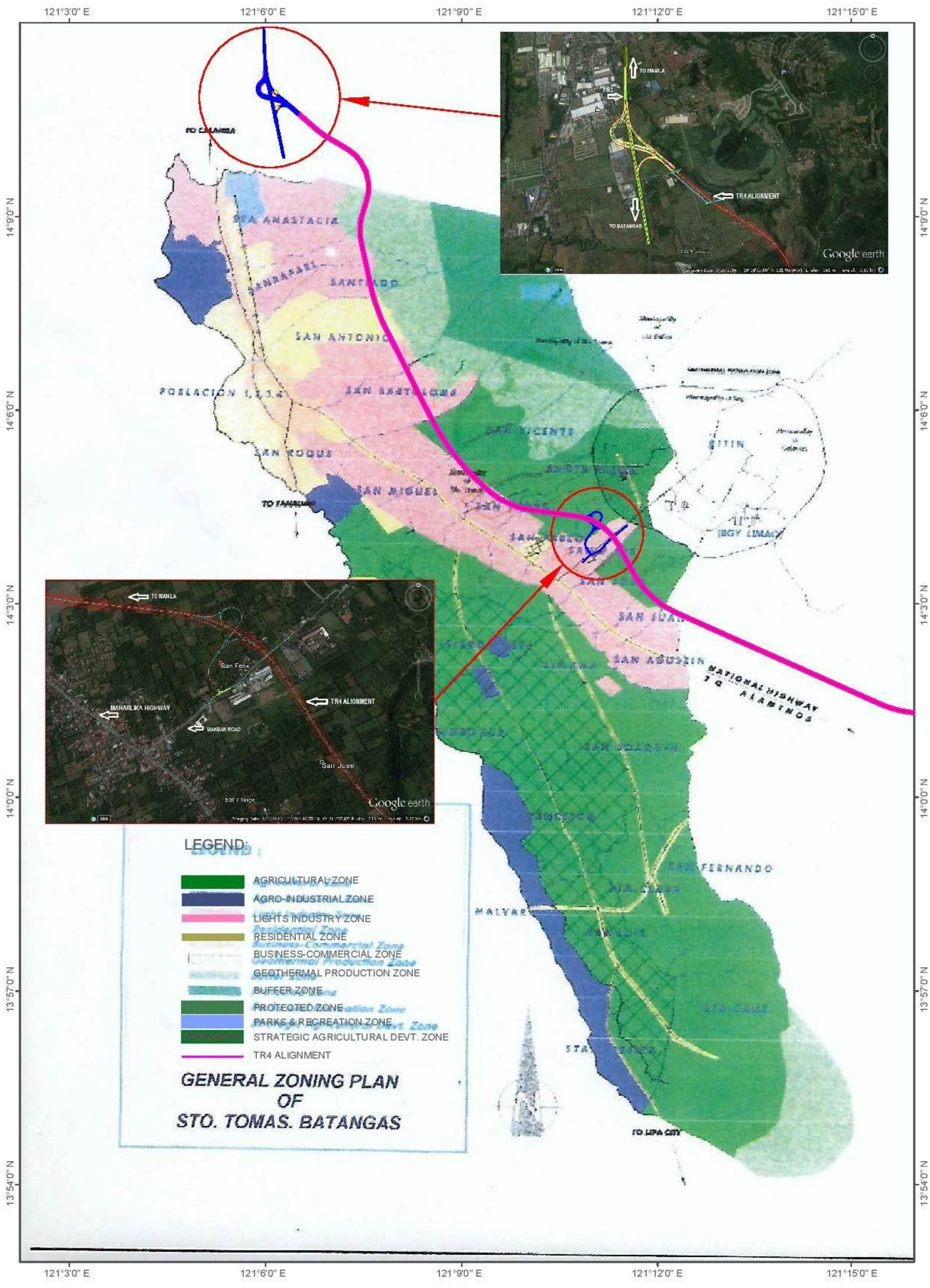


Figure 2-2: Sto. Tomas Land Use Map

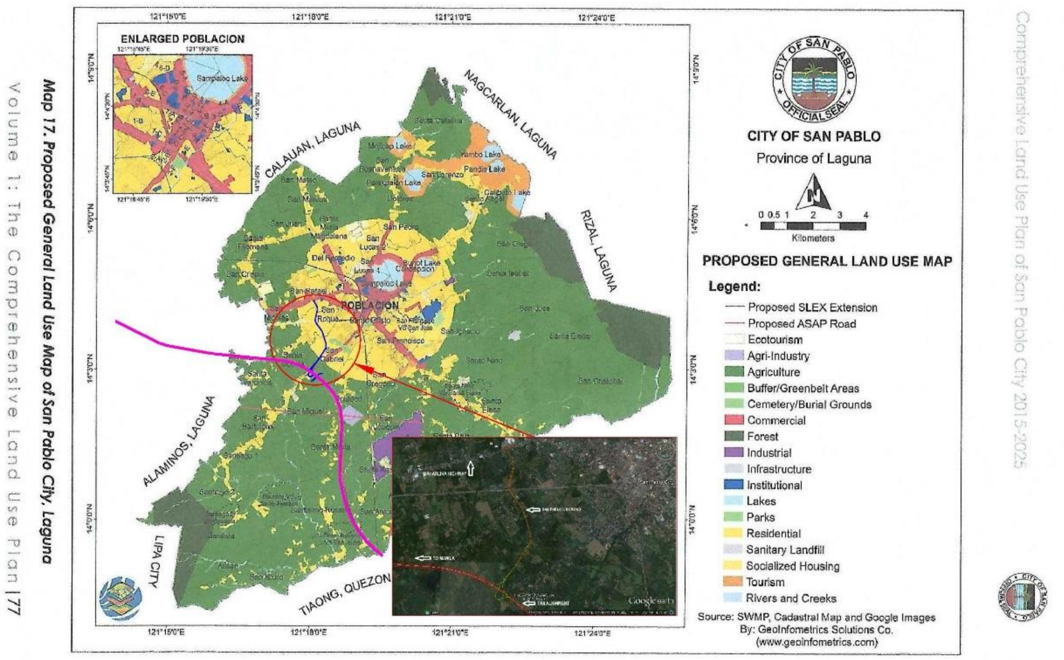


Figure 2-3: San Pablo Land Use Map

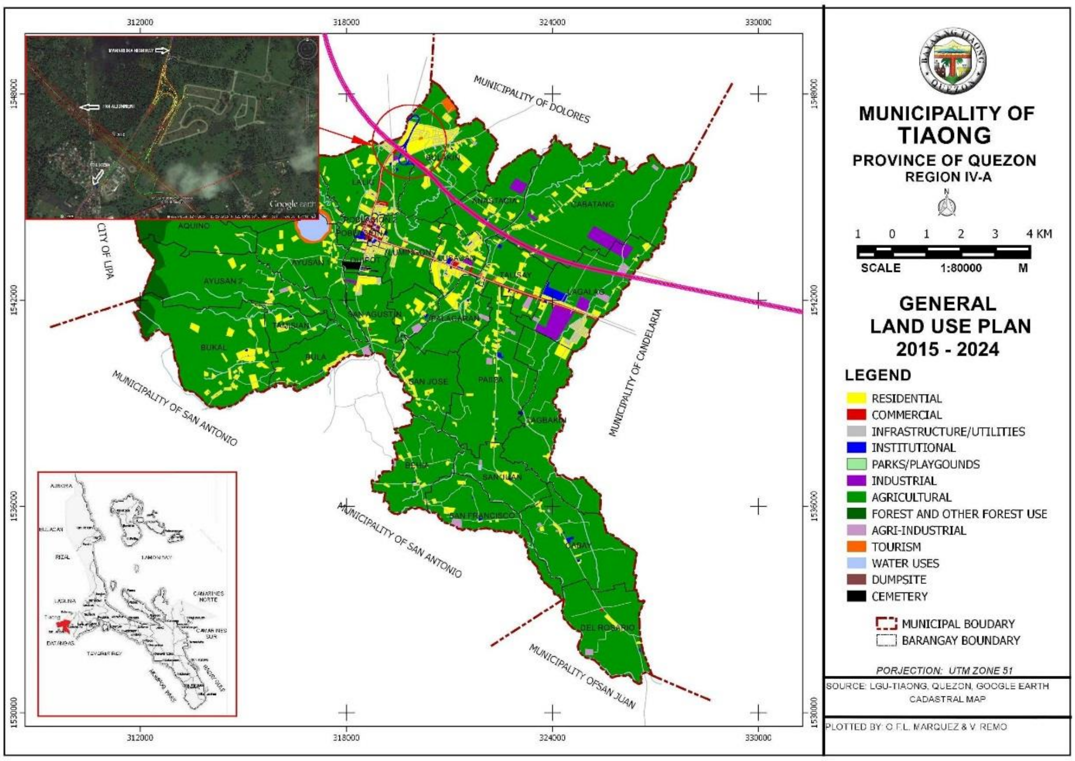


Figure 2-4: Tiaong Land Use Map

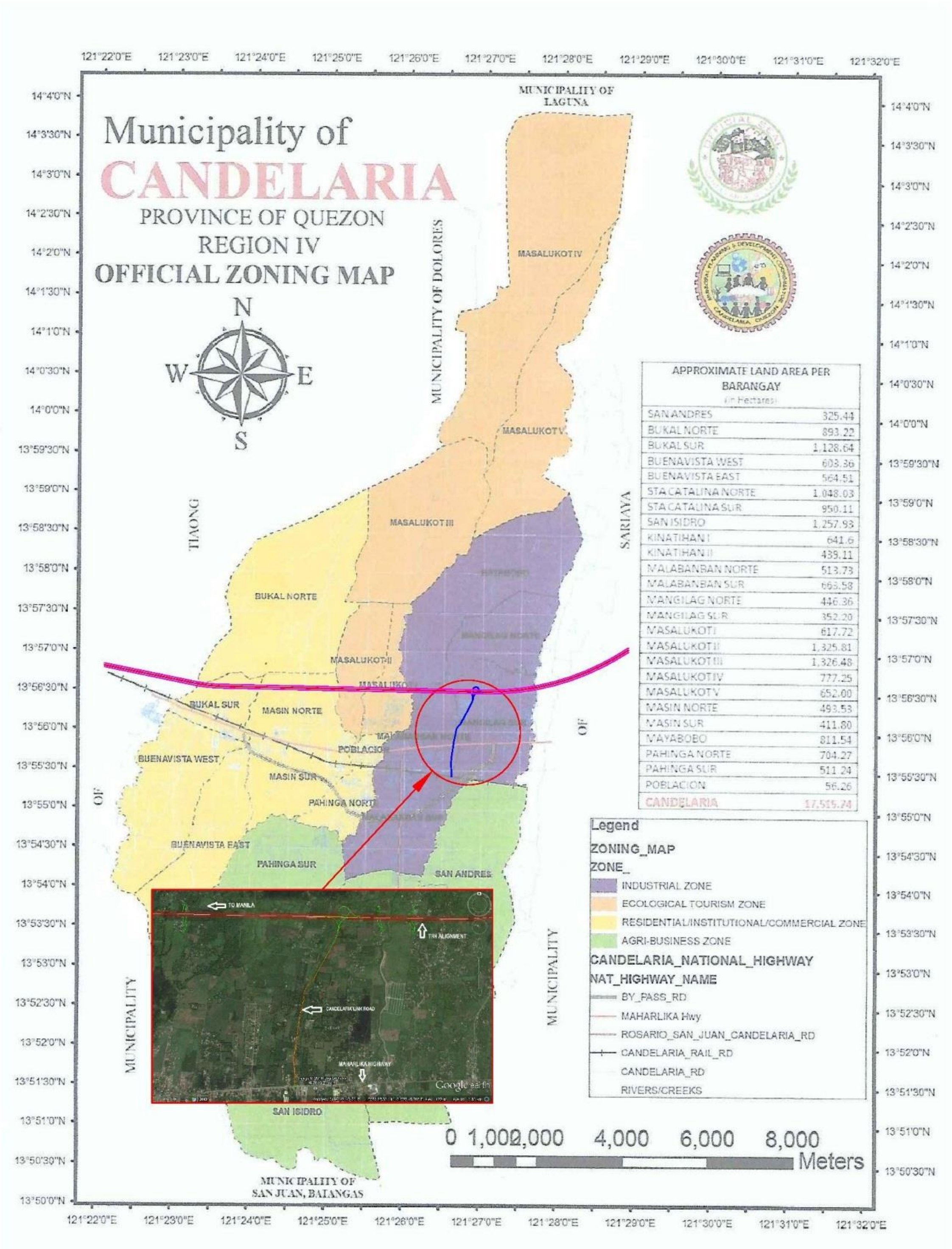


Figure 2-5: Candelaria Land Use Map

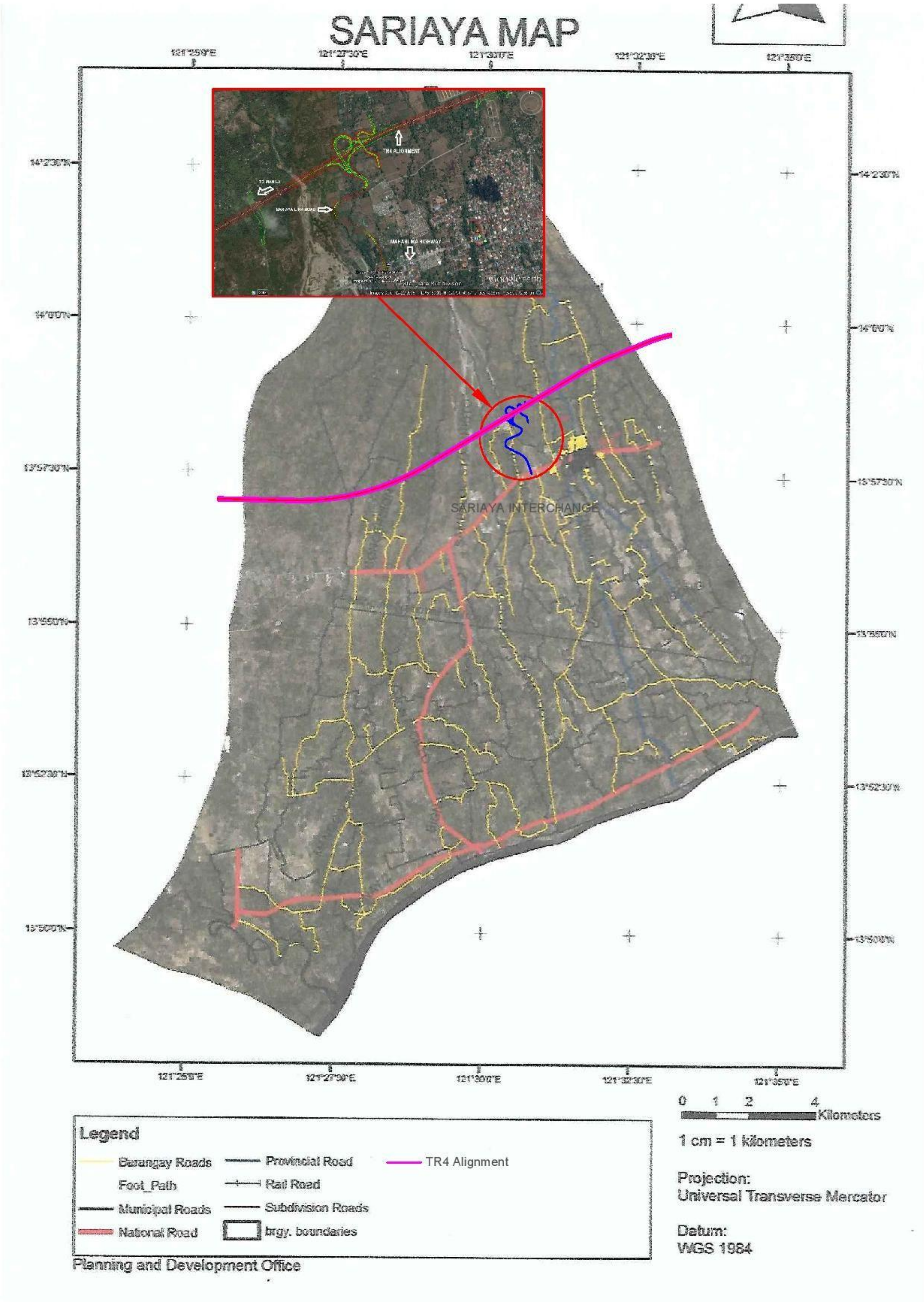


Figure 2-6: Sariaya Land Use Map

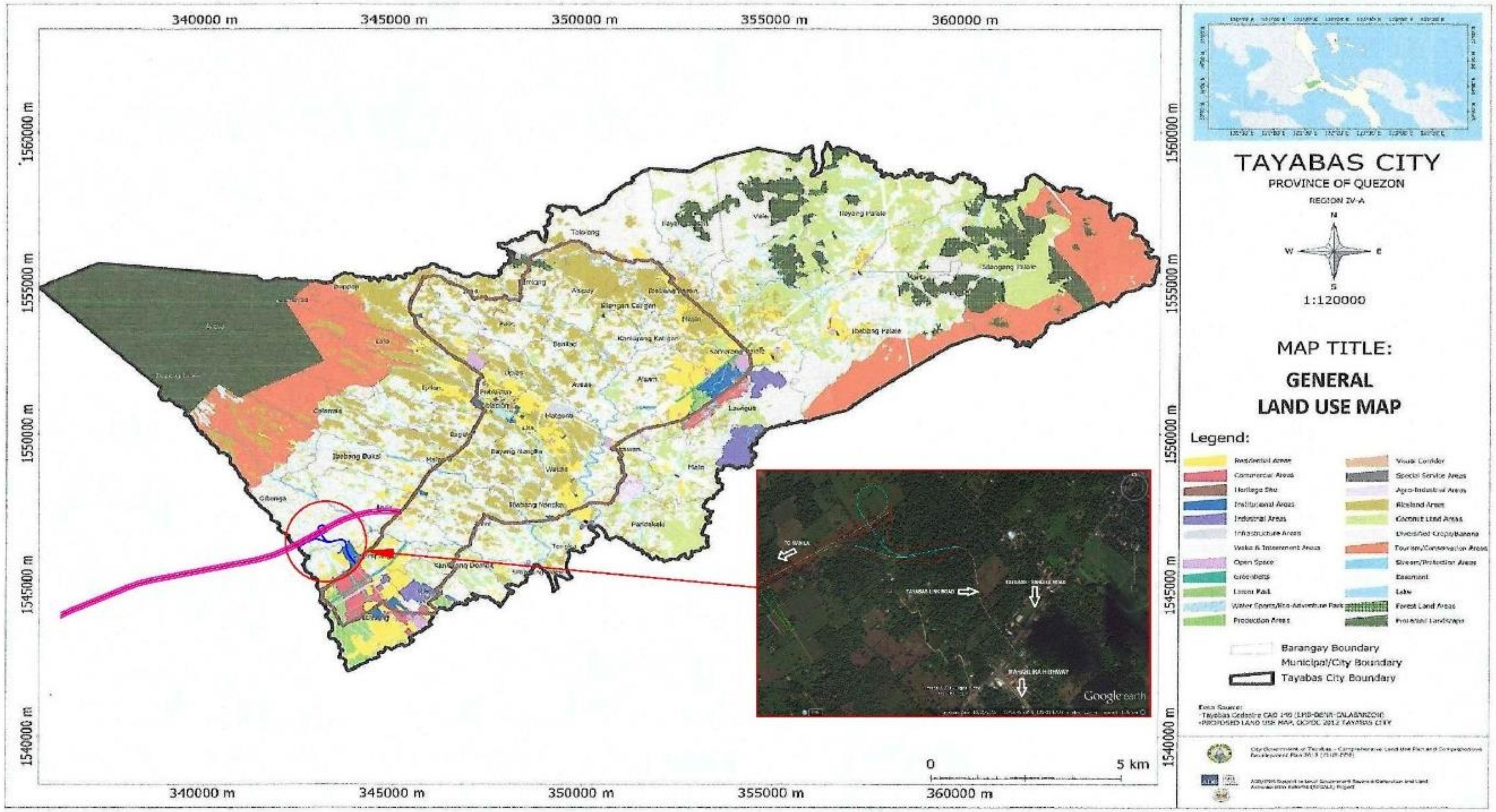


Figure 2-7: Tayabas Land Use Map

Table 2-1: Total land Area, Certified A&D and NPAAD Areas in the Provinces Sub-region (1998 & 2002)

Province	Total Land Area (hectares)	Certified Alienable and Disposable Land (hectares)	Agricultural Lands/NPAAD (hectares)	% NPAAD Areas by Province	% Share of NPAA Areas by Province
Batangas: 2000	316,581	267,760	133,485	42.16	19.93
1988		265,419	119,437	37.73	24.30
Annual Growth Rate, 1988-2000		0.07%	0.98%	4.43	4.37
Laguna: 2000	175,973	134,720	97,255	55.27	14.52
1998		134,720	49,032	27.86	9.98
Annual Growth Rate, 1988-2000		0%	8.20%	27.41	4.54
Quezon: 2000	879,660	474,439	350,405	40.25	52.32
1998		472,361	270,746	31.10	55.08
Annual Growth Rate, 1988-2000		0.04%	2.45%	-9.15	2.76
Sub-Region	1,372,214	876,919	700,582	51.05	100.00
1998		874,500	439,215	32.00	100.00
Annual Growth Rate, 1988-2000		0.02%	4.96%	19.05	

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

The major crop planted in the sub-region is coconut accounting for 347,749 hectares of the total 556,164 hectares of cropland, followed by palay and fruit trees.

Table 2-2: Croplands by Major Crops and Province Sub-Region, 2001 (in hectares)

Major crops	Total cropland	Batangas	Laguna	Quezon	Total
Coconut	347,749	16	16	66	100
Palay	101,474	34	22	37	100
Fruit Crops/Mixed Fruit Trees	33,833	61	17	5	100
Corn	20,711	19	0	79	100
Pasture Land	16,255	9	2	89	100
Banana	15,769	5	0	94	100
Sugarcane	3,661	24	0	0	100
Coffee	5,910	5	0	91	100
Diversified Crops	8,921	0	0	100	100
Total Croplands	1,880	0	100	0	100
Total	556,164	25	15	59	100

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

The vast agricultural lands of the sub-region is under immense pressure for conversion to other land use and from 1988 to 1999, a total of 7,563 hectares were converted mainly for residential and industrial purposes.

Table 2-3: Land Conversion in the Province Sub-Region (1988-1999)

Province	Agricultural Land converted (has.)	Distribution of Agricultural Lands Converted to Other Use by Major Category (%)			
		Commercial	Industrial	Residential	Others
Batangas	4,705	7.47	16.61	66.9	9.03
Laguna	2,325	14.09	31.41	50.67	3.83
Quezon	533	7.70	0.47	60.57	31.26
Total	7,563	10	20	61	9

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

Based on the respective City/Municipal Development Office, the proposed project alignment will pass through areas classified by their respective comprehensive land use plans as shown in **Figures 2-1 to 2-7 and briefly described in Table 2-4**.

Table 2-4: General Land Use along the Proposed TR4 Alignment

City/Municipality, Province	General Existing Land Use
Calamba City, Laguna	Industrial and Residential uses.
Santo Tomas, Batangas	Generally, a long portion of this section is mostly agricultural. It also runs in parallel alongside the Reserved Area (Mt. Makiling buffer zone) for about 6 km. About 1.5km is residential use near the MakBan road.
Alaminos, Laguna	This stretch is dominated by agricultural use with partly residential use near crossing the Maharlika Highway.
San Pablo City, Laguna	Mostly agricultural in use.
Tiaong, Quezon	Dominated by agricultural use except in portion in Tiaong that crosses the Maharlika Highway, which is residential.
Candelaria, Quezon	Dominated by agricultural use.
Sariaya, Quezon	Dominated by agricultural use
Tayabas City, Quezon	Mixed agricultural and residential usage.

2.1.1.3.2 The Makiling Forest Reserve[2]

Primarily, the Makiling Forest Reserve (MFR) was intended as a laboratory for educational use and scientific works to University of the Philippines at Los Baños (UPLB) communities and for educators to study the diverse life e.g., plants and animals that are found in the forest.

The classification or feature between a Forest Reserve and a Buffer Zone can be defined in terms of predominant land use, i.e., whether dominated by forestland, grassland, and human settlements. Other factors to characterize them include relief or topography, size, erosion hazard, and land suitability.

Since its recognition as forest reserve in 1910 and over the period of time, several changes in government policy happened in administering the MFR. In 1987 under Executive Order 224 issued by President Corazon Aquino, the entire MRF was set aside for energy generation. The opinion was

[2]*Adapted from 2014 EIS for the SLEX Phase II TR4 Project*

challenged by the UPLB and in 1990 to date under RA 6967, UPLB has the exclusive control over the management of MRF.

UPLB has recognized a multi-stakeholder approach that allows other organizations including private institution to participate and help through reforestation efforts and other forest protection activities.

Hence, SLTC through its commitment to sustainable environmental protection could initiate partnership with UPLB in the rehabilitation effort such as tree planting of areas that could be identified by the latter. SLTC could seek partnership with UPLB and other stakeholders of MRF through implementing similar project activities that promote forest awareness. Other project activity may include placement of signages or boundary markings to define the limits of the forest reserve.

Upon consultation with the Planning Development Office of the Municipality of Sto. Tomas, the Buffer Zone along its political boundary is defined by a 500 meter distance from the nearest Forest Reserve limits. Technically, the TR4 alignment will neither encroach onto Forest Reserve nor the Buffer Zone.

2.1.1.4 Potential Impacts and Mitigating Measures

2.1.1.4.1 Change / Inconsistency in Land Use

The principal impact on the land use during construction phase is the loss of productive agricultural land from conversion to built-up/paved land use. The loss of agricultural land will be duly compensated consistent with the Right of Way Acquisition (ROWA) procedures of the government under the DPWH guidelines.

During project operation, additional lands along the project alignment may be converted to residential, commercial and/or industrial areas due to improvement in access. This indirect impact will be partly mitigated through coordination with jurisdictional local government planning and land use agencies to evaluate and implement appropriate adjustment or refinements in their respective zoning ordinances.

2.1.1.4.2 Encroachment in Environmentally Critical Areas (ECAs)

The TR4 alignment is about 800 m to the nearest boundary of the declared buffer zone of Mt. Makiling Forest Reserve (MFR). Thus, the project will not encroach in the buffer zone of MFR.

However, the SLTC may consider having consultation meetings with UPLB to come up with mutually agreed mechanisms and activities for the protection and conservation of the MFR in adherence to its commitment on sustainable environmental protection.

2.1.1.4.3 Possible Tenurial / Land Issue

The initial TR4 alignment will have potential significant impacts to the facilities and operation of MakBan Geothermal Power Plant (MGPP) since it will be crossing / dividing the latter’s geothermal well fields. Some of the major concerns are presented below:

- Isolation / Inaccessibility of some injection wells;
- Constraints on expansion projects;
- Impact on well works, well surveillance activities, and maintenance of vertically erected pipelines;
- Increase risk of vehicular accidents impacting the geothermal pipelines;
- Pipeline rupture due to traffic accidents could result in plant shutdown, serious injuries, and environmental damage;
- Disruption of routine activities in the field e.g., movement of heavy equipment, materials and people;
- Narrow roads with blind curves on steep slopes not suitable access to the MakBan Interchange; and,
- Increased exposure to public, potentially resulting in pilferage and vandalism of assets.

In addition, the initial TR4 alignment will also affect the existing structures of Maibarara Geothermal Inc. (MGI). In particular, the right-of-way will encroach at the MGI's existing water well, electrical post close to the main gate of MGI Power Plant, and transmission lines/posts located at the gate of Southridge Subdivision.

These are among the major reasons for the TR4 re-alignment. The concerns of the MGI and MGPP are addressed in the proposed re-alignment. The SLTC presented the best option among the 3 options on the adjustment of TR4 alignment to Philippine Geothermal Production Company, Inc. (PGPCI) in a letter dated February 12, 2014 (**Annex F**). Subsequently, the PGPCI issued its approval to the proposed re-alignment in a letter to SLTC dated March 7, 2014 (**Annex G**).

The potential traffic implication on existing road (MakBan road, though its current use includes public use) had been recognized during the design stage of the TR4 project. As part of the plan on TR4, the DPWH will widen the existing MakBan road leading to the town of Bay, Laguna. The proposed TR4 interchange is designed to cater to the motorists from northeast part of Laguna such as Bay, Sta. Cruz, Pila, Pagsanjan, etc.

As a proof of commitment to improve the access roads, the communications between the DPWH and SLTC to widen the MakBan Road, including San Pablo Access Road and Candelaria Access Road are presented in **Annex H to Annex J**:

- Letter from the Special Committee on Southern Tagalog Development Chairman, ISIDRO S. RODRIGUEZ, JR., dated September 12, 2012;
- Letter from the DPWH Undersecretary for PMO Operations, RAFAEL YABUT, dated September 19, 2012; and,
- Letter from the Toll Regulatory Board Officer-in-Charge, JOSEPHINE T. TURBOLENCIA, dated September 25, 2012.

2.1.1.4.4 Access to Visual Aesthetics

The project will be traversing along the footslopes of Mt. Makiling and Mt. Banahaw. A closer aesthetic view of the mountains will result from the project operation. However, the alignment will be fenced on both sides to prohibit the access to the mountains.

2.1.1.4.5 Impact of Waste Generation on the Land

The project is not expected to generate domestic wastes since throwing of wastes will be prohibited. Signboards will be posted in strategic locations to remind the users of the regulation. Domestic wastes could be generated at the gas stations with fastfoods and restaurants that will be located besides the TR4. However, the concerned establishments will be responsible in the proper waste management as will be stipulated in their respective ECCs. Thus, devaluation of adjacent lands is not expected due to improper waste management.

Table 2-5: Potential Impacts on Land Use and Mitigation Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation or Enhancement
LAND USE AND CLASSIFICATION					
Change/Inconsistency in Land Use Conversion of productive agricultural land into paved/built up area.	x	x	x		Compensation consistent with the Right of Way Acquisition (ROWA) procedures of the government under the DPWH guidelines.
Indirect impact of change in land use beyond the ROW					Coordination with the LGUs to evaluate and implement appropriate adjustment or refinements in their respective zoning ordinances.

Potential Impact	P	C	O	A	Options for Prevention, Mitigation or Enhancement
Encroachment in Environmentally Critical Areas (ECA's) The alignment is about 800 m to the nearest boundary of the declared buffer zone of MFR	x	x	x		SLTC may conduct consultation meetings with the UPLB to come up with mutually agreed mechanisms and activities for the protection and conservation of the MFR.
Possible Tenurial/Land Issue The re-alignment should be at least 200m distance from the nearest MakBan well	x	x	x		Regular coordination with PGPC/MakBan to ensure that the project construction and operation is in accordance with its approved plan Re-alignment should be at least 200 m from the nearest MakBan well with mitigating engineering measures
Access to Visual Aesthetics The alignment will be offering a closer view of the mountains	x	x	x		Fencing on both sides of the alignment to prevent access to the mountains
Impact of Waste Generation on the Land Prohibit improper waste disposal	x	x	x		Install signages on proper waste management Ensure compliance of concerned establishments with environmental regulations

2.1.2 Geology / Geomorphology

2.1.2.1 Scope

This section covers general geology, tectonic setting, topography, geo-hazard, volcanic hazards, and erosion at the regional scale and direct and indirect impact areas.

2.1.2.2 Methodology

This section presents the Project in its regional and local geological and geomorphological settings. Secondary data contained in the May 2014 EIS for the SLEX Phase II TR4 Project were considered and updated to coincide with this proposed road re-alignment. Geotechnical investigations along the road alignment were provided by SLTC.

Secondary information was derived from published and unpublished reports including maps by individuals, and government agencies, namely:

- Mines and Geosciences Bureau (MGB);
- Philippine Institute of Volcanology and Seismology (PHIVOLCS); and
- National Mapping and Resource Information Authority (NAMRIA)

Elevation contours shown in the NAMRIA maps were correlated with the Google Earth terrain maps. The secondary information were reviewed, and validated during the site visit held on June17 and18, 2016.

2.1.2.3 Surface Landform / Topography / Terrain / Slope

2.1.2.3.1 Topography and Geomorphology

The TR4 road alignment is a 56.862-kilometer stretch of mostly gently undulating topography with localized rolling terrain when traversing the southern flank of Mt. Makiling. Elevation varies from 50 meters above sea level (masl) to 230 masl. A plot of the TR4 on a composite NAMRIA topographic map is presented in **Figure 1-3**.

The project site fronts the rising slopes leading to the peaks of Mt. Makiling on the west and Mt. Banahaw on the east. Drainage patterns on areas near the southern slopes display medium dendritic but form an overall semi-annular pattern together with those draining from the cone of these volcanic mountains. The general slope direction at TR4-A is west-northwest but changes to south- southwest from TR4-B to TR4-D. The last stretch at TR4-E has gentle slopes towards the south-southeast defining the south-eastern flank of Mt. Banahaw. **Figure 2-8** is a slope map along the TR4 alignment. The regional landscape reflects a strong volcanic imprint manifested by the presence of numerous active and inactive strato-volcanoes, cinder cones, maars, and volcano-tectonic depressions termed calderas. Taal Volcano is the nearest active volcano which last erupted on 1977. Prominent volcanic peaks include Mounts Sungay, Makiling, Banahaw, Malepunyo, Macolod, Batulao and Mataas na Gulod.

Slopes are steep near the summit region of stratocones becoming moderate to gentle along the alluvial fan reach, to nearly flat at the alluvial plains and coastal areas. Central to these volcanic landforms, drainage patterns are typically radial incised by deep V-shaped valleys along its upper reaches. A Regional Geomorphologic Map is shown in **Figure 2-9**.

The morphology along individual road segments is as follows:

- TR4-A segment transects mostly undulating to rolling terrain with localized hilly morphology from Km 58 to Km 63. Elevation from 150 masl to 200masl while traversing the western slopes of Mt. Makiling. Towards the south-southeast to MakBan Interchange, the terrain becomes flat with elevation that varies from 190 masl to 220 masl.

- TR4-B traverses a general undulating morphology except for the rolling terrain from Km 68.5 to Km 69.5 which traverses the southern slopes of Mt. Olila and with elevation of 240 masl to 270masl. The general slope gradually decreases towards the San Pablo Interchange (Km 80) with elevation from 210 masl to 90 masl.

- TR4-C morphology is generally flat to undulating with elevation of 90masl at the San Pablo Interchange then gently slopes towards the south at 50masl in the vicinity of Tiaong Interchange (Km 87).

- TR4-D traverses a flattish to broadly undulating terrain with gentle slopes towards the south-southwest. Elevation varies from 50 masl near Tiaong Interchange to 110masl as the road segment approaches Candelaria Interchange (Km 102). Major river channels are deeply incised with almost vertical banks.

- TR4-E follows the mid-slope of Mt. Banahaw with elevation that rises from 110masl to an average elevation of about 250 masl from the Sariaya Interchange at Km 110 to Tayabas Interchange at Km 113.5. Morphology is generally undulating. River channels are deeply incised (e.g., at Brgy. Sto. Cristo, Sariaya).

2.1.2.3.2 Potential Impacts and Mitigation Measures

Cut and fill of land surfaces which is the major activity during the construction phase will alter the land surface particularly in slope areas where specified road grades need to be maintained. However, the change in land surface although recognizable is acceptable. The development will utilized the dominantly flattish to undulating terrain at the stretch of the road alignment. The proposed re-alignment will also veer away from the footslope of Mt. Makiling. The final landform and localized slope gradient will be dictated by the proposed road alignment layout, development and location of facilities.

Project operations will not significantly alter the topography. The final landform at the end of site development will be the same at the onset of the project operation. Project operation will strictly adhere to the development / operational plans and will only cover areas where the road already existed and the zones where the toll road facilities are located.

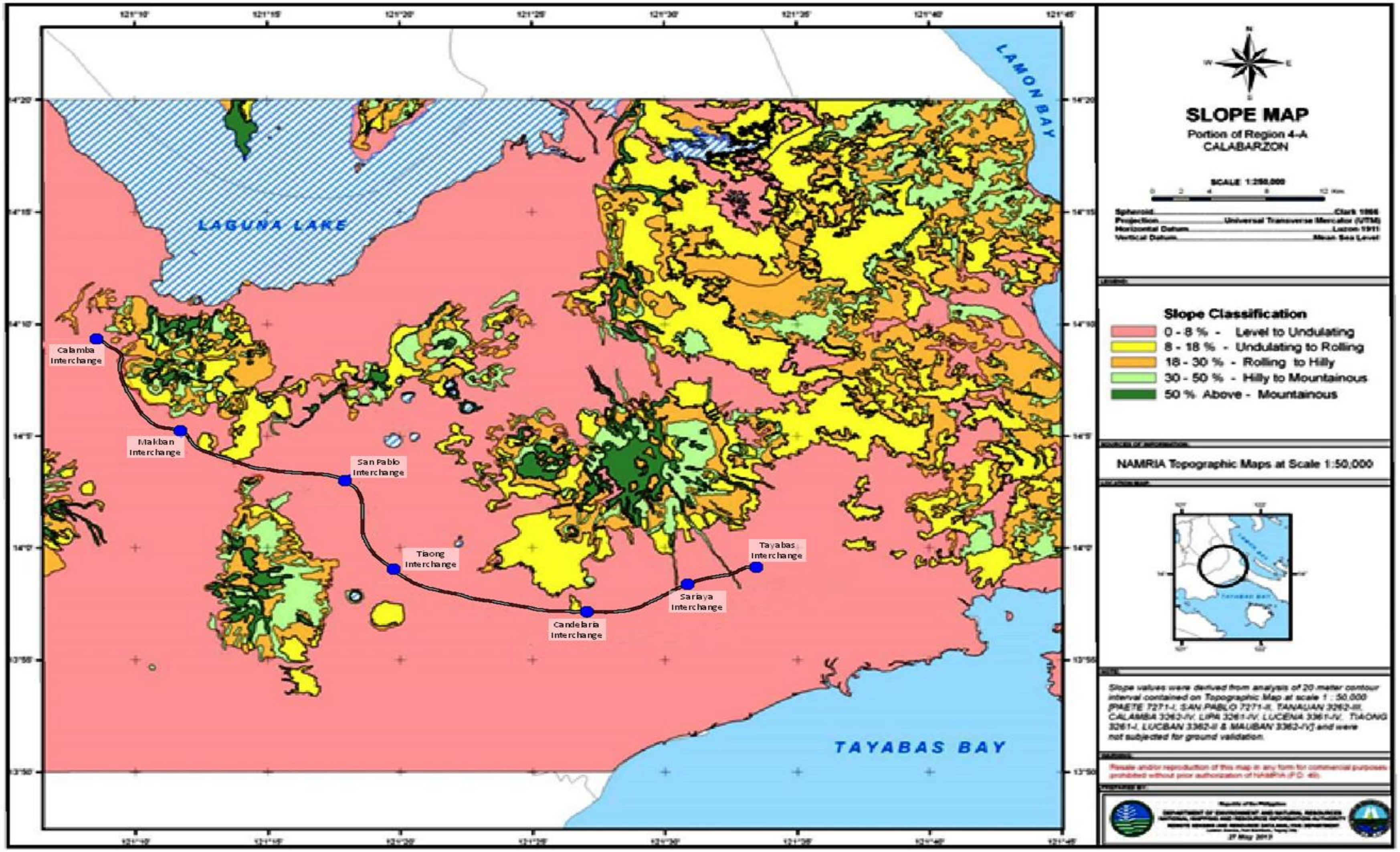


Figure 2-8: Slope Classification Map along TR4 Alignment
(*Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)*

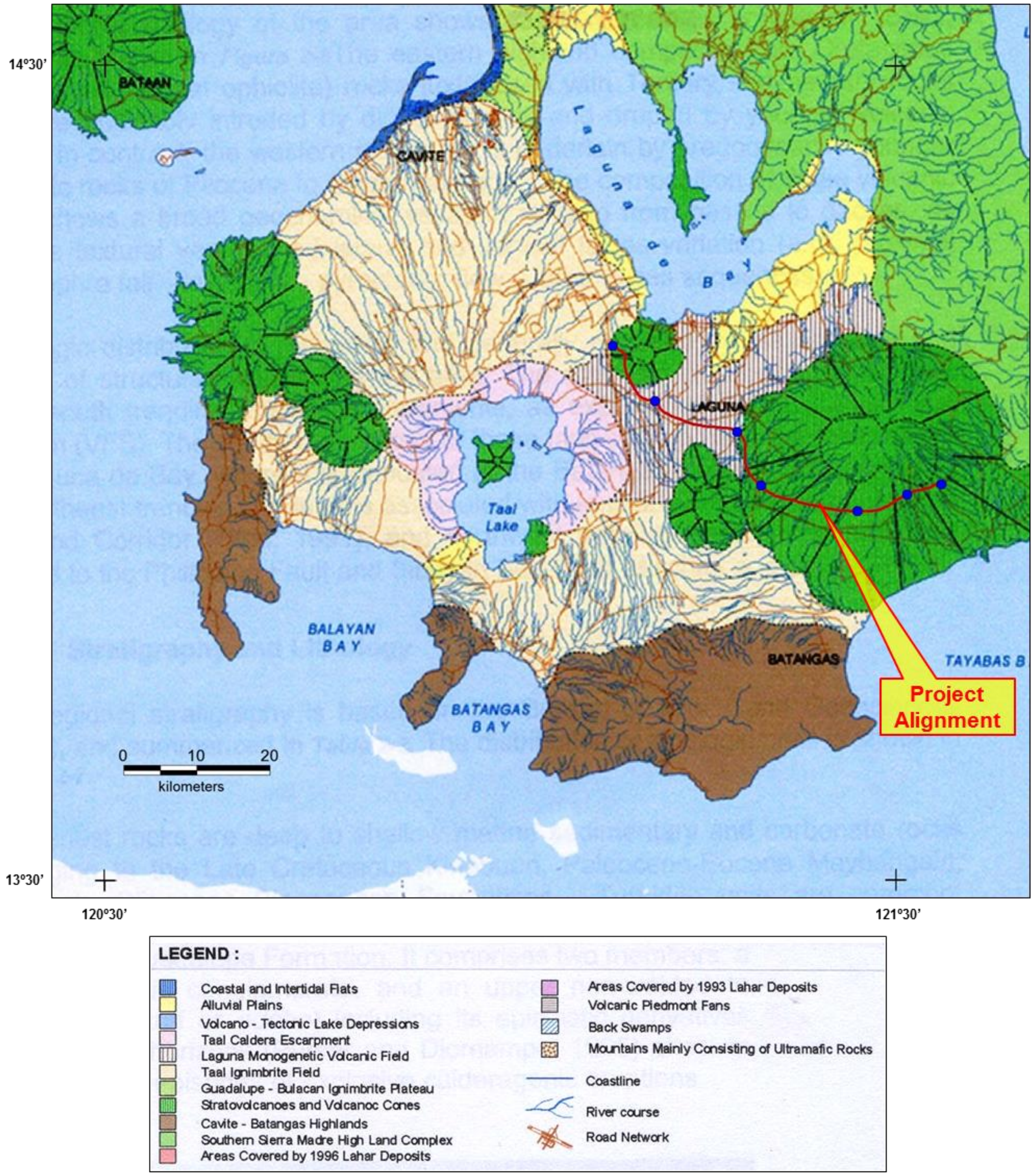


Figure 2-9: Regional Geomorphologic Map
(*Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)*

2.1.2.4 Sub-surface Geology/Underground Conditions

2.1.2.4.1 General Geology

2.1.2.4.1.1 Regional Tectonic Setting

The Philippine Archipelago is situated in a complex tectonic zone created by the interaction between the Philippine Sea Plate and the southeastern edge of the Eurasian Plate (Aurelio, 2000). The formation of this so-called Philippine Mobile Belt is influenced by subductions, collisions and major strike-slip faults. The major trenches, which serve as manifestation of subduction zones and major fault structure traces of Luzon Island, are shown in **Figure 2-10**.

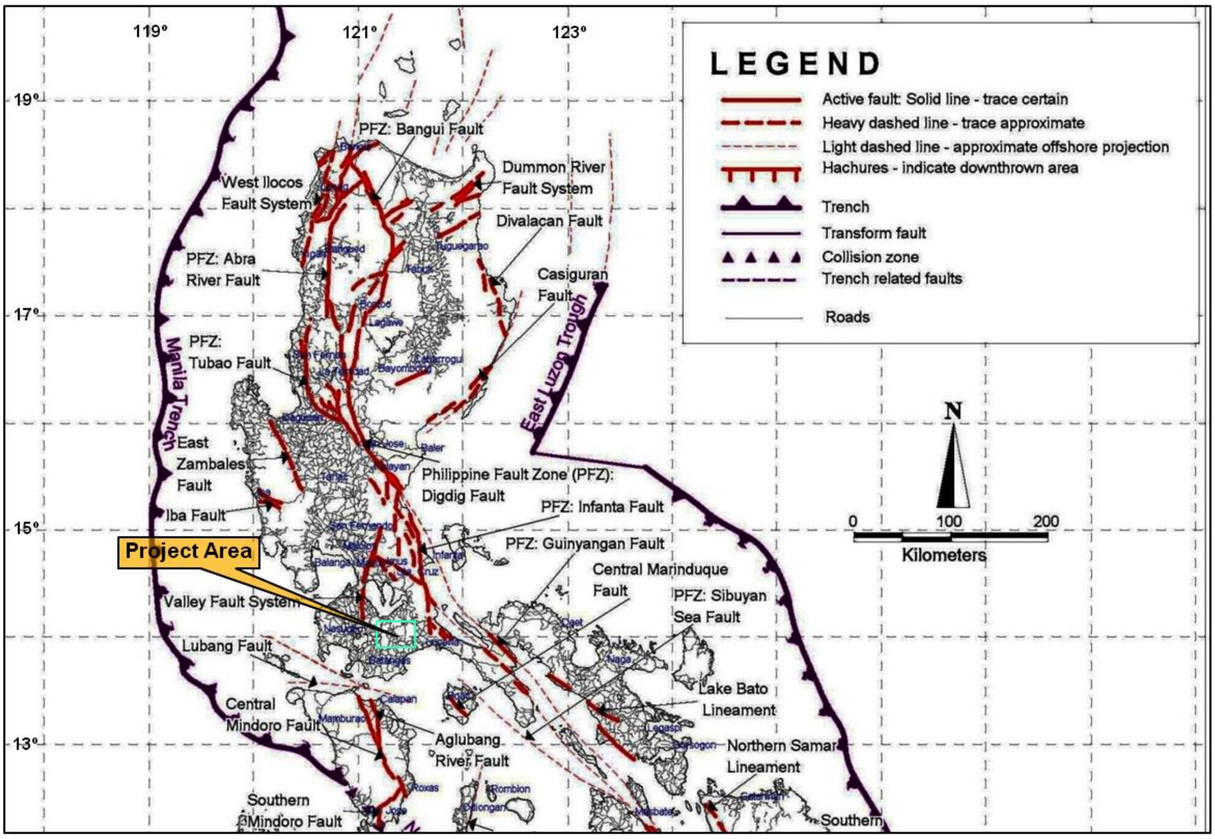


Figure 2-10: Tectonic Features and Major Faults of Luzon Island
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

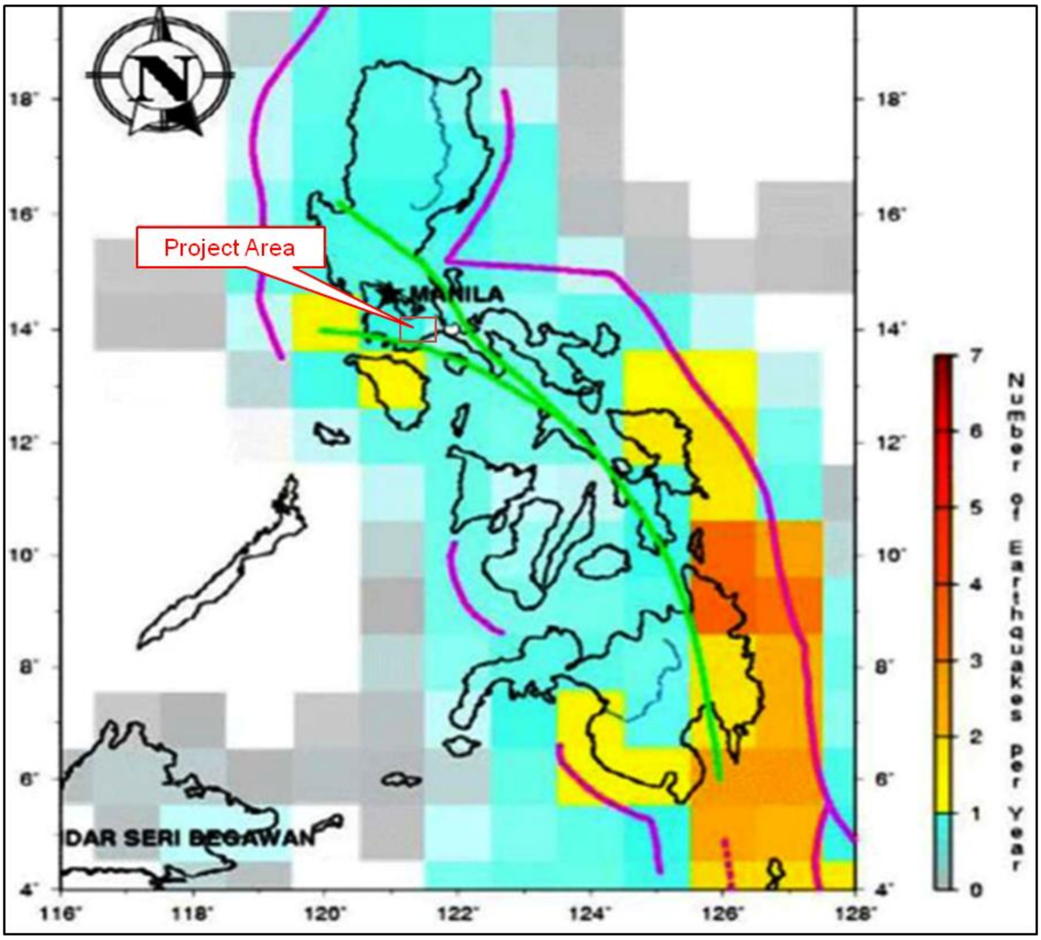
The project area is situated in southwestern region of Luzon Island, a mobile belt or a fast deforming plate boundary zone. This mobile belt is in between two opposing subduction zones: (i) the west-dipping Philippine Trench – East Luzon Trough subduction zones; and, (ii) the east-dipping north-south trending Manila Trench (Cardwell et al., 1980). The Philippine Sea Plate subducts under Luzon on the east (along the Philippine Trench) while the Sunda block (part of the Eurasian plate) subducts under Luzon along the Manila Trench on the west (Marchadier and Rangin, 1990). A linear alignment of volcanic landforms (the west Luzon Island arc) lies sub-parallel to the trend of the Manila Trench associated with subduction of the South China Sea plate beneath the island of Luzon (Cardwell et.al, 1980; Wolf and Self, 1983).

The southern terminus of Manila Trench is marked by a prominent structural suture marking the collisional boundary of the Palawan-Mindoro micro-continental fragment with the west Luzon Island arc system (Karig, 1983; Marchadier and Rangin, 1990).

Transecting the entire length of the archipelago is the 1,300-km long active Philippine Fault Zone (PFZ). This fault system takes up part of the motion due to the subducting plates and had been the loci of numerous destructive earthquakes in the country (Daligdig and Besana, 1993).Southwest of Luzon is a collision zone where the Palawan-Borneo block collides with SW Luzon, producing a highly seismic zone near Mindoro island.

2.1.2.4.1.2 Regional Seismicity

On the account of the movement of the tectonic features and fault systems, the project region experiences one earthquake per year of Magnitude 5 (M 5) and above (**Figure 2-11**).

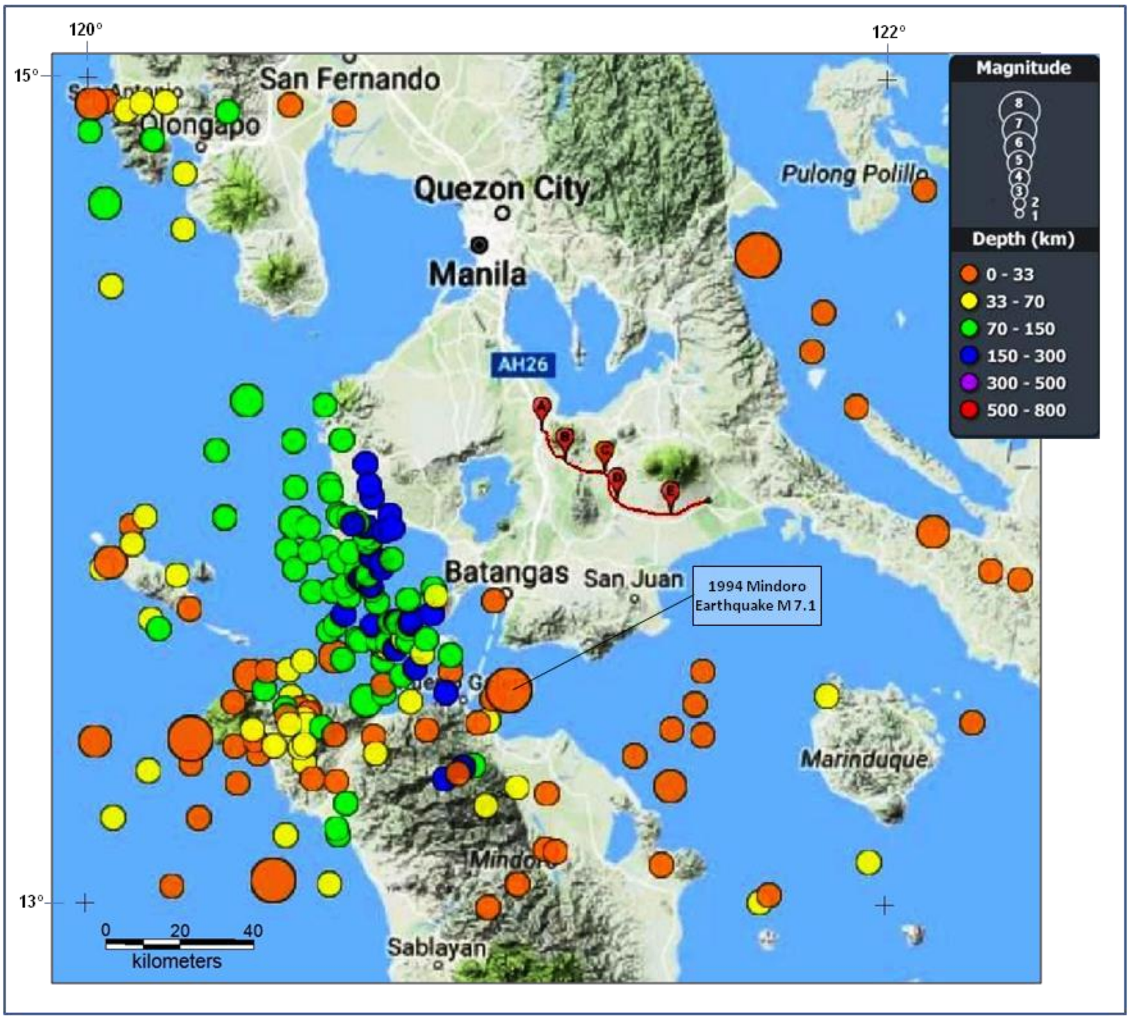


Note: Major Tectonic Boundaries: Subduction Zone-purple, Ridges-red, Transform faults-green

Figure 2-11: Number of Earthquakes per Year, Magnitude 5 and greater, all depths
(*Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)*

The National Earthquake Information Center of the United States Geological Survey (USGS-NEIC) maintains a catalogue of worldwide earthquakes. A catalogue search performed in the project region yielded 190 earthquakes with magnitudes of M[3] 5 and above from 1937 to present. The epicenters of these earthquakes are shown in **Figure 2-12**.

[3] *Magnitude is a number that characterizes the relative size of an earthquake and is based on measurement of the maximum motion recorded by a seismograph. Most commonly M scale used are (1) local magnitude (ML), commonly referred to as "Richter magnitude", (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). The moment magnitude (Mw) scale, based on the concept of seismic moment, is uniformly applicable to all sizes of earthquakes but is more difficult to compute than the other types. All magnitude scales should yield approximately the same value for any given earthquake. (Source: USGS)*



Note: Earthquake search are within coordinates 13º to 15º N latitude and 120º to 122.5º E longitude.

Figure 2-12: Epicenters of earthquakes M≥5 in the project region
(*Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)*

Seismic events tend to cluster in the offshore region along Verde Island Passage between the southwest coast of Batangas and Mindoro Island. Intermediate depth (70 to 300 km) seismic events appear to have originated from the movement of the northwest trending Lubang Fault, while shallow (<70 km) earthquakes are apparently caused by the movements of the westward splay of the Lubang Fault, the Aglubang River Fault and the Central Mindoro Fault.

2.1.2.4.1.3 Lithology

The rock formations/units that underline the TR4 belong to the Macolod Volcanic Complex a group of numerous Pliocene-Pleistocene volcanic centers which are confined within a narrow structurally bounded northeast trending lineament called the Macolod Corridor (MGB, 2004 after Forster et.al, 1990). The volcanic complex consists of basalts, andesites, dacites, trachyandesites, rhyolite, pyroclastic rocks and lahar deposits which are widely distributed from the volcanic landscape and on the undulating to rolling terrain of Batangas, Laguna, Rizal, and Quezon provinces.

The volcanic rocks comprising the Macolod Volcanic Complex have a wide range of composition from basalt to rhyolite but intermediate rocks are the most common. Basalts occur only in small monogenetic centers in the Macolod Corridor, while dacites and rhyolites seem to be exclusively present in the Laguna de Bay area and Mt. Makiling. The basalts are mostly calc-alkaline. The Laguna de Bay lavas are andesites to rhyolites.

The Macolod Volcanic Complex consists of the following rock units, from oldest to youngest: Quaternary Taal Tuff (Qtt), Laguna Formation (Qvp), and Quaternary Volcanics (Qv).

Quaternary (Recent) Alluvium (Qal) are fluvialtile deposits of unsorted and unconsolidated clay, silt, sand, and gravel from reworked pyroclastic and volcanic rocks that occur along valleys and coastal plains. The distribution of these rock units as depicted on the Geologic Map, is shown in **Figure 2-13**.

Quaternary Taal Tuff (Qtt). The Quaternary Taal Tuff consists of base surges and phreatic and phreatomagmatic eruptions related to the Taal Volcano. The volcanic activity, which had started since 2.2 Ma[4], deposited volcanic rocks spread over an area of more than 2000 km^2; crossing the 640 m-high Tagaytay ridge towards Manila Bay to the north; flowing southward to Balayan and Batangas bays; depositing up to 300 m of pyroclastics to the east in the Mt. Makiling-Mt. Malepunyo-and San Pablo areas; and entering the Nasugbu plain through a gap between Mt. Batulao and Mt. Cariliao to the west. Thirty-three historic eruptions of Taal volcano (from 1572 to 1977) unloaded calc-alkaline andesitic to dacitic magma that deposited pumice flows, ignimbrite, scoria agglutinate and scoria flows (Listanco, 1994). Recent eruptions of Taal produced basaltic and andesitic deposits.

Quaternary Volcanics (Qv). The Quaternary Volcanics consisting of pyroclastic flow, lahar, airfall and lava deposits comprise the cone of Mt. Makiling and other satellitic edifices include La Mesa tuff ring, Bijiang, Mapinggan and Masaia. Immediately south of Mt. Makiling is a deeply eroded north-south trending volcanic range that includes Mapinggon, Bulalo and Malepunyo.

In the San Pablo area, particularly the andesites from Mt. Atimbia and the dacite from Mt.Mapingon, maars and tuff rings show typical features of base surge and airfall deposits resulting from phreatic or phreatomagmatic eruptions. Included in the Quaternary Volcanics are the lava flows and breccias on the upper regions and lahars and pyroclastic flows below elevations of 800 to 600 masl of Mt. Banahaw. While Mt. San Cristobal is a complex lava dome structure, Mt. Banahaw de Lucban is characterized by a dome that caused debris-avalanche on the eastern flanks. Mt. San Cristobal basalts and andesites range in age from 1.71 to 1.29 Ma (Oles et al., 1991). Accounts of Mt. Banahaw eruptions date back to 1539, 1730, 1743 and 1909.

Laguna Formation (Qvp). Thick volcano-sedimentary series of welded and unwelded pyroclastic flows intercalated with lava flows, lahars, airfall tuff, base surges, volcaniclastic rocks, and fluvial and lacustrine sediments constitute the Laguna Formation. Exposures of clasts supported volcaniclastic rocks abound on the undulating to rolling and hilly terrain of Candelaria to Sariaya and Lucena area. In general, Laguna Formation blankets the eastern and southern slopes of Mt. Banahaw. The Laguna Formation is equivalent to the Guadalupe Formation (MGB, 2004 after Schoell et al., 1985).

[4] *Ma = millions (10^6) of years before present*

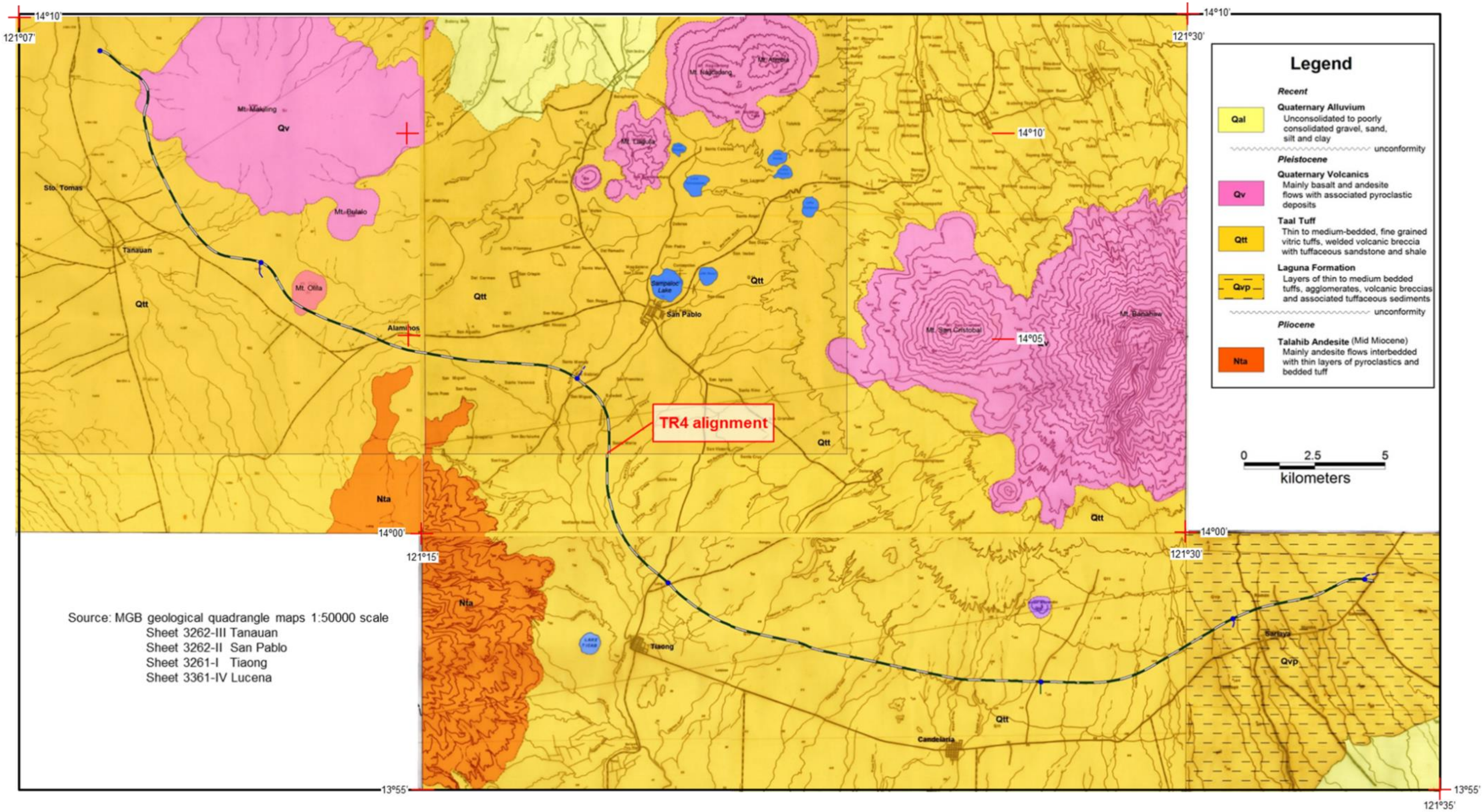


Figure 2-13: Geologic Map

2.1.2.4.1.4 Structural Geology

In the southwestern part of the Island where the Project is situated, the distribution of volcanic features appear to be structurally controlled along a series of NE-SW trending tensional lineaments that defines a rift structure referred to as the Macolod Corridor (Defant etal., 1988; Foster et al., 1990). **Figure 2-14** presents the Structural Geologic Map of the Macolod Corridor.

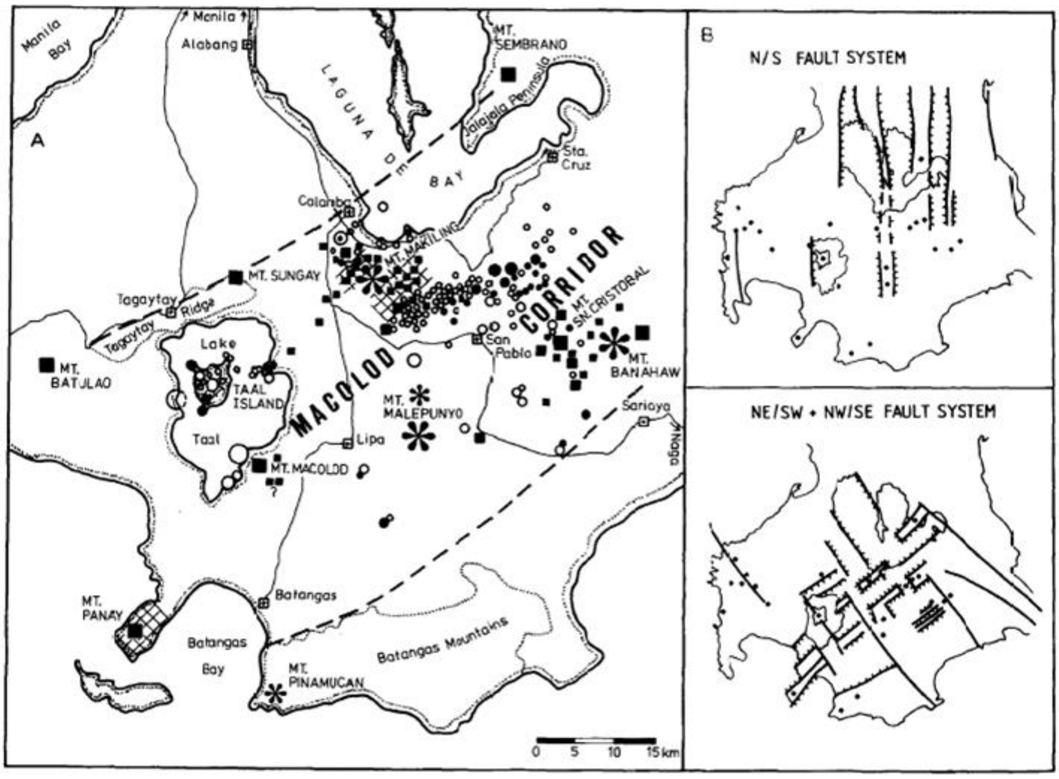


Figure 2-14: Structural Geologic Map of Macolod Corridor
(Source: Forster et al., 1990)

The active fault[5] systems surrounding the project site are the West Valley Fault, the Philippine Fault, and the Lubang Fault (**Figure 2-15**). Relative distances of these faults to the proposed project site are indicated below:

Segment of the Philippine Fault	≈	60 km east of TR4-A and 15 km east of TR4-E
Lubang Fault (WBF)	≈	65 km southwest of TR4
West Valley Fault (WVF)	≈	15 km northwest of TR4-A and 65 km northwest of TR4-E

Local geologic structures observed in the immediate vicinity of the proposed alignment are the nearly horizontal to low angle, thin- to medium- bedded and massive tuffaceous ignimbrite deposits. There were no geological lineaments or faults encountered at the project area.

2.1.2.4.1.5 Surficial Deposits

Renardet S. A. in association with Design Science was commissioned by SLTC to conduct geotechnical (soil) investigations as part of the detailed engineering design for the proposed alignment. Boreholes were driven at various sites of the TR4 where major structures such as bridges, overpasses and underpasses, or deep cuts are foreseen. Shallow test pitting and auger hole drilling were also conducted to characterize the subgrade conditions. The geotechnical characteristics of the soils and bedrock were obtained by correlation from boreholes and relevant laboratory tests executed by A.M. Geoconsult & Associates Inc.

[5] *Faults are considered active if there has been movement observed or evidence of seismic activity during the last 10,000 years*

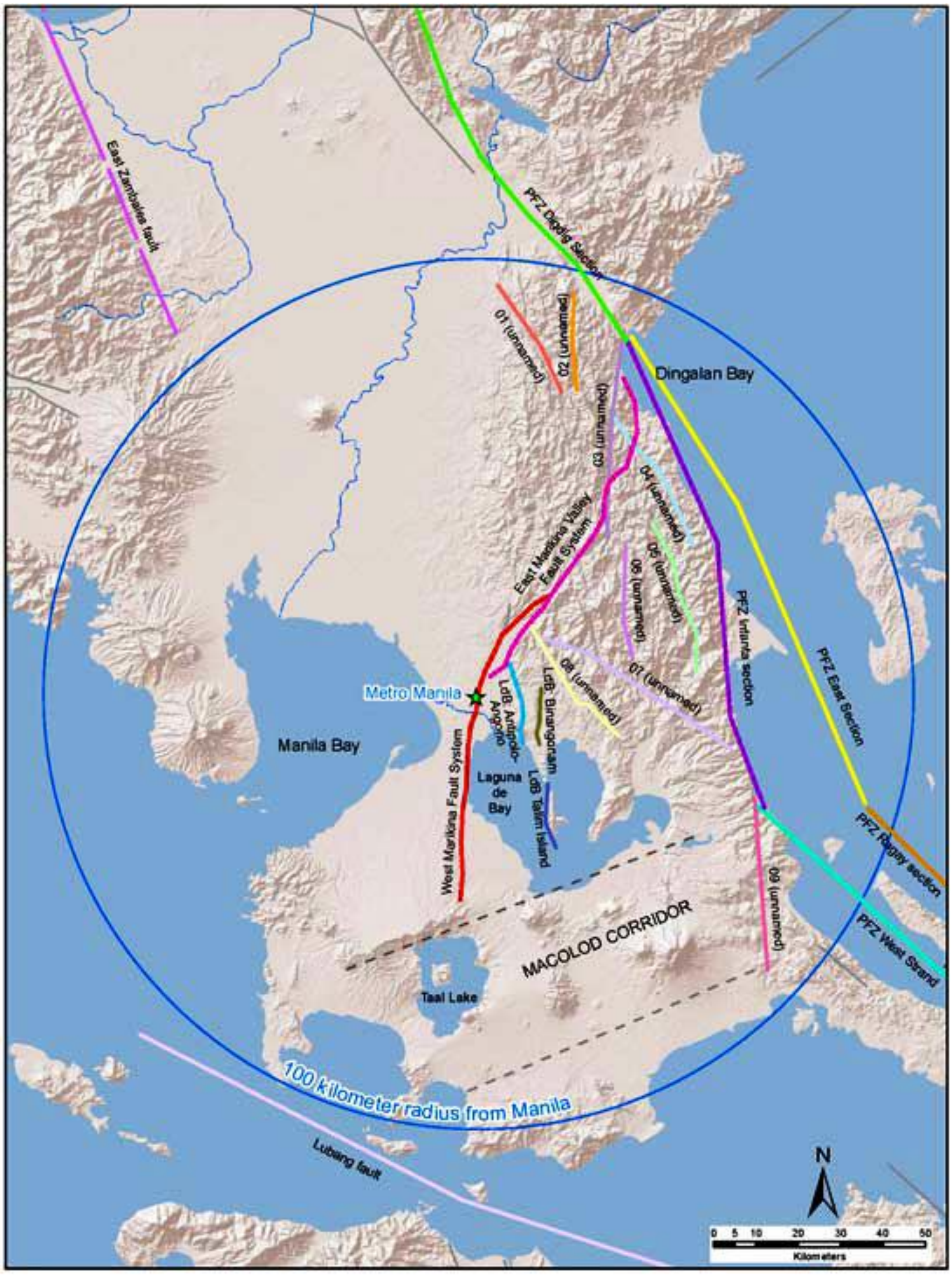


Figure 2-15: Major Active Fault System in the Project Region
(Source: Wong et al., 2006)

The following summarizes the soils and the underlying bedrock of the five alignment sections as reported in the geotechnical reports (**Annex K**).

- **TR4-A (Sto. Tomas to MakBan)**

The depth of boreholes varies from 15 m to 35 m. The deposits drilled are alternate sequences of silt and sand with lenses of lean clay and gravel. The silt is generally stiff to very stiff and contains varying amount of medium dense to very dense sand. The thickness of the alluvial deposits ranges from 1 to over 30 m; sometimes interbeds of fine-to coarse-grained pyroclastic rocks are present, there ascertained thickness varies from 1 m to 9 m.

Boreholes were also driven in hilly areas, where considerable cuts are foreseen. In the hilly area between STA 57+650 and STA 58+080 (Brgy. Makiling, Calamba City), a sequence of poorly to well-graded and very dense silty sand was encountered. From 58+220 to58+700 where the alignment cuts the external edges of a basalt quarry in Brgy. San Rafael, Sto Tomas, an alternating silty sand and silty clayey sand is interbedded with the fractured volcanic formation. The rock levels consist of a highly fractured basalt and diorite deposits with tuff intercalations. From STA 59+280 to STA 59+590 (Brgy. San Rafael and Brgy. Santiago, Sto. Tomas), variable thickness of stiff to very hard silt and silty sand overlie the fractured tuff.

The depth of the water level measured during the drilling operations varies generally between 3.0 m and 7.2 m; notably greater depths have been measured at STA 59+100 road underpass in Brgy. San Rafael, Sto Tomas where the water level has been recorded at 16.20 m.

The depth of the water level recorded at bridge sites exhibits a wide variability. The data recorded, compared with the different ground elevations at borehole location, do not result in a reliable definition of the water table elevation. It is therefore probable that the presence of water detected is due to local accumulation in pockets and lenses of more pervious soils alternating to the predominant silty and clayey deposits. The depth of water level in the boreholes located in hilly areas is locally variable.

- **TR4-B (MakBan to San Pablo)**

The depth of soil investigation varies from 20 m to 35 m. The deposits detected show alternate sequences of silt and sand with occasional pockets or lenses of lean clay and gravel. The silt is generally stiff to very stiff and contains varying amount of medium dense to very dense sand. The thickness of the alluvial deposits ranges from 8 m to over 20 m; sometimes interbedding of fine-to coarse-grained pyroclastic rocks are present, their ascertained thickness varies from 1 m to 15 m.

Exploratory boreholes were drilled in hilly areas where cuts are foreseen. In the hilly area of MakBan, heterogeneous sequences of silty sand and clayey silt with some levels of gravel overlying or interbedded with tuff deposits have been detected.

At STA 68+200 centerline, the ground condition shows residual silt with sand, about 2-m thick, underlain by highly weathered volcaniclastic sandstone becoming completely weathered from 13 m depth to the maximum explored depth of 25 m below ground surface. Groundwater was observed at 10.0 m depth.

At left side of STA 68+200, the ground condition shows residual sand present to a depth of about 6 m below existing site grade. This upper layer is underlain by variably weathered volcaniclastic sandstone to the termination depth of the boring at 35.0 m. Groundwater was observed in the boring at 9 m depth at the time of field exploration.

At STA 68+400 left side, the ground condition in the upper 7.0 m consisted of interlayered residual silt, sand, and gravel. Beneath that depth is completely weathered volcaniclastic sandstone to the maximum explored depth of 36 m below ground surface. Groundwater was encountered at 10.50 m depth.

From STA 73+375 to STA 73+485 (Brgy San Miguel) where the alignment cuts a hill slope, a 2 m thick layer of detrital material overlays the volcanic formation.

The depth of the water level measured during the drilling operations varies generally between 2.6 m and 4.3 m; notably, greater depths have been measured at STA 72+660 road overpass in Brgy. Palma wherein the water level has been recorded at 8.0 m and at STA 77+520 road overpass in Brgy. Sta. Veronica at 11.20 m.

The depth of the water level recorded at bridge sites exhibits a wide variability. The data recorded, compared with the different ground elevations at borehole location, do not result in a reliable definition of the water table elevation. It is probable that the presence of water detected is due to local accumulation in pockets and lenses of more pervious soils alternating to the predominant silty and clayey deposits.

Soils from test pits and auger holes that were driven up to 2 m depth are dominated by fine-grained soils. Most of the soils pertain to A-7-5 and A-7-6 groups are classified as clayey soils by the American Association of State Highway and Transportation Officials (AASHTO); a minor portion, showing a predominant silty-sandy fraction, is included in A-4 and A-6 groups. Occasional evidence of more sandy deposits can be found, being classified as A-2-6 and A-2-7 (clayey-silty sand). The gravel fraction is only locally present. The average thickness of topsoil, where roots, organic matter are predominant is 25 cm.

- **TR4-C (San Pablo to Tiaong)**

The deposits detected show alternate sequences of silt and sand with occasional pockets or lenses of lean clay and gravel levels. The silt is generally stiff to very stiff and contains varying amounts of medium dense to very dense sand. The thickness of the alluvial deposits which are interbedded with fine-to coarse-grained pyroclastic rocks varies from 8 m to over 20 m.

From STA. 82+900 to STA. 85+600, extensive rice paddies are present along the road alignment. The laboratory tests results and the site investigations have indicated that the presence of organic matter is limited to a thin surface layer of soil.

The depth of the groundwater level measured during the drilling operations varies between 2.5 m and 4.8 m depth; locally (at STA. 86+540, a railway crossing) the water table level has been recorded at 9.0 m depth. During the drilling investigation at Balago bridge (STA. 86+039 to STA. 86+134), the water table exhibited a localized artesian flow.

Fine-grained soils predominate in the alignment. Most of the soils pertain to A-7-5 and A-7-6 groups (AASHTO); a minor portion showing a predominant silty-sandy fraction is included in A-4 and A-6 groups. Occasional evidence of more sandy deposits can be found, being classified as A-5 (silty-clayey sand) and A-2-4 (silty sand). The gravel fraction is practically missing. The thickness of topsoil, where roots, organic matter are significantly present, has been measured from excavation of test pits and auger holes. An average thickness of 30 cm has been evaluated.

- **TR4-D (Tiaong to Candelaria)**

Sub-surface profiles encountered from boreholes 20 m to 30 m deep showed alternate sequences of silt and sand with lenses of lean clay and gravel. The sand, generally medium dense to very dense, contain a varying amount of stiff to very stiff silt. Near the surface levels, clayey-silty soils are predominant from STA. 92+300 to STA. 02+400 except between STA. 100+040 and STA. 100+480. The thickness of the alluvial deposits ranges from 2 m to over 9 m.

Exploratory boreholes were performed in the area where a trench cut is foreseen from STA. 100+040 to STA. 100+480. In this portion, the road alignment cuts the toe of the Mt. Banahaw. A sequence of andesitic/basaltic rock was intercepted between 2 m to 7m. The bedrock is generally fractured in the upper portion, becoming massive with depth. Sandy silt with minor gravels overlies the volcanic rock.

The depth of the water level measured during the drilling operations varies generally between 1.5 m and 8.0 m. A shallow water level 0.5 m deep was measured at STA. 88+825 along the bank of an irrigation channel. In particular, greater depths have been measured at STA. 90+320 and STA. 93+650 road overpasses wherein the water level has been recorded respectively at 13.0 m and 14.0 m; and, at STA. 94+850 and STA. 101+960 road overpasses where water level is 16.0 m deep.

The depth of the water level recorded at bridge sites exhibits a wide variability. The data recorded, compared with the different ground elevations at borehole location, do not result in a reliable definition of the water table elevation. It is probable that the presence of water detected is due to local accumulation in pockets and lenses of more pervious soils alternating to the predominant silty and clayey deposits.

Test pits and auger holes, 1.5 m deep, were driven to determine the strength of the natural subgrade. Samples collected consist of cohesive soils of mostly clay with few silt of medium plasticity.

- **TR4-E (Candelaria to Tayabas)**

Boreholes drilled to a maximum depth 30 m showed an upper sequence of sand with lenses of lean clay and gravel underlain by agglomerates and tuffs.

The sand levels, generally medium dense to very dense, contain a varying amount of stiff to very stiff silt. Clayey-silty soils are predominant in the upper layers from STA. 107+800 to STA. 113+758 with thickness from 1 m to 2 m.

The surface sediments overlay volcanic agglomerates made up of a coarse fraction, large blocks, sub-angular to sub-rounded cobbles and gravel set in a silty-sandy matrix. The coarse elements are mainly andesite, porphyritic andesite, and basalt often a vesicular texture. The matrix gives to the grains an apparent cohesion caused by surface tension in the pore water. The cohesion may be lost through the time when the pore pressure increases due to a variation of moisture content in the soil.

The volcanic agglomerates are sometimes interbedded with thin tuff layers. The ascertained thickness of the formation is over 30 m. It is visible in deep gullies and river banks cut along the slopes of Mt. Banahaw.

The groundwater level measured during the drilling operations varies notably between 9.0 m and 25.0 m. Loss of drilling fluid has been recorded at STA. 103+590 (road overpass) where a level of fractured volcanic rocks is encountered. No groundwater evidence has been detected at STA. 108+465 (Sariaya Interchange).

The measures of the groundwater level recorded at bridge sites exhibit a wide variability. The data recorded, compared with the different ground elevations at borehole location, do not result in a reliable definition of the water table.

2.1.2.4.2 Potential Impacts and Mitigation Measures

The project development will involve mostly shallow land excavation/grading. During the process, it is unlikely that the sub-surface geology and underground conditions will be impacted. Hence, the underlying rock types are expected to remain the same. There will be no alteration on what could be expected at depth during and after the project development. Further, climate change will not affect the sub-surface geology and underground conditions of the project area.

The underlying rock types within the project area are the Quaternary Alluvium and the volcanic rocks associated with the eruption of Taal, Makiling and Banahaw. Present geological information within and around the site do not indicate the occurrence of any underlying cavernous limestone. Hence, it is not expected that any subsidence or collapse will happen in the future. However, the pavement structure maybe susceptible to ground settlement due to the weight of filling materials.

2.1.2.5 Geologic Hazards

The Philippines, given its geological and geographical location, is vulnerable to several natural hazards that should be considered in planning for a development. MGB categorizes the geologic natural hazards as fault related/seismic, volcanic and mass movements that are relevant to the Project.

2.1.2.5.1 Fault-related / Seismic Hazards

The hazards directly associated with earthquakes at the TR4areintense ground shaking, ground rupture and liquefaction with landslides as collateral hazards. Landslides, both seismic and rain-induced, are discussed under the mass movement hazards.

2.1.2.5.1.1 Intense Ground Shaking

Intense ground shaking due to ground acceleration causes vibrations and structural distortions in dams, appurtenant structures and equipment, and their foundations. In general, the intensity of ground shaking is magnitude-dependent, and gradually decreases with distance from the source. Difference in ground conditions, however, may cause deviations from this expected norm particularly in areas underlain by recent alluvium.

As previously mentioned, the nearest earthquake generators to the project area are the WVF, the Lubang Fault and a segment of the Philippine Fault. Apaleoseismic study by Nelson and others (2000) suggests that the northern part of the WVF has a recurrence interval of 200-400 years for magnitude 6 to 7 earthquakes on the fault for an annual probability occurrence rate of 0.5% to 0.25%.PHIVOLCS in a presentation entitled “Earthquake Hazards and Risk Scenario for Metro Manila and Vicinity: the Need for Whole Society Preparedness” (May 20, 2015), mentioned that the last major earthquake from the Valley Fault happened in 1658 (Adel, June 2015).The Lubang Fault is located offshore between Batangas Peninsula and Mindoro Island. The 1972 M 7.5 and the 1994 M 7.1 earthquakes originated from this fault (see **Figure 2-12**).

The stratified nature of the Quaternary volcaniclastic rocks suggest that ground condition in the site approximate that of the medium soil category as proposed by Fukushima and Tanaka (1990). A medium soil category according to the Japan Society of Civil Engineers is where the thickness of the Pleistocene deposit (in this case, the Taal Tuff and Laguna Formation) above bedrock is greater than 10 m. Thenhaus and others (1994) performed a probabilistic estimate of ground shaking intensities of the region based on a hypothetical earthquake with Ms 8.2 and with 10%probability of exceedance in 50 years. For any of the possible earthquake sources in the region, the estimated peak horizontal ground acceleration (PHGA) amplitude may range from 0.39g to 0.4g where g is the acceleration due to gravity (**Figure 2-16**).

A deterministic approach for estimating peak horizontal ground acceleration using the attenuation relation was formulated by Fukushima and Tanaka (1990). The attenuation relation is given by the equation:

$$\mathbf{Log_{10}A = 0.41M - log_{10}(R + 0.032*100.41M) - 0.0034\ R + 1.30}$$

where A is the mean of the peak acceleration from two horizontal components at each site (cm/sec^2); R is the shortest distance between the site and fault rupture (km); and M is the surface wave magnitude. Mean ratio (coefficient) according to the nature of the subsurface are then applied to the derived A-value.

For a Ms 7.5 as the maximum credible earthquake (MCE) originating from the Lubang Fault and the Philippine Fault, and a Ms 7.2 MCE from the WVF, the estimated peak horizontal ground acceleration amplitude at the project area is shown in **Table 2-6**. The computed ground shaking intensities should be factored in the design of the structures which incorporates seismic loading in addition to static and dynamic loads.

Table 2-6: Computed Peak Ground Acceleration Values for the Project Site in Relation to Potential Earthquakes

Earthquake			A	Computed PGA (g) acceleration for medium soil
Ms	Source	Distance (km)		
7.5	Philippine Fault	15	0.41	0.35
7.5	Philippine Fault	60	0.15	0.13
7.5	Lubang Fault	65	0.14	0.12
7.2	West Valley Fault	15	0.37	0.32
7.2	West Valley Fault	65	0.12	0.10

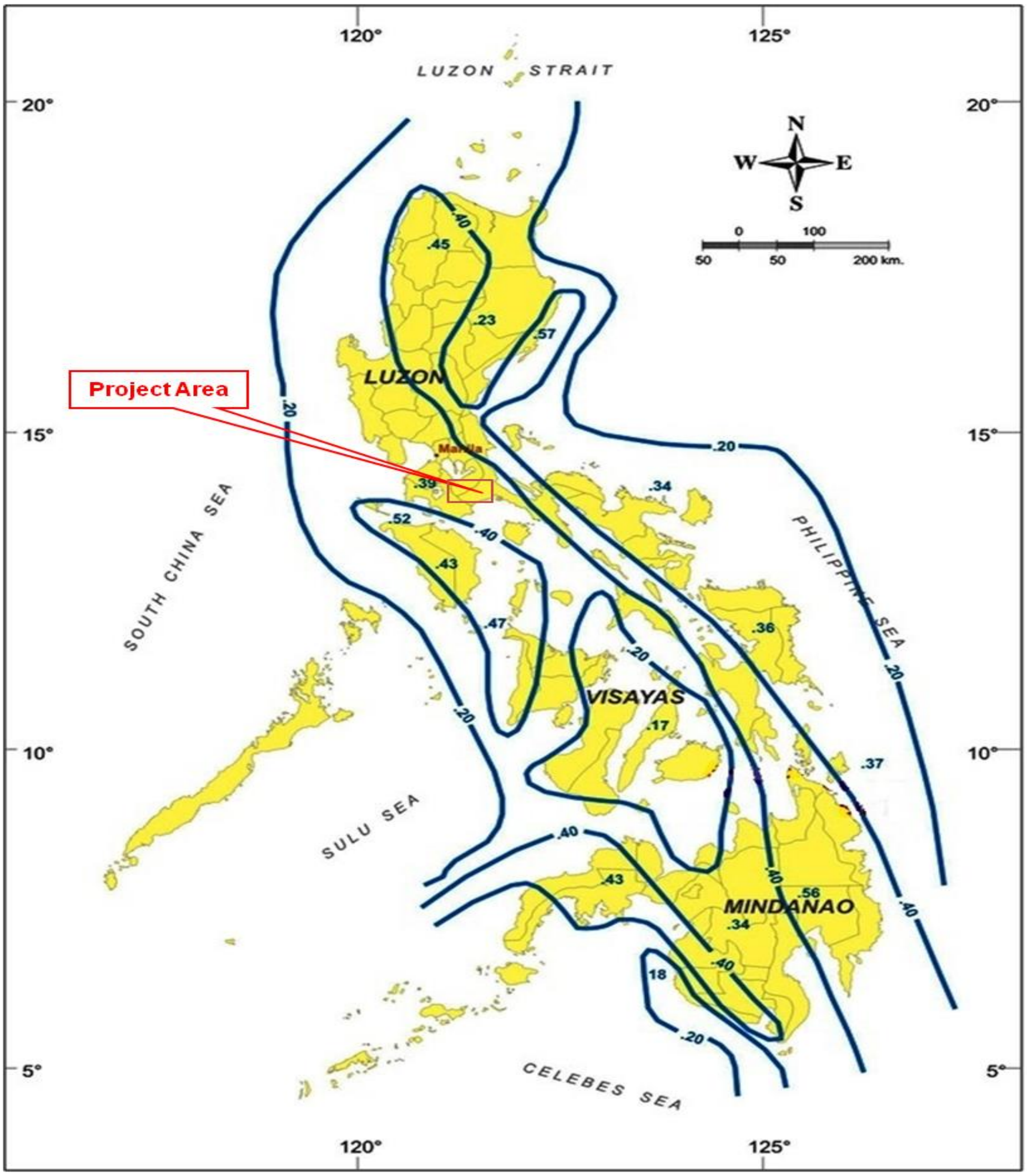


Figure 2-16: Estimated Peak Horizontal Ground Acceleration for Medium Soils
(*Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)*

2.1.2.5.1.2 Ground Rupture

Ground or surface rupture occurs when movement on a fault breaks through to the surface. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. Fault rupture almost always follows pre-existing faults. The length of ground rupture and the width of the zone of deformation generally increase with the magnitude and type of earthquake. A ground rupture is rarely confined to a simple narrow and distinct line and the zone of deformation could be as wide as 100 m (PHIVOLCS). Any structure built across faults especially active ones is at risk as the two sides of the fault slip past each other. PHIVOLCS, as a matter of policy, recommends at least a 5-meter buffer zone on both sides of the identified or inferred fault of active lineament. The Project is located at least 15 km from the nearest know active fault (WVF and PF) and it is unlikely that a ground rupture due to the movement of this fault will affect the road alignment.

In the light of the examples of the February 6, 2012 Negros M 6.9 and October 15, 2013 Bohol M 7.2 earthquakes where the surface trace or ground rupture of the hypocenter did not follow nor were generated by any of the mapped faults (Aurelio, 2012, 2013) in the two Islands, it should be noted that in case a large earthquake occur in the Project region, such event may not be necessarily generated by the WVF or the PF. A new surface rupture may be generated anywhere (including the Project area) away from the WVF/PF presently indicated in existing fault maps as the active faults.

2.1.2.5.1.3 Liquefaction and Liquefaction-induced Lateral Spreading

Torres and others (1990) cited at least three sedimentary environments favorable for liquefaction to take place. These are (1) deltaic, (2) alluvial plain, and (3) sands pit environment. These conclusions were derived from historical records of liquefaction including the 1990 earthquake wherein liquefaction occurred in Metro Manila aside from that in Dagupan City. In all historical cases, the main determinants that influence an area's susceptibility to liquefaction are mainly (1) grain size, (2) depth of water table, and (3) thickness of the deposit. It was found that in all cases, the soils were composed mainly of fine to coarse sand with some clay component. Where the clay content of the soil was in significant amounts, this was found to inhibit liquefaction. Similarly, the studies revealed that the critical depth of the water table at which liquefaction may reach the surface is 2-3 meters in areas where the saturated sand layer were 2-10 meters thick. Areas susceptible to liquefaction may possibly experience any one or combinations of the following liquefaction-related hazards in the event of an earthquake with magnitude greater than 5.

a) Flow slides or large translational or rotational site failures mobilized by existing static stresses.
b) Limited lateral spreads of the order of a few centimeters triggered and sustained by the earthquake ground shaking.
c) Ground settlement and surface manifestation of underlying liquefaction, such as sand boils.

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure built-up or liquefaction in a shallow underlying deposit during an earthquake (Rauch, 1997).

Liquefaction-induced lateral spreading occurs on mild slopes of 0.3% to 5% underlain by loose sands and shallow water table (Bartlett and Youd, 1992). Such soil deposits are prone to pore pressure generation, softening, and liquefaction during large earthquakes. If liquefaction occurs, the unsaturated overburden soil can slide as intact blocks over the lower, liquefied deposit.

The Potential Liquefaction Hazard Map of the Philippines by PHIVOLCS indicated that the project area is not susceptible to liquefaction. No liquefaction has been reported to have occurred in the project area.

2.1.2.5.1.4 Differential Settlement

Differential settlement is the unequal settling of a material, soil - in this case, during an earthquake although differential settlement can also occur from the load imposed by a structure. Other common causes of differential settlement as a result of ground subsidence during an earthquake include consolidation or failure of the ground under a foundation, and densification of sand and gravel layers due to ground shaking and liquefaction.

When all parts of a structure (in this case, the road embankments) rest on the same kind of soil, and the loads on the structure and the design of its structural system are uniform throughout, differential settlement is normally not a concern. However, where soils, loads, or structural systems differ between parts of a structure, different parts of the structure may settle by substantially different amounts. Excessive differential settlement can cause foundation failures.

An approximate evaluation of soil settlements by consolidation following the application of the embankment load was performed using the geotechnical characteristics of the soils as obtained by correlation from boreholes and relevant laboratory tests. Settlement was determined for compressible soil layers.

It is to be considered that the total settlement of an embankment will be caused by consolidation of foundation soil and the consolidation of embankment material itself, and the secondary compression in the embankment after its completion.

2.1.2.5.2 Mass Movement Hazards

Mass movement or mass wasting refers to a broad range of geologic processes involving the transport of soil and rock debris with the spread ranging from fast to barely perceptible. These includes, falls, topples, creep, slides and flows; avalanches; slumps of soil, rocks and sediments, or a mixture of all three. Falls and topples are frequently associated with rock slopes while the latter three are related to soil slopes.

Natural hazards such as earthquakes, volcanoes, intense rainfall and floods, water-level changes, storm waves, or rapid stream erosion can induce mass movements.

2.1.2.5.2.1 Landslides

Landslides or slope failure includes any or combination of the following: falls (rock or debris), slides (topple, rotational or planar), avalanches (rock or debris), flows, creep, solifluction and complex. Field identification of landslide-prone areas includes:

- Topography (steep slopes)
- Existing landslide
- Scars or deposits from previous landslides
- Depth, type, and clay content in soils
- Vegetation or the lack of it
- Presence and amount of water
- Wildfire potential which results in slopes exposed to rapid runoff and the resulting mud and debris flows

Slope failure which produces mass movements is caused by a number of factors relating to the physical properties of the material and the subsequent history of crustal movements, erosion, and weathering processes. Some factors that lead to slope instability are:

- Removal of lateral or underlying support;
- Lateral pressure;
- Inherent weak material;
- Planar features such as faults, joints, bedding planes, foliation, cleavage;
- Orientation of slope;
- Amount of weathering; and
- Changes in inter-granular forces.

Figure 2-17 is shows the alignment on the composite MGB Landslide Susceptibility Map. Generally, the alignment area is categorized as having a low susceptibility to landslides except for river crossings where the river banks are steep and is prone to mass movement.

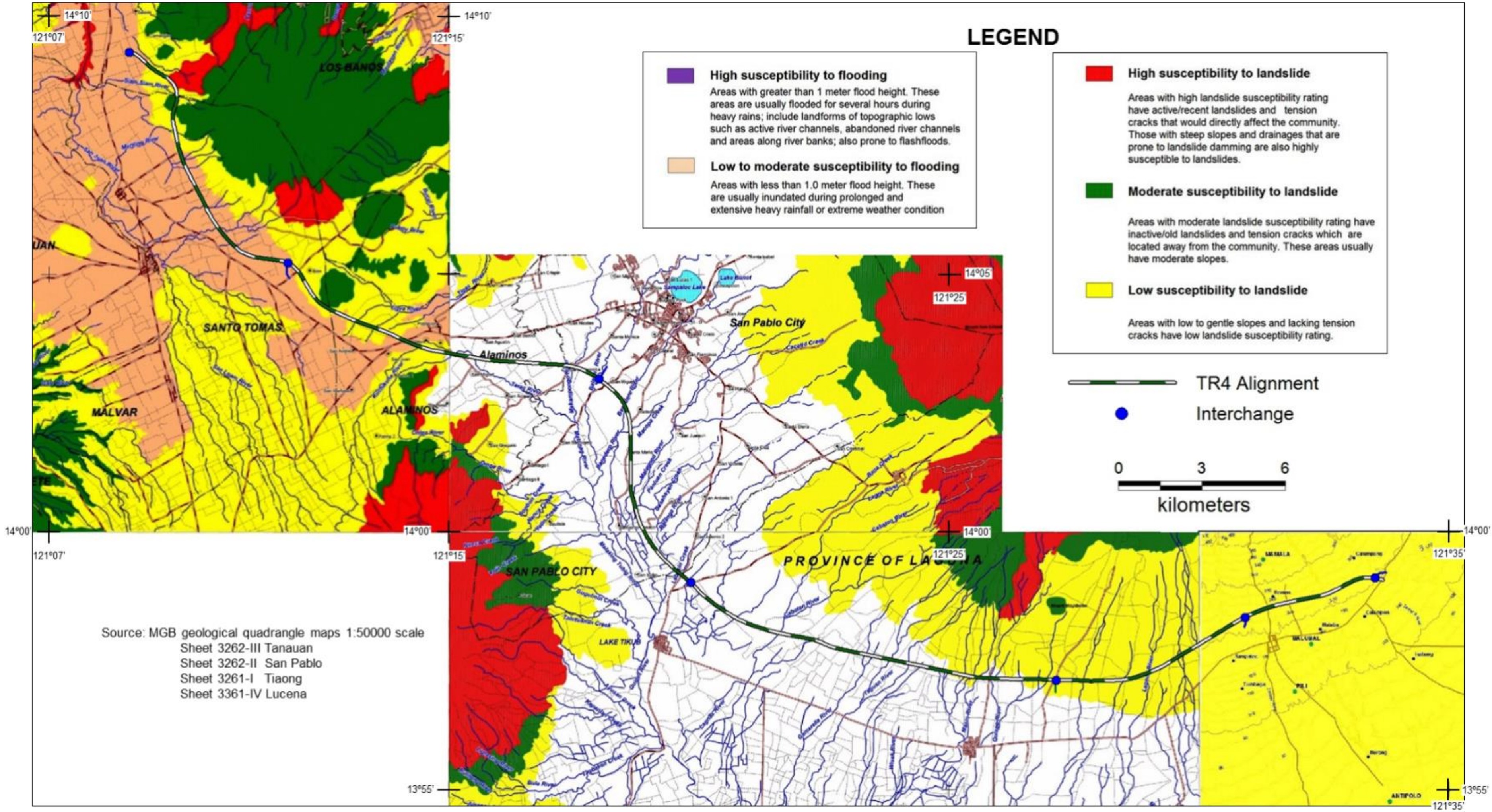


Figure 2-17: Composite Landslide and Flood Susceptibility Map (Source: MGB Landslide and Susceptibility Maps, 1:50000 scale)

2.1.2.5.3 Volcanic Hazards

Analogous to earthquakes, the degree and extent of vulnerability of an area to volcanic hazards depends on its proximity to an active volcano. Within the immediate vicinity of the project area, the nearest active volcano is Taal Volcano (Mt. Makiling and Mt. Banahaw are considered inactive volcanoes). Eruption-related volcanic hazards for Taal Volcano include airfall tephra, base surge, fissuring and ground subsidence, seiches/tsunami and flooding (Arboleda and Ruelo, 1986).

Considering the more than 20 km distance of the project site to Taal Volcano, it is unlikely that the area will be directly and adversely affected by eruption-related volcanic hazards from the Taal Volcano, if the scale of eruptions were of similar magnitude to those of historic times. Possibly, the area may be affected by minimal ash fall if the wind speed and direction are directed towards its location. In this event, residents in the area may experience temporary respiratory discomfort particularly those with known history of respiratory ailment and allergies.

2.1.2.5.4 Potential Impacts and Mitigating Measures

Certain sections of the alignment will require excavating the road surface out of hillsides. Cutting of slopes could induce landslides that would potentially damage the structure or even cause accidents to motorist.

The climate change projection of PAGASA indicates that in the periods 2020 and 2050, the project region will experience an increase in rainfall and number of days with high precipitation for the months June to August and September to November **(see *Section 2.2.1.4*)**. This increase could potentially induce mass movement. However, the alignment area is categorized as having a low susceptibility to landslides **(see *Figure 2.17*)** except for river crossings where the river banks are steep and is prone to mass movement.

Geotechnical parameters have been established for slope design calculations. The evaluation of slope stability of natural earth materials is essentially by establishing a factor of safety (FS). An FS is defined as the ratio of driving forces which move slope mass down a slope and resisting forces which oppose such movement. The goal of slope stability analysis is to ensure the integrity of the final slopes under both static and seismic (earthquake-loading) conditions.

Detailed geotechnical studies for the project were conducted by Renardet S.A. and Design Science Inc. (2015) that included road embankment and slope stability analyses. The analyses considered both static and seismic (dynamic) conditions. The studies recommended a Factor of Safety (FoS), Fs = 1.3 for static condition, and Fs = 1.0 for seismic condition.

Often in seismic geotechnical design, it is not realistically feasible to design with ample FoS against failure as is done in static design, an "engineering apparent seismic FoS of less than 1 does not necessarily imply failure (G. Gazetas, I. Anastasopoulus, E. Garini "Soil Dynamics and Earthquake Engineering" Vol. 57. February 2014 as cited in Renardet S.A. and Design Science Inc. 2015)

Several slope stabilization methods are available for rock slopes and soil slopes. These include reinforcement measures such as shotcrete and anchors, geometry modification, drainage techniques such as drainage trenches and drainage galleries. Revegetation of slopes also adds to the soil slope stability.

2.1.3 Pedology

2.1.3.1 Scope

This section covers the description and projected impacts of the project on soil.

2.1.3.2 Methodology

Sieve mapping of road alignment and government published soil map.

2.1.3.3 Baseline

Figure 2-18 shows the distribution of soil types within the project site and vicinity. Most of the Antipolo to Alaminos clay-loam is concentrated from the coastal flats to the undulating terrain towards the western boundary. Soil types become more of the Antipolo-Alaminos on the rolling to hilly terrain with pilar soil type on the upper elevated moderate terrain.

The soil along the alignment being derived from fine grained volcanic rock has high clay content that ranges from 40% -60% in the top 50 cm layer (**Table 2-7**).

The high clay content makes the soil cohesive and has capacity to resist soil erosion. On the other hand, the high percentage of fine materials (clay) can cause turbidity when suspended in water.

The areas with sandy soils are limited to the narrow river valleys and localized alluvium.

Generally, the water table along the alignment is deep (~60m). With the high clay content, pollutants can be filtered before reaching the water table. Thus, groundwater pollution due to the construction and operation of the road is very unlikely.

Table 2-7: Physical and Chemical Properties of Soils along the Alignment

Soils	Chemical Property		Particle size distribution (%)			
	pH	CEC (meg/100y)	Base Saturation	Sand	Silt	Clay
Concepcion, Sariaya	5.1	23.6	15.2	11.9	31.7	56.4
Mamala, Sariaya	5.5	14.0	11.0	14.8	26.0	59.2
Santisimo Rosario, San Pablo	7.1	38.2	26.1	15.4	44.0	40.6
Alaminos, Laguna	6.0	46.0	29.0	16.0	33.4	50.6

Source: SLTC (BSWM, 1988 Note: Values are average for 0-50cm depth)

2.1.3.4 Potential Impacts and Mitigating Measures

2.1.3.4.1 Loss of Topsoil / Overburden

The area to be affected by excavation will be the stretch where the road will be constructed. At this section, the topsoil will be scraped and replaced with good sub-grade material. It is included in the project planned development that displaced topsoil will be dumped on relatively depressed areas for revegetation activities in the future.

The topsoil along agricultural lands will be collected and temporarily stored along the key areas/points in the ROW limits or delivered into the material staging area for re-use in turfing and slope stabilization in conjunction with some bio-engineering activities. All construction camps, material staging areas, and access/service roads will be constructed inside the ROW limits to prevent the loss of land for crop production.

2.1.3.4.2 Soil Erosion

Erosion vulnerability at the project site is generally low having a general morphology of flat to undulating with localized rolling topography. The overall slope gradient is less than 5°.

2.1.3.4.3 Change in Soil Quality / Fertility

The dominant soil type is Alfisols with high aluminum, iron, calcium, magnesium, and potassium and is good for agriculture and forest plantation. Since the underlying rock type will not be altered during the development and actual project operation, the resulting soil quality from the long process of extensive chemical and physical weathering would definitely be the same.

2.1.3.4.4 Compaction and Contamination of Soil

Soils of productive agricultural area adjoining subproject road, haul roads, construction camps and at other construction establishments may be compacted due to the movement of heavy equipment, transport vehicles, and storage of materials. Mitigation measure includes control of movement of construction vehicles; new haulage roads will be limited on the barren lands; and rehabilitation of construction camps and material storage areas to its original condition after the completion of work.

2.1.3.4.5 Disfiguration of the Landscape

Damage to the landscape will occur during civil works, excavation, embankment formation, and cutting of trees. Although this impact is unavoidable, it becomes significant as sections of the roads are located on hilly terrain visible from great distance. Mitigation measures include: i) minimize displacement of vegetation and all trees removed will be compensated using native species; ii) source the rock and sand from existing license quarries; iii) balance cut and fill; iv) prohibit disposal of spoils on the valley side; and, vi) construction of drainage facilities to prevent soil from being saturated and increase its susceptibility to erosion. All these are integral part of the construction procedures.

The vegetation replacement will follow the DENR Memorandum Order 2012-02 or the uniform replacement ratio for cut or relocated trees. The replacement for premium species such as narra will be 1:100 while for other tree species, it will be 1:50. The final list of the tree species to be cut or relocated will be identified during the tree inventory and the final computation for the replacements will be included in the tree inventory report as part of the application for the tree cutting permit.

All contractors are required to submit a Debris Transportation and Disposal Plan no later than 30 days after the issuance of Notice to Proceed. The issuance of the Completion Certificate by the Engineer will also be reckoned, among others. A certification from the Construction Supervision Consultant-Environment Specialist will also be issued to the Contractors after the successful implementation of the Environmental Management Plan.

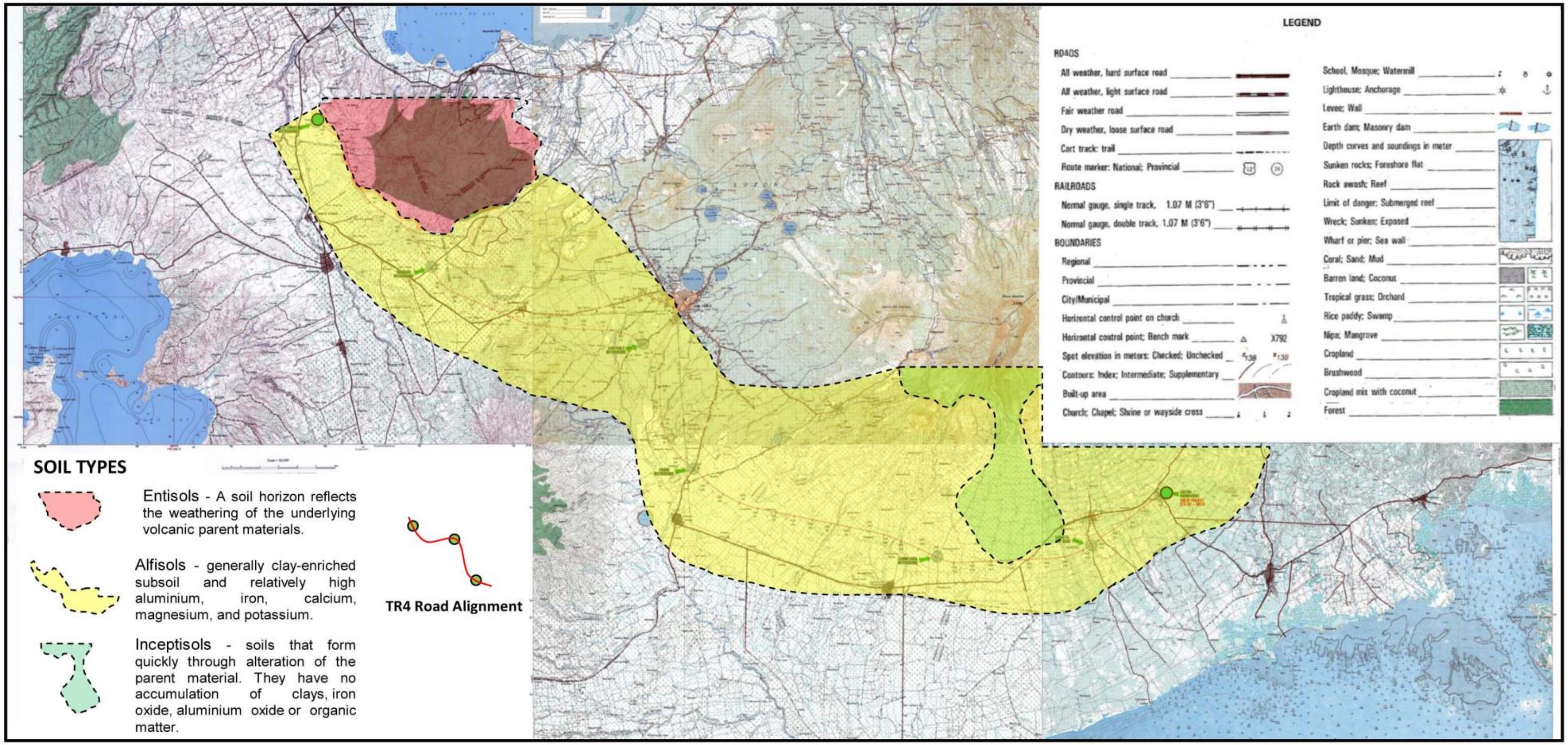


Figure 2-18: Soil Type Distribution along TR4 Alignment
(Source: SLTC, 2016)

Table 2-8: Summary of Findings and Conclusion on Pedology

Road Segment	Findings
TR4-A Calamba City, Laguna to MakBan, Sto. Tomas, Batangas	Entisols at about the initial 1 km of the alignment - do not show any profile development other than A horizon which basically reflects the weathering of the underlying volcanic parent materials. Alfisols for the rest of the alignment - generally clay-enriched subsoil and relatively high aluminum (Al) and iron (Fe) fertility. Alfisols represent one of the more important soil orders for food and fiber production. They are widely used both in agriculture and forestry, and are generally easier to keep fertile than other humid-climate soils. Alfisols have undergone only moderate leaching with relative abundance of calcium, magnesium, and potassium.
TR4-B MakBan, Sto. Tomas, Batangas to San Pablo City, Laguna	Blanketed by Alfisols with high aluminum, iron, calcium, magnesium, and potassium.
TR4-C San Pablo City, Laguna to Tiaong, Quezon	Blanketed by Alfisols with high aluminum, iron, calcium, magnesium, and potassium.
TR4-D Tiaong, Quezon to Candelaria, Quezon	Blanketed by Alfisols with high aluminum, iron, calcium, magnesium, and potassium.
TR4-E Candelaria, Quezon to Tayabas City, Quezon	Generally blanketed by Alfisols with a small portion of Inceptisols. Inceptisols[6]are soils that form quickly through alteration of the parent material. They are older the entisols and have no accumulation of clays, iron oxide, aluminum oxide or organic matter.

Table 2-9: Key Potential Impacts on Pedology and Mitigation Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement
Loss of Topsoil/Overburden		x			Confine earth movement as planned.
		x	x		Use scraped topsoil for the revegetation
Compaction and Contamination of Soil		x			Control movement of heavy equipment and vehicles
		x			Confine construction of haul roads on barren lands
		x			Rehabilitation of construction sites upon completion
Disfiguration of the Landscape		x			Minimize removal of vegetation
		x			Balance cut and fill
		x			Prohibit spoil disposal on the valley side
		x			Provision of drainage system

Notes: P = Pre-Construction; C= Construction, O = Operation; A = Abandonment or Closure

[6] *Ditto*

2.1.4 Terrestrial Biology

2.1.4.1 Scope

This section covered terrestrial floristic and faunal investigation both of the initial alignment and of the re-alignment of the proposed TR4 to identify potential impacts to local ecological conditions, assess the level of impacts, and propose measures to mitigate these impacts. For the initial alignment, the scope covered the whole road-right-of-way (RROW) of 56.862 kilometers by 60 meters wide totaling to 387.96 hectares. On the other hand, the second sampling only focused on the re-aligned sections which are not covered in the initial investigations.

2.1.4.2 Methodology

1. Conducted ecological measurements of the floral and faunal assemblages at the Project Site and its vicinity;

2. Assessed the conservation status of flora and fauna documented in the area based on DAO 2007-01 and IUCN/CITES criteria where relevant;

3. Identified and assessed the potential impacts of the TR4 to local biodiversity and ecological conditions and proposed mitigation measures.

2.1.4.2.1 General Description of Project Area

The initially proposed TR4 alignment traverses generally open grassland areas in Laguna at the buffer zone of Mt. Makiling and mixed residential-agricultural areas and urban landscapes in Quezon Province towards Lucena City (**Table 2-10**). Across all sites, majority of the plants documented are weed vegetation, except for sporadic distribution of trees along the Mt. Makiling buffer zone vegetation transects.

For the re-alignment portion, the general cover is characterized by discontinuous stretch of brushlands, agricultural lands and grasslands, most of which are under private ownership. The re-alignment would traverse an area which is 800 m from the nearest boundary of Mt. Makiling buffer zone. The vegetation of the assessed areas were mostly on residential, private farm lots or backyards planted with root crops and fruit trees which include corn, coconut, banana, mango, lanzones among others.

2.1.4.2.2 Floristic Sampling

The initial survey of trees was conducted using a modified strip-plot method where a 2m x 20 m belt quadrat was laid out on each side of the belt transect per station, covering a total of 80 m2 per station. Trees were identified down to species level when possible and measurements were taken for Circumference-at-Breast-Height (CBH) and plant height. Undergrowth flora were assessed using the quadrat method along dendrological transects, where 1.0 m2 quadrats were spaced every 25 m.

Table 2-10: Location of Sampling Stations for Floral Assessment of Sites to be Traversed by the TR4 Project

TR4 Section	Sampling Site	Location	
		Coordinates	Elevation
Initial Road Alignment*			
TR4-A	1. Brgy. Kamaligan, Calamba City, Laguna	N 14° 09’ 36.4’’ E 121° 09’ 15.2’’	194 m ASL
TR4-A	2. Brgy. Kamaligan, Calamba City, Laguna	N 14° 09’ 41.2’’ E 121° 09’ 07.8’’	206 m ASL
TR4-A		N 14° 06’ 50.0”	225 m ASL

TR4 Section	Sampling Site	Location	
		Coordinates	Elevation
	3. Brgy. San Bartolome, Sto. Tomas, Batangas	E 121° 10' 10.9"	
TR4-A	4. Brgy. San Miguel, Sto. Tomas, Batangas	N 14° 06' 15.7" E 121° 10' 39.3"	205 m ASL
TR4-A	5. Brgy. San Miguel, Sto. Tomas, Batangas A	N 14° 06' 22.7" E 121° 10' 33.9"	203 m ASL
TR4-E	6. KM 114+109, LucenaCity	N 13° 58' 15.77" E 121° 33' 40.40"	
TR4-E	7. KM 112+00, Sariaya	N 13° 57' 33.7" E 121° 32' 45.2"	140 m ASL
TR4-E	8. KM 105+350 Guisguis Road	N 13° 56' 24.8" E 121° 29' 16.8"	134 m ASL
TR4-E	9. KM 103+450 Palmes Verdez Concepcion Road	13°56'16.10"N 121°28'20.71"E	
TR4-E	10. KM 101+300 Mayabobo Road, Mangilag Norte	N 13° 56' 29.1" E 121° 27' 2"	127 m ASL
TR4-D	11. KM 99+600 Tibanglan Road	N 13° 56' 50.9" E 121° 26' 14.1"	114 m ASL
TR4-D	12. KM 98+700 Masalukot Road	-	-
TR4-D	13. Mabini Street	-	-
TR4-D	14. Brgy. Anastacia	N 13° 58' 23.8" E 121° 21' 31.6"	75 m ASL
TR4-D	15. Brgy. Bokal Norte	N 13° 57' 19" E 121° 23' 46.3"	93 m ASL
TR4-D	16. Brgy. Lagalag	N 13° 57' 32.9" E 121° 23' 41.5"	103 m ASL
TR4-C	17. M. Leonor St., San Pablo City, Laguna	N 14° 2' 47.1" E 121° 17' 59.2"	97 m ASL
TR4-C	18. Brgy. San Francisco - Brgy. Santissima Rosario	N 13° 59' 47.2" E 121° 18' 31.7"	228 m ASL
TR4-B	19. MakBan Road, San Felix, Sto. Tomas, Batangas	N 14° 05' 11.5" E 121° 12' 07.1"	-
TR4-B	20. Alaminos National Road	N 14° 03' 41.4" E 121° 12' 56.6"	218 m ASL
Road Re-Alignment			
TR4-A	21. near Batangas-SLEX Bridge, Calamba City, Laguna	N 14° 09' 01.1" E 121° 08' 43.3"	-
TR4-A	22. Ridgemont Hill, Calamba City, Laguna	N 14° 08' 43.1" E 121° 09' 29.4"	-
TR4-A	23. beside Ponteverde Subd., Sto. Tomas, Batangas	N 14° 07' 56.8" E 124° 09' 23.2"	-
TR4-A		N 14° 07' 10.3"	-

TR4 Section	Sampling Site	Location	
		Coordinates	Elevation
	24. near Axeia Subdivision, Sto. Tomas, Batangas	E 121° 09' 44.7"	
TR4-A	25. Brgy San Felix, Alaminos, Laguna	N 14° 05' 10.8" E 121° 11' 57.1"	-
TR4-E	26. Brgy. Concepcion 1, Sariaya, Quezon	N 13° 56 07.2 E 121° 28' 1.8"	-
TR4-E	27. Brgy. Concepcion 1, Sariaya, Quezon	N 13° 56' 11" E 121° 28' 49.6"	-
TR4-E	28. Brgy. Sampaloc 1, Sariaya, Quezon	N 13° 57' 58.5" E 121° 31' 10.5"	-
TR4-E	29. Brgy. Mamala 2, Sariaya, Quezon	N 13° 58' 23" E 121° 32' 18.9"	-
TR4-E	30. Bgry. Gibanga, Tayabas City, Quezon	N 13° 58' 46.5" E 121° 33' 07.6"	-
TR4-E	31. Brgy. Calumpang, Tayabas City, Quezon	N 13° 58' 48.4" E 121° 33' 32"	-

Source: The Initial Road Alignment is adapted from 2014 EIS for the SLEX Phase II TR4 Project

The survey along the TR4-A and TR4-E re-alignment sections was conducted with quadrats measuring 4mx20m and 1mx1m for canopy and undergrowth layers in 11 sites, respectively. Canopy layer is represented by trees and plants with >10 cm diameter at breast height (dbh) while undergrowth layer is represented by plants with less than 1m in height such as grasses and wildlings.

The diameter at breast height (dbh), height and occurrence of species within these layers were recorded. The plant species within the quadrats were identified and recorded. Parameters such as frequency, density, tree basal area, dominance and importance value (IV) were computed for canopy. Frequency or occurrence and listing were provided for the undergrowth layer.

2.1.4.2.3 Avifaunal Sampling

Birds were surveyed using the modified transect method, where the birds encountered along a transect line were recorded, but not the distance between the birds and the observer (Bibby et al., 1992). Birds were identified using local names by acoustic calls and visual appearance with the aid of field guides (Rabor, 1977, 1986; Kennedy et al., 2000; Fisher and Hicks, 2000; Strange, 2000). Mist nets were also used to capture birds.

For the re-alignment, a preliminary secondary data gathering of previous and related faunal studies were conducted to determine the extent and status of faunal species present in the area. Ocular observation through transect walk and species listing were primarily used for bird survey. Mist nets were employed in selected sites to supplement species documentation. Eleven transect and observation sites are established to determine bird species composition in the area (**Table 2-10**). Recording of bird species outside the transect line wherever possible was also conducted to supplement species' recording along marginal areas between canopy and open areas and other areas with moderately dense vegetation with regular bird activity. Bird identification follows Kennedy et.al. (2000).

For both assessments, the species' conservation status and their categories follow the red list assessment of the following: International Union for Conservation of Nature (IUCN) Red List of Threatened Species, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention of Migratory Species of Wild Animals (CMS), and Department of

Environment and Natural Resources (DENR) Administrative Order No. 2004-15- National List of Threatened Fauna.

2.1.4.2.4 Bat and Non-Volant Mammal Sampling

Bats were captured using mist nets installed along probable flyways and fruiting areas. Non-volant mammals were sampled using live traps baited with fried coconut strips and laced with peanut butter. Traps were installed in decaying logs and probable habitats. Captured bats and non-volant mammals were subjected to biometric measurements to aid in their identification.

The sampling in the re-alignment also used mist nets which were strategically set in possible flyways for insectivorous and fruit bats. Information on other mammals and small non-volant mammals sighted in the area e. g., civet cats, was obtained through interview with the locals with an aid of field materials. Recorded bats were identified using the Ingle and Heaney (1992), while identification for mammals follows Heaney, et al (1998).

2.1.4.2.5 Herpetofauna Sampling

Frogs were sampled using the cruising method or purposive sampling. Wetland areas and streams were thoroughly searched for frogs, aided by the frog’s vocalization. All captured species of frogs were subjected to morphometrics (snout-vent length, SVL). Identification of frogs was based on Alcala (1986) and Alcala and Brown (1998)

For the sampling in the re-alignment, opportunistic observations were conducted in all possible microhabitats such as creeks, streams, tree holes/buttress and litter areas near riparian and riverine habitat. The identification also used the Alcala and Brown (1998) and Alcala (1996) as references.

2.1.4.2.6 Ecological Measurements

For their initial alignment, the density, frequency, coverage, and their relative measures, including species diversity were calculated using the following formulas (Brower, 1989):

Density is the number of individuals per unit area, $Di = ni / Ai$, where Relative Species Density (RD_i) is the number of individuals (D_i) of a given species (n_i) as a proportion of the total number of individuals of all species ($\sum D_i$) in a given area:

$$RDi = \frac{Di}{\sum Di} x100$$

Frequency (f) is the chance of finding a given species within a sample, $f_i = j_i/k_i$, where f_i is the frequency of species i, j_i is the number of quadrats in which species i occurs, and k is the total number of quadrats taken. Relative frequency is then the frequency of a given species (f_i) as a proportion of the sum of the frequencies for all species ($\sum f_i$):

$$Rfi = \frac{fi}{\sum fi} x100$$

Basal Coverage of trees was calculated based on the diameter-at-breast-height values, converted into area measurements using $Area = \pi r^2$, where Relative Basal Coverage (RC_i) is the basal area of individuals (C_i) of a given species (n_i) as a proportion of the total basal coverage of individuals of all species ($\sum C_i$),

$$RCi = \frac{Ci}{\sum Ci} x100$$

Importance value (IV) was determined from the sum of the relative measures of density, frequency, and coverage. The importance value gives an over-all estimate of the influence or importance of a species in a plant community (Brower, 1989):

$$IV_i = RD + RC + RF$$

Species diversity was computed using Simpson's index of diversity, where a value close to 1.0 is considered highly diverse.

$$Ds = \frac{\sum ni(ni-1)}{N(N-1)}$$

The same abovementioned formulas for the density, frequency and coverage were used in the calculation for the sampling in the re-alignment sections. For the species diversity, the Shannon Weiner Index (H') is used instead of Simpson's index of diversity as shown below:

Shannon Weiner Index (***H'***)

$$H' = -\sum_{i=0}^{n}\left(\frac{ni}{N}\right)\ln\left(\frac{ni}{N}\right)$$

where:

n_i= the total number of individuals in each species
N = the total number of all individuals

Pielou's Evenness Index (***J***) = $J = \frac{H'}{\ln S}$

where: S = the total number of species

Dominance Index = $D = 1 - J$

The ecological parameters of diversity (H') and evenness (J) of the sampling area were characterized and described using the categories based on the biodiversity scale used by Fernando (**Table 2-11**). Through existing references and literature, ecological distribution and conservation status of the species were presented.

Table 2-11: Fernando's Biodiversity Scale

Relative Values	Shannon Index	Pielou's Evenness Index
Very High	3.5 and above	0.75-1.00
High	3.0-3.49	0.50-0.74
Moderate	2.5-2.99	0.25-0.49
Low	2.0-2.49	0.15-0.24
Very Low	1.9 and below	0.05-0.14

The dates of the sampling activities for terrestrial ecology are shown in the **Table 2-12**:

Table 2-12: Sampling Dates for Terrestrial Ecology

Section	Coverage (from – to)	Sampling Dates
TR4-A	Sto. Tomas Interchange via Sto. Tomas to MakBan Interchange	May 15-16, 2013
TR4-B	MakBan Interchange to San Pablo City	May 20, 2013
TR4-C	San Pablo City to Tiaong, Quezon	May 19, 2013
TR4-D	Tiaong to Candelaria, Quezon	May 17-18, 2013
TR4-E	Candelaria to Tayabas/Lucena City	May 17, 2013
TR4-A and TR4-E realignment	Calamba to Alaminos and Sariaya to Tayabas City	June 8-10, 2016 and June 15-17, 2016

Sampling sites were selected and survey was done at each of the 5 sections (TR4-A to TR4-E) of the project. Major considerations in the choice of the sampling sites were based on the existing a) vegetation type (grassland, agro-forestry to cultivated rural/urban trees) and, b) prevailing land uses (mixed agricultural to built-up to urban area). Reckoned from a main transect line, either strip-plot method (quadrat sampling) or route survey was employed depending on the type, distribution and composition in order to obtain a representative sample for each of the toll road sections. Likewise, several observation points were noted along the transect line. The locations of transect/sampling stations and observation points are presented in **Table 2-10** with the transect survey map as shown in **Figures 2-19 to 2-21**.

Figure 2-19: Location Map Showing the Sampling Sites of the Initial Terrestrial Flora Assessment

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

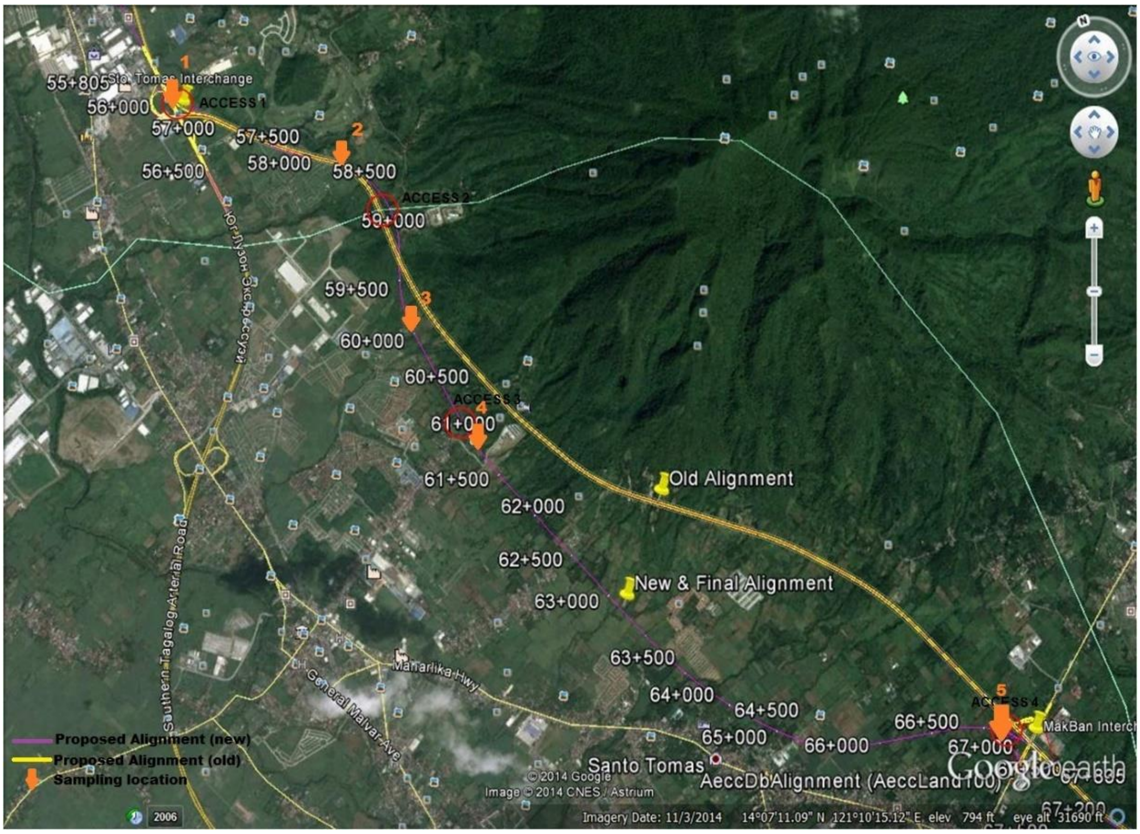


Figure 2-20: Location of Sampling Sites at TR4-A Re-alignment

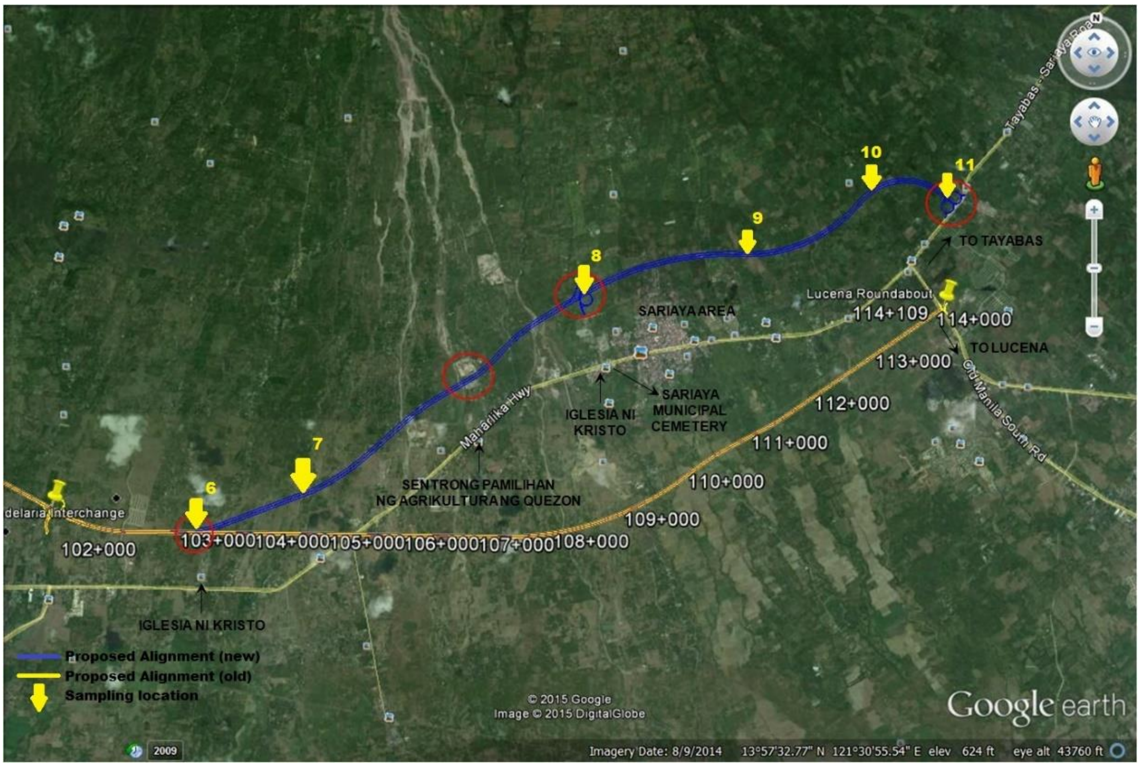


Figure 2-21: Location of Sampling Sites at TR4-E Re-alignment

2.1.4.3 Baseline Conditions

2.1.4.3.1 Terrestrial Flora

2.1.4.3.1.1 Initial TR4 Alignment[7]

1. General Conditions

The general conditions from TR4-A to TR4-E being presented in this sub-section were based from the fieldworks conducted for the 2014 EIS of the TR4 Project. This sub-section presents the terrestrial ecology at TR4-B to TR4-D which will remain part of the proposed re-alignment. The conditions at TR4-A and TR4-E are presented as reference relative to the existing conditions at the proposed re-aligned sections.

a) **TR4-A Section (KM 57 to KM 67)**

This survey started from the interconnection at Calamba City where a toll plaza or interchange will be constructed. Approximately 10-kilometer stretch, the road alignment will pass through 12 barangays of Sto. Tomas until reaching the MakBan Geothermal Plant area where another interchange is to be built.

In Calamba City, the project area is largely mixed residential/built-up and industrial in land use. The approach to Sto. Tomas runs parallel to the Mt. Makiling Forest Reserve Area (buffer zone) which is approximately six (6) kilometers long. Due to this classification, a modified strip-plot method was used to survey the area. Seven (7) transects were laid which yielded 172 various species of trees, shrubs, palms and grasses. Photographic profiles of the vegetational composition are shown in **Plates 2-1** to **2-3**.

b) **TR4-B Section (KM 67 to KM 79)**

While MakBan Geothermal Plant area is still part of Sto. Tomas, Batangas, the vegetation changes as the elevation slopes down to the national road heading towards Alaminos and farther to San Pablo City, Laguna. A 9-kilometer stretch of land starting from the preceding interchange is planted to mixed agricultural crops that include papaya, banana, and coconut and fruit trees such as santol, mango and tamarind that were easily recognizable from a distance. Forest trees encountered were narra, talisay, kapok, ditaandagoho, and kakawate. There were also a few datespalm. **Plates 2-1 to 2-19** are photo-documentation of the survey route along this TR4 section.

c) **TR4-C Section (KM 79 to KM 87)**

This proposed road alignment traverses seven barangays in San Pablo City (from San Miguel to San Antonio II) which is generally agricultural in use prior to crossing the Maharlika Highway in the Municipality of Tiaong, Quezon. Both localities are largely dominated by coconut plantation and fruit orchards (lanzones, rambutan, atis and chico) while the roadsides are dotted with a variety of shrubs and ornamentals with noticeable presence of patches of banana shoots. The photo-documentation of the survey sites are shown in **Plates 2-14 and 2-15**.

d) **TR4-D Section (KM 87 to KM 101)**

The prevailing vegetation cover from the preceding section is still observable in this section of the TR4 alignment. The terrain is generally flat along the approximately 14-kilometer stretch from Tiaong to Candelaria, Quezon. Three (3) observation points along the transect route were established as follows: Mayabobo Road in Mangilag Norte (KM 101+300), Tibanglan Rd. (KM 99+600), and at Masalukot Rd. (KM 98+700). The 3 sites are of rural settings given the road surface condition and widely spaced group of settlements. Species identified included narra, malapapaya, agoho, pili, Gmelina, coconut, banana and some ornamental plants. Shown in **Plates 2-9 to 2-13** are the peripheral view of the proposed TR4-D alignment.

[7] *Adapted from 2014 EIS for the SLEX Phase II TR4 Project*

e) TR4-E Section (KM 101 to KM 114)

The toll road alignment at this section covers the Quezon municipalities of Candelaria, Sariaya and heading towards Tayabas City. The section starts at the proposed Candelaria interchange to the Sariaya slip road/ramp and ending at a roundabout in Tayabas City.

The proposed 13-kilometer section runs parallel to the Maharlika Highway and intersects at two points wherein the last is at the roundabout. The area is largely open grassland to patches of cultivated lands although there are urbanized portions particularly in locations near the national road. Observation points were likewise established.

Plate No. 2-1: Vegetation Profile of Sampling Stations from Calamba to Batangas
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Transect 1
Brgy. Kamaligan, CalambaCity, Laguna


Transect 1
Brgy. Kamaligan, CalambaCity, Laguna


Transect 2
Brgy. Kamaligan, CalambaCity, Laguna


Transect 2
Brgy. Kamaligan, CalambaCity, Laguna


Newly Cultivated Area at Transect 2


Cassava Plantation at Transect 2

Plate No. 2-2: Vegetation Profile of Sampling Stations from Calamba to Batangas
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

Transect 3
Brgy. Kamaligan, Calamba City, Laguna

Transect 3
Brgy. Kamaligan, Calamba City, Laguna

Transect 4
Brgy. San Bartolome, Sto. Tomas, Batangas

Transect 4
Brgy. San Bartolome, Sto. Tomas, Batangas

Transect 5
Brgy. San Bartolome, Sto. Tomas, Batangas

Transect 5
Brgy. San Bartolome, Sto. Tomas, Batangas

Plate No. 2-3: Vegetation Profile of Sampling Stations from Calamba to Batangas
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

Transcect 6
Brgy. San Miguel, Sto. Tomas, Batangas

Transcect 6
Brgy. San Miguel, Sto. Tomas, Batangas

Plate No. 2-4: Roadside Sampling at Lucena City
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)


Lucena City (KM 114+109 Area)


Lucena City (KM 114+109 Area)


Lucena City (KM 114+109 Area)


Lucena City (KM 114+109 Area)


Lucena City (KM 114+109 Area)


Lucena City (KM 114+109 Area)


Lucena City (KM 114+109 Area)

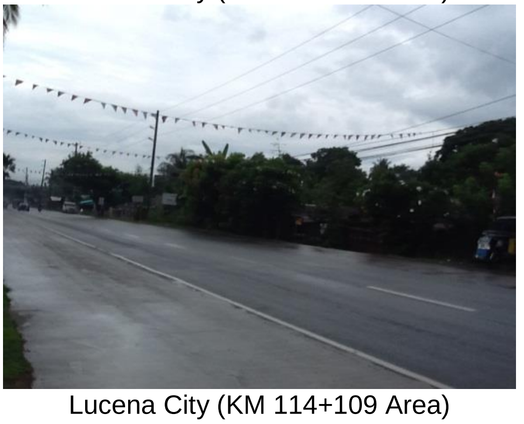

Lucena City (KM 114+109 Area)

Plate No. 2-5: Roadside Sampling at Sariaya, Quezon

(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Sariaya (KM 112+00 Area)

Plate No. 2-6: Roadside Sampling at Guisguis Road
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Guisguis road (KM 105+350 Area)


Guisguis road (KM 105+350 Area)

Guisguis road (KM 105+350 Area)

Guisguis road (KM 105+350 Area)


Guisguis road (KM 105+350 Area)


Guisguis road (KM 105+350 Area)

Plate No. 2-7: Roadside Sampling at Palmes Verdes Concepcion Road
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Palmes Verdes Concepcion road (KM 103+450)

Plate No. 2-8: Roadside Sampling at Mangilag Norte, Mayabobo Road
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*

Mangilag Norte, Mayabobo Road (KM 101+300 Area)

Mangilag Norte, Mayabobo Road (KM 101+300 Area)

Mangilag Norte, Mayabobo Road (KM 101+300 Area)

Mangilag Norte, Mayabobo Road (KM 101+300 Area)

Mangilag Norte, Mayabobo Road (KM 101+300 Area)

Mangilag Norte, Mayabobo Road (KM 101+300 Area)

Plate No. 2-9: Roadside Sampling at Tibanglan Road
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)


Tibanglan Road (KM 99+600 Area)

Plate No. 2-10: Roadside Sampling at Masalukot Road
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Masalukot Road (KM 98+700 Area)

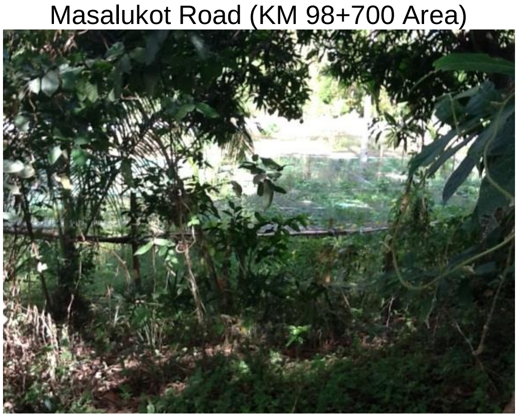

Masalukot Road (KM 98+700 Area)


Masalukot Road (KM 98+700 Area)


Masalukot Road (KM 98+700 Area)


Masalukot Road (KM 98+700 Area)


Masalukot Road (KM 98+700 Area)


Masalukot Road (KM 98+700 Area)

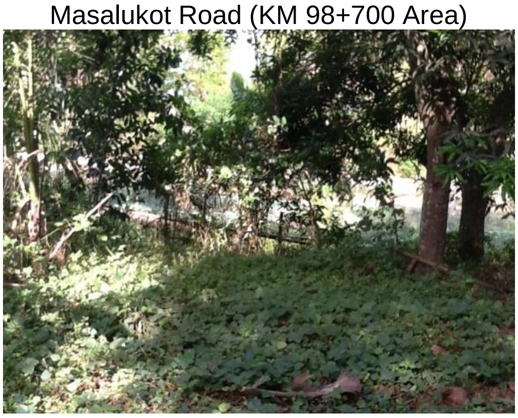

Masalukot Road (KM 98+700 Area)

Plate No. 2-11: Roadside Sampling at Mabini St.
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Mabini St.


Mabini St.


Mabini St.


Mabini St.


Mabini St.


Mabini St.

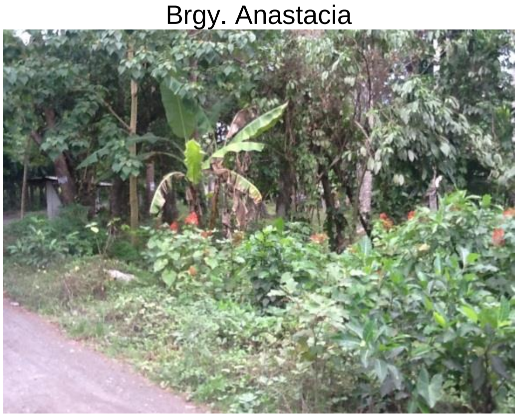
Plate No. 2-12: Roadside Sampling at Brgy. Anastacia
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Brgy. Anastacia


Brgy. Anastacia


Brgy. Anastacia


Brgy. Anastacia


Brgy. Anastacia


Brgy. Anastacia


Brgy. Anastacia


Brgy. Anastacia

Plate No. 2-13: Roadside Sampling at Brgy. Bukal Norte
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*

Brgy. Bukal Norte

Brgy. Bukal Norte

Brgy. Bukal Norte

Brgy. Bukal Norte

Brgy. Bukal Norte

Brgy. Bukal Norte

Brgy. Bukal Norte

Brgy. Bukal Norte

Plate No. 2-14: Roadside Sampling at Brgy. Lagalag
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Brgy. Lagalag


Brgy. Lagalag


Brgy. Lagalag


Brgy. Lagalag


Brgy. Lagalag


Brgy. Lagalag


Brgy. Lagalag


Brgy. Lagalag

Plate No. 2-15: Roadside Sampling at M. LeonorSt.,San PabloCity, Laguna
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna


M.LeonorSt.,San PabloCity, Laguna

Plate No. 2-16: Roadside Sampling at Brgy. San Francisco
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Brgy. San Francisco- Brgy. Santissimo Rosario


Brgy. San Francisco- Brgy. Santissimo Rosario


Brgy. San Francisco- Brgy. Santissimo Rosario


Brgy. San Francisco- Brgy. Santissimo Rosario

Plate No. 2-17: Roadside Sampling at San Felix, Sto. Tomas, Batangas
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


MakBan Road, San Felix, Sto. Tomas, Batangas


MakBan Road, San Felix, Sto. Tomas, Batangas


MakBan Road, San Felix, Sto. Tomas, Batangas


MakBan Road, San Felix, Sto. Tomas, Batangas

Plate No. 2-18: Roadside Sampling at Alaminos Road
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Alaminos National Road, PR4 Alignment


Alaminos National Road, PR4 Alignment


Alaminos National Road, PR4 Alignment


Alaminos National Road, PR4 Alignment


Alaminos/Sto. Tomas Road


Alaminos/Sto. Tomas Road

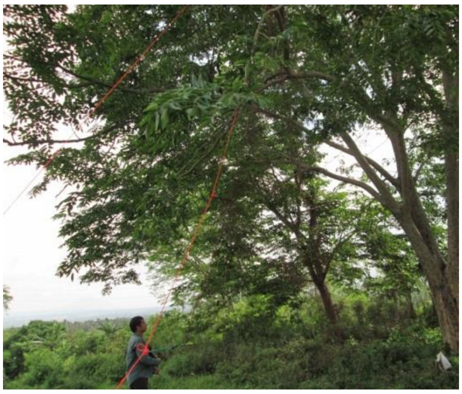
Plate No. 2-19: Established Netline at Brgy. Kamaligan, Calamba City, Laguna
(*Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)*


Netline 1


Netline 2


Netline 3

Plate No. 2-20: Established Netline at Brgy. San Bartolome, Sto. Tomas, Batangas


Netline 1


Netline 2


Netline 3

2. Survey Results

***a)* General Ground Cover**

Seven vegetation transects in open grassland areas across all sampling sites revealed a total of 246 species in 75 families, distributed into 101 species of trees, 1 aroid, 2 ferns, 14 grasses, 47 herbs, 2 introduced ornamental species, 9 palms, 2 sedges, 37 shrubs, 30 vines, and 1 zingiber species (**Table 2-13**).

Out of the 246 species of plants recorded, 224 species (91%) are Not Evaluated (NE) in either DAO 2007-01 or IUCN Redlist (2013) criteria, while 4 species are categorized under DAO 2007-01 as ;; Endangered – Kamagong (*Diospyros philippinensis*) and Molave (*Vitex parviflora*), Critically Endangered – Narra (*Pterocarpus indicus*) and Other Threatened Species (OTS) - Pili (*Canarium ovatum*). The IUCN Redlist (2013), on the other hand, listed 1 species as Data Deficient (*Mangifera indica*), 10 species of Least Concern (*Commelina benghalensis, Cyperus rotundus, Pongamia pinnata, Gnetum gnemon, Rotala mexicana, Mimosa pudica, Eleusine indica, Saccharum spontaneum, Prunus javanica, Canarium asperum*), and 6 species as Vulnerable (*, Araucaria heterophylla, , Delonix regia, Pterocarpus indicus, Artocarpus blancoi, Ficus ulmifolia*).

Table 2-13: List of Plants, Their Habit, and Conservation Status Based on DAO 2007-11 and IUCN Redlist (2017)

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Acanthaceae	Yellow creeper	*Arachis durarensis*	Vines	NE	NE
Agavaceae	Baston de San Jose	*Cordyline terminalis*	Shrub	NE	NE
Aizoaceae	Paanbalibis	*Boerhavia erecta L.*	Herbs	NE	NE
Cornaceae	Malatapay	*Alangium longiflorum Merr.*	Tree	Vulnera ble	OTS
Amaranthaceae	Cockscomb/Palo ng manok	*Celosia cristata L.*	Ornamen-tal herbs	NE	NE
Amaranthaceae	Kuletes	*Amaranthus viridus L.*	Herbs	NE	NE
Amaranthaceae	Urai	*Amaranthus spinosus*	Herbs	NE	NE
Amaranthaceae	Urai pula	*Amaranthus rubra*	Herbs	NE	NE
Amaranthaceae	Wild Alternanthera	*Alternanthera tenella*	Herbs	NE	NE
Amaryllidaceae	Bakong	*Crinum asiatum L.*	Ornamen-tal	NE	NE
Anacardiaceae	Balinghasai	*Buchanania arborescens (Blume) Blume*	Tree	NE	NE
Anacardiaceae	Kamiring	*Semecarpus philippinensis Engl.*	Tree	NE	NE
Anacardiaceae	Mangga	*Mangifera indica L.*	Tree	Data Deficient	NE
Anacardiaceae	Sineguelas	*Spondias purpurea L.*	Tree	NE	NE
Annonaceae	Anonas	*Annona reticulate*	Treelet	NE	NE
Annonaceae	Atis	*Annona squamosa L.*	Treelet	NE	NE
Annonaceae	Biriba	*Rollinia deliciosa*	Tree	NE	NE
Annonaceae	Guyabano	*Annona muricata L.*	Treelet	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Annonaceae	Ilang-ilang	*Cananga odorata Hook.f.&Th.*	Tree	NE	NE
Apocynaceae	Chichirica	*Catharantus roseus*	Herbs	NE	NE
Apocynaceae	Dita	*Alstonia scholaris (L.) R. Brown*	Tree	NE	NE
Apocynaceae	Lanete	*Wrightia pubescens R. Br. ssp. Laniti (Blanco) Ngan*	Tree	NE	NE
Apocynaceae	Pandacaqui china	*Ervatamia pandacaqui*	Ferns	NE	NE
Apocynaceae	White Pandacaqui china	*Ervatamia pandacaqui (Poir.) Pich. C.V. white*	Shrub	NE	NE
Araceae	Amlong	*Rhapidophora pinnata*	Vines	NE	NE
Araceae	Badiang	*Alocasia portei*	Herbs	NE	NE
Araceae	Pongapong	*Amorphophallus paeniifolius (Dennt.) Nicolson*	Herbs	NE	NE
Araceae	Yautia	*Xanthosoma violaceum Schott.*	Herbs	NE	NE
Araliaceae	Bunlao	*Gendarusa vulgaris*	Herbs	NE	NE
Araliaceae	Galamay-amo	*Schefflera odorata*	Vines	NE	NE
Araliaceae	Malapapaya	*Polyscias nodosa*	Tree	NE	NE
Araucariaceae	Araucaria	*Araucaria heterophylla*	Tree	Vulnerable	NE
Arecaceae	African oil palm	*Elais queenensis*	Palm	NE	NE
Arecaceae	Betel nut Palm	*Areca catechu*	Palm	NE	NE
Arecaceae	Buri	*Corypha alata*	Palm	NE	NE
Arecaceae	Coconut	*Cocos nucifera*	Palm	NE	NE
Arecaceae	Date palm	*Phoenix dactylifera L.*	Palm	NE	NE
Arecaceae	Dumayaka	*Arenga tremula*	Palm	NE	NE
Arecaceae	Fishtail palm	*Caryota mitis*	Palm	NE	NE
Arecaceae	Kapalaran	*Aglaomena spp.*	Aroids	NE	NE
Arecaceae	Mc. Arthur Palm	*Ptchosperma macarthurii H. Wendl.*	Palm	NE	NE
Arecaceae	Palmera	*Chrysolidocarpus lutescens*	Palm	NE	NE
Asclepediaceae	Milkweed	*Asclepias curassavica L.*	Herbs	NE	NE
Asteraceae	Bidenslee	*Bidens pilosa L.*	Herbs	NE	NE
Asteraceae	Bulak manok	*Crassocephallum crepidioides (Benth) S. Moore*	Herbs	NE	NE
Asteraceae	Hagonoy	*Chromolaena odorata*	Vines	NE	NE
Asteraceae	Pisau-pisau/Tagulinao	*Emilia sonchifolia*	Herbs	NE	NE
Asteraceae	Wild daisy	*Tridax procumbens*	Herbs	NE	NE
Asteraceae (compositae)	Tree marigold	*Tagetes erecta*	Shrub	NE	NE
Bixaceae	Achuete	*Bixa Orellana*	Treelet	NE	NE
Bonbacaceae	Kapok	*Ceiba pentandra*	Tree	NE	NE
Boraginaceae	Anonang	*Cordia dichotoma Forster f.*	Tree	NE	NE
Burseraceae	Bogo	*Garuga floribunda*	Tree	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Burseraceae	Pagsahingin	*Canarium asperum Benth.*	Tree	Least concern	NE
Burseraceae	Pagsahingin bolog	*Canarium callophyllum Perk.*	Tree	NE	NE
Burseraceae	Pili	*Canarium ovatum*	Tree	Vulnerable	OTS
Caesalpiniaceae	Caballero	*Caesalpinia pulcherrima*	Shrub	NE	NE
Caesalpiniaceae	Fire tree	*Delonix regia*	Tree	Vulnerable	NE
Caesalpiniaceae	Golden shower	*Cassia fistula*	Tree	NE	NE
Caesalpiniaceae	Kamachili	*Pithecelobium dulce*	Tree	NE	NE
Caesalpiniaceae	Kamot pusa	*Mesoneurum cucullatum*	Vines	NE	NE
Caesalpiniaceae	Kulibangbang	*Bauhinia rubra*	Shrub	NE	NE
Caesalpiniaceae	Sampalok	*Tamarindus indica L.*	Tree	NE	NE
Cannaceae	Bandera Española	*Canna flacida Salisb.*	Herbs	NE	NE
Casuarinaceae	Agoho	*Casuarina equisetifolia Forst.*	Tree	NE	NE
Celtidaceae Link.	Anabiong	*Trema orientalis (L.) Blume*	Tree	NE	NE
Cleomaceae	Cleome	*Cleome speciosa*	Herbs	NE	NE
Cleomaceae	Seruwali	*Cleome rutidosperma DC.*	Herbs	NE	NE
Combretaceae	Talisay	*Terminalia catappa L.*	Tree	NE	NE
Commelinaceae	Sabilau	*Commelina benghalensis*	Herbs	Least Concern	NE
Compositae	Sambong	*Blumea balsamifera L. DC*	Shrub	NE	NE
Convolvulaceae	Kamkamote	*Ipomoea triloba*	Vines	NE	NE
Convolvulaceae	Kupit-kupit	*Merrremia emarginata (Burm. f) Hallier f.*	Herbs	NE	NE
Convolvulaceae	Malakamote	*Ipomoea obscura*	Vines	NE	NE
Convolvulaceae	Tamleng	*Merremia cordata*	Vines	NE	NE
Convolvulaceae	Wild ampalaya	*Momordica conchinchinensis*	Vines	NE	NE
Costaceae	Zigzag plant/stepladder plant	*Costus speciosus*	Herbs	NE	NE
Cyperaceae	Busicad	*Cyperus difformis Linn.*	Sedge	NE	NE
Cyperaceae	Mutha	*Cyperus rotundus L.*	Sedge	Least Concern	NE
Ebenaceae	Kamagong	*Diospyros philippinensis*	Tree	NE	Endangered
Euphorbiaceae	Aguioi	*Alchornia rugosa (Lour.) Muell. -Arg.*	Treelet	NE	NE
Euphorbiaceae	Alim	*Melanolepsis multiglandulosa (Reinw ex Blume)*	Tree	NE	NE
Euphorbiaceae	Apanang	*Neotrewia cumingil (Muell.-Arg) Pax & Hoffm.*	Shrub	NE	NE
Euphorbiaceae	Baghdad coffee (Balatong aso)	*Cassia tora L.*	Herbs	NE	NE
Euphorbiaceae	Banato	*Mallotus philippensis (Lam.) Muell. -Arg.*	Treelet	NE	NE
Euphorbiaceae	Bignai	*Antidesma bunius*	Tree	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Euphorbiaceae	Binayuyu	*Antidesma ghaesimbella*	Tree	NE	NE
Euphorbiaceae	Binunga	*Macaranga tanarius(L.) Muell. -Arg.*	Treelet	NE	NE
Euphorbiaceae	Breynia/Karmai bugkau	*Breynia racemosa (Blume) Muell.-Arg.*	Shrub	NE	NE
Euphorbiaceae	Cassava	*Manihot esculenta*	Shrub	NE	NE
Euphorbiaceae	Golondrina	*Euphorbia hirta L.*	Herbs	NE	NE
Euphorbiaceae	Hyptis	*Hyptis suaveolens Poit.*	Herbs	NE	NE
Euphorbiaceae	Malabagang	*Glochidian album (Blanco) Boerl.*	Shrub	NE	NE
Euphorbiaceae	Malabalante	*Homalanthus populneus (Geisei) Pax var. Laevis (Blanco)*	Shrub	NE	NE
Euphorbiaceae	Manioca plant	*Manihot arborescens*	Treelet	NE	NE
Euphorbiaceae	Maraotong	*Acalypha indica L.*	Herbs	NE	NE
Euphorbiaceae	Matang hapon	*Breynia vitis-adaea (Burm.f.) C.E.C. Fischer*	Shrub	NE	NE
Euphorbiaceae	Matang hipon	*Breynia rhamnoides (Retz) Muell.-Arg.*	Shrub	NE	NE
Euphorbiaceae	Pascuas	*Euphorbia pulcherrima Willd.*	Shrubs	NE	NE
Euphorbiaceae	Subiang	*Bridelis penangiana Hook. F.*	Tree	NE	NE
Euphorbiaceae	Surusampalok	*Phyllanthus debilis Klein ex Willd*	Herbs	NE	NE
Euphorbiaceae	Taguang uwak	*Croton leiophyllus Muell-Arg. Var leiophyllus*	Tree	NE	NE
Euphorbiaceae	Takip asin	*Macarange grandifolia (Blanco) Merr.*	Tree	NE	NE
Euphorbiaceae	Tangan-tangan	*Ricinus communis*	Shrub	NE	NE
Euphorbiaceae	Teramycin plant/Kalnag	*Glochidion pubicarpum Elm.*	Herbs	NE	NE
Euphorbiaceae	Tubang bakod	*Jatropha curcas*	Shrub	NE	NE
Euphorbiaceae	Tubli vines	*Derris tuble*	Vines	NE	NE
Fabaceae	Acapulco	*Cassia alata L.*	Shrub	NE	NE
Fabaceae	Aroma	*Acacia famesiana (L.) Willd*	Shrub	NE	NE
Fabaceae	Bani	*Pongamia pinnata (L.) Merr.*	Tree	Least Concern	NE
Fabaceae	Calopogonium	*Calopogonium mucunoides Desv.*	Vines	NE	NE
Fabaceae	Hairy leaf centrosema	*Centrosema pubescens*	Vines	NE	NE
Fabaceae	Kakawate	*Gliricidia sepium*	Shrub	NE	NE
Fabaceae	Prickly narra	*Pterocarpus indicus Willd. Forma echinatus*	Tree	Vulnerable	Critically Endangered
Fagaceae	Tahitian chestnut	*Castanopsis tahitii*	Shrub	NE	NE
Flacourtiaceae	Bagarbas	*Hydnocarpus sumatrana (Miquel) Koorders*	Tree	NE	NE
Flacourtiaceae/salicaceae	Governor's plum	*Flacourtia jangonias*	Shrub	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Gnetaceae	Kuliat vine	*Gnetum gnemon*	Vines	Least Concern	NE
Gramineae	Para grass	*Brachiara mutica (Forssk.) Stapf*	Grass	NE	NE
Heliotropiaceae	Trompo elephant	*Heliotropium indicum L.*	Herbs	NE	NE
Lamiaceae	Malasolasi	*Ocimum spp.*	Herbs	NE	NE
Lauraceae	Marang	*Litsea cordata (Jack) Hook.f.*	Tree	NE	NE
Lauraceae	Puso-puso	*Neolitea vidalii Merr.*	Tree	NE	NE
Lauraceae	Sablot	*Litsea glutinosa (Lour.) C.B. Rob*	Tree	NE	NE
Leeaceae	Kaliantan	*Leea philippinensis*	Shrub	NE	NE
Leguminosae	Dilang baka	*Hypyis capitata Jacq.*	Herbs	NE	NE
Lauraceae	Avocado	*Persea americana L.*	Tree	NE	NE
Lythraceae	Banaba	*Lagerstroemia speciosa L.*	Tree	NE	NE
Lythraceae	Efficascent plant	*Rotala Mexicana*	Herbs	Least Concern	NE
Malvaceae	Dilang-butiki	*Elephantopus escaber L.*	Herbs	NE	NE
Malvaceae	Escoba	*Sida retusa*	Herbs	NE	NE
Malvaceae	Kolokolot	*Urena lobata*	Herbs	NE	NE
Malvaceae	Kolotkolotan	*Triumfetta rhomboidea*	Herbs	NE	NE
Malvaceae	Variegated malubago	*Hibiscus tiliaceus var. variegate*	Tree	NE	NE
Malvaceae	Walis-walisan	*Sida acuta Burm. F.*	Herbs	NE	NE
Meliaceae	Bayanti	*Aglaia Llanosiana C. DC.*	Treelet	NE	NE
Meliaceae	Igyo	*Dysoxylum gaudichaudianum*	Tree	NE	NE
Meliaceae	Kuling baboy	*Dysoxylon excelsum Blume*	Tree	NE	NE
Meliaceae	Lanzones	*Aglaia domestica*	Tree	NE	NE
Meliaceae	Large-leafed mahogany	*Sweitenia mahogani*	Tree	NE	NE
Meliaceae	Neem tree	*Azadirachta indica*	Tree	NE	NE
Meliaceae	Santol	*Sandoricum koetjape*	Tree	NE	NE
Menispermaceae	Ambal	*Pycnarrhena manillensis Vid.*	Vines	NE	NE
Menispermaceae	Calopogonium	*Tinospora glabra*	Vines	NE	NE
Menispermaceae	Cyclea	*Cyclea merrillii Diels.*	Vines	NE	NE
Menispermaceae	Ligtang	*Anamirta cocculus (L.) Wightt Arn.*	Vines	NE	NE
Menispermaceae	Makabuhay puti	*Tinospora glabra*	Vines	NE	NE
Mimosaceae	Giant Ipil-ipil	*Leucaena pulverulenta*	Tree	NE	NE
Mimosaceae	Makahiya	*Mimosa pudica*	Herbs	Least Concern	NE
Mimosaceae	Makahiyang babae	*Caesia mimosoides L.*	Herbs	NE	NE
Mimosaceae	Makahiyang lalaki	*Aeschynonene indica L.*	Herbs	NE	NE
Mimosaceae	Rain tree	*Samanea saman (Jack) Merr.*	Tree	NE	NE
Moraceae	Alangas	*Ficus heteropoda*	Tree	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Moraceae	Antipolo	*Artocarpus blancoi (Elmer) Merr.*	Tree	Vulnerable	NE
Moraceae	Basikong	*Ficus botryocarpa Miq. Var. botryocarpa*	Tree	NE	NE
Moraceae	Hauili	*Ficus septica Burma f. var. septica*	Tree	NE	NE
Moraceae	Himbabao	*Broussonetia luzonica*	Tree	NE	NE
Moraceae	India rubber tree	*Ficus elastica Noisette ex Blume*	Tree	NE	NE
Moraceae	Isis	*Ficus ulmifolia Lam.*	Tree	Vulnerable	NE
Moraceae	Kalios	*Streblus asper L.*	Treelet	NE	NE
Moraceae	Kalokoi	*Ficus callosa*	Tree	NE	NE
Moraceae	Kamansi	*Artocarpus communis*	Tree	NE	NE
Moraceae	Kubi	*Artocarpus nitidus*	Tree	NE	NE
Moraceae	Langka	*Artocarpus heterophylla*	Tree	NE	NE
Moraceae	Malagumihan	*Artocarpus elasticus Reinw. Ex Blume*	Tree	NE	NE
Moraceae	Malatibig	*Ficus sattherthwaitei Elmer*	Tree	NE	NE
Moraceae	Mulberry	*Morus alba*	Treelet	NE	NE
Moraceae	Niyog-niyogan	*Ficus pseudopalma Blanco*	Treelet	NE	NE
Moraceae	Opling buntutan	*Ficus heteropleura*	Shrub	NE	NE
Moraceae	Pandurata	*Ficus pandurata*	Tree	NE	NE
Moraceae	Tangisang layugan	*Ficus latsonii*	Tree	NE	NE
Moringaceae	Malunggay	*Moringa oleifera*	Shrub	NE	NE
Musaceae	Banana	*Musa sapientum*	Herbs	NE	NE
Myrtaceae	Bagras	*Eucalyptus deglupta*	Tree	NE	NE
Myrtaceae	Bayabas	*Psidium guajava*	Treelet	NE	NE
Myrtaceae	Duhat	*Syzygium cumini*	Tree	NE	NE
Myrtaceae	Tambis	*Eugenia spp.*	Tree	NE	NE
Oleandraceae	Pakong kalabaw	*Nepthrolepis biserrata*	Ferns	NE	NE
Oxalidaceae	Balimbing	*Averrhoa carambola L.*	Treelet	NE	NE
Oxalidaceae	Kamias	*Averhoa balimbi*	Shrub	NE	NE
Papilionaceae	Centrosema	*Centrosema plumiere*	Vines	NE	NE
Papilionaceae	Manimanihan	*Indigofera hirsuta L.*	Herbs	NE	NE
Papilionaceae	Payang payang	*Moghania strobilifera (L.)J. St. ex Jack*	Herbs	NE	NE
Passifloraceae	Karungot	*Passiflora foetida*	Vines	NE	NE
Piperaceae	Buyo/Ikmo	*Piper betel L.*	Vines	NE	NE
Piperaceae	Olasiman/ Olasiman ihalas	*Peperomia pellucida*	Herbs	NE	NE
Piperaceae	Paminta	*Piper nigrum L*	Vines	NE	NE
Poaceae	Agingay	*Rottbellia exaltata*	Grass	NE	NE
Poaceae	Amorseco	*Chrysopogon aciculatus*	Grass	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Poaceae	Ayas-as	*Setaria palmifolia (Koenig.) stapf.*	Grass	NE	NE
Poaceae	Carabao grass	*Paspalum conjugatum Berg.*	Grass	NE	NE
Poaceae	Carpet grass	*Axonopus compressus*	Grass	NE	NE
Poaceae	Chicken grass	*Panicum flavidum Retz*	Grass	NE	NE
Poaceae	Cogon	*Imperata cylindrica (L.) Beauv.*	Grass	NE	NE
Poaceae	Guinea grass	*Panicum maxicum*	Grass	NE	NE
Poaceae	Kawayang tinik	*Bambusa spinosa*	Grass	NE	NE
Poaceae	Nut grass	*Erichloa procera*	Grass	NE	NE
Poaceae	Paragis	*Eleusine indica (L.) Gaertn.*	Grass	Least Concern	NE
Poaceae	Talahib	*Saccharum spontaneum L.*	Grass	Least Concern	NE
Poaceae	whipping grass	*Sporobolus indicus L.*	Grass	NE	NE
Polygonaceae	Balabak	*Polygonum pulchrum BL.*	Shrub	NE	NE
Polygonaceae	Palosanto	*Triplaris cumingiana*	Tree	NE	NE
Rhamnaceae	Manzanitas	*Ziziphus mauritiana*	Shrub	NE	NE
Rhamnaceae	Salapao	*Ventilago dichotoma*	Vines	NE	NE
Rhamnaceae	Spiny Salapao	*Ventilago dichotoma var. spinosa*	Vines	NE	NE
Rhizophoraceae	Bakawang gubat	*Carallia brachiata (Lour.) Merr.*	Tree	NE	NE
Rosaceae	Palawan cherry	*Prunus javanica*	Tree	Least concern	NE
Rubiaceae	Bangkal	*Nauclea orientalis*	Tree	NE	NE
Rubiaceae	Bangkoro	*Morinda bracteata*	Shrub	NE	NE
Rubiaceae	Kape	*Coffea Arabica*	Shrub	NE	NE
Rubiaceae	Rosal	*Gardenia florida L.*	Shrub	NE	NE
Rutaceae	Kasopangil	*Clerodendron intermedium*	Shrub	NE	NE
Sapindaceae	Kapulasan	*Nephelium lappaceum L. var. pellens (Hiem) Leenh*	Tree	NE	NE
Sapindaceae	Litchi/ Longan	*Dimocarpus longan Lour.ssp. Longan var. longan*	Tree	NE	NE
Sapindaceae	Rambutan	*Nephelium ramboutan-ake(Labill.) Leenlh*	Tree	NE	NE
Sapotaceae	Banete	*Diploknema ramiflora (Merr.) Lam*	Tree	NE	NE
Sapotaceae	Caimito	*Chrysophyllum cainito*	Tree	NE	NE
Sapotaceae	Chico	*Manilkara sapota (L.) Royer*	Treelet	NE	NE
Sapotaceae	Tisa	*Lucuma nervosa*	Shrub	NE	NE
Schizaeaceae	Nito	*Lygodium flexuosum (L) Sw*	Vines	NE	NE
Schizaeaceae	Nitong hapon	*Lygodium japonicum*	Vines	NE	NE
Solanaceae	Balloon plant	*Physalis peruviana L.*	Herbs	NE	NE
Solanaceae	Malatalong	*Solanum torvum Sw*	Herbs	NE	NE
Solanaceae	Talong punay	*Datura metel L.*	Shrubs	NE	NE

Family	Common Name	Scientific Name	Habit	IUCN Redlist (2017)	DAO 201-11
Sterculiaceae	Bayok	*Pterospermum diversifolium*	Tree	NE	NE
Sterculiaceae	Cacao	*Theodroma cacao*	Shrub	NE	NE
Sterculiaceae	Kalumpang	*Sterculia foetida L.*	Tree	NE	NE
Sterculiaceae	Malabulak	*Bombax ceiba*	Tree	NE	NE
Sterculiaceae	Tan-ag	*Kleinhovia hospita Linnaeus*	Tree	NE	NE
Tiliaceae	Danglin	*Grewia minutiflora Juss.*	Tree	NE	NE
Tiliaceae	Salsaluyot	*Corchorus aestuans L.*	Herbs	NE	NE
Ulmaceae/ Celtidaceae	Malaikmo	*Celtis philippinensis var. philippinensis*	Tree	NE	NE
Urticaceae	Dalunot	*Pipturus arborescens*	Treelet	NE	NE
Urticaceae	Hanopol tubig	*Poikilospermum grande (Wedd.) Merr*	Liana	NE	NE
Verbenaceae	Alagao	*Premna odorata Blanco*	Treelet	NE	NE
Verbenaceae	Alipong	*Gmelina philippinensis*	Shrub	NE	NE
Verbenaceae	Coronitas	*Lantana camara L.*	Shrub	NE	NE
Verbenaceae	Kandikandilaan	*Stachytarpheta jamaicacensis*	Herbs	NE	NE
Verbenaceae	Lagundi	*Vitex negundo*	Shrub	NE	NE
Verbenaceae	Molave	*Vitex parviflora Juss.*	Tree	Vulnera ble	Endang er-ed
Verbenaceae	Molawin aso	*Premna nauseosa Blanco.*	Tree	NE	NE
Verbenaceae/La miaceae	Yemani	*Gmelina arborea*	Tree	NE	NE
Vitaceae	Alangingi	*Cayratia guineensis G.Don*	Vines	NE	NE
Vitaceae	Ayo	*Tetrastigma loheri*	Vines	NE	NE
Vitaceae	Ayong kabayo	*Ampelocissus martini Planch.*	Vines	NE	NE
Zingiberaceae	Langkuas kulot	*Zingiber zerumbet*	Zingiber s	NE	NE

**NE – Not Evaluated/ Not Assessed*
Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

***b)* Trees**

1) Transect 1- Brgy. Kamaligan, Calamba City, Laguna

Transect 1 in Barangay Kamaligan, Calamba City recorded 22 species of trees dominated by bangkal (*Nauclea orientalis*) with an importance value of 72.14, followed by giant ipil-ipil (*Leucaena pulverulenta*), pandurata (*Ficus pandurata*), hauili (*Ficus septica*), and alim (*Melanolepis multiglandulosa*) with importance values of 39.33, 34.52, 32.59, and 32.27, respectively (**Table 2-14**). Stands of bangkal, however, were not natural growth but were purposely planted by the current owners of the property. The area borders the Ayala Golf Course on the southwestern side, where some areas are cultivated for cassava farming. Calculated Simpson’s species diversity index was 0.87, indicating moderate species diversity.

Table 2-14: Importance Values of Top Five Tree Species Recorded in Transect 1- Brgy. Kamaligan, Calamba City, Laguna

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Bangkal	*Nauclea orientalis*	169	0.88	0.0169	27.13	17.89	27.13	72.14
Giant Ipil-ipil	*Leucaena pulverulenta*	82	0.64	0.0082	13.16	13.01	13.16	39.33
Pandurata	*Ficus pandurata*	67	0.64	0.0067	10.75	13.01	10.75	34.52
Hauili	*Ficus septica Burma f. var. septica*	61	0.64	0.0061	9.79	13.01	9.79	32.59
Alim	*Melanolepsis multiglandulosa (Reinw ex Blume)*	60	0.64	0.0060	9.63	13.01	9.63	32.27

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

2) Transect 2- Brgy. Kamaligan, Calamba City, Laguna

Transect 2 in Barangay Kamaligan, Calamba City identified about 16species dominated by pandurata (*Ficus pandurata*) with an importance value of 44.02followed by giant ipil-ipil (*Leucaena pulverulenta*) at 38.50, and igyo (*Dysoxylum gaudichaudianum*) at 26.82 (**Table 2-15**). Takip-asin (*Macaranga grandifolia*) and binunga (*Macaranga tanarius*) were also abundant in this transect with importance values of 25.36 and 22.17, respectively. Simpsons's species diversity index is relatively high at 0.92.

Table 2-15: Importance Values of Top Five Tree Species Recorded in Transect 2- Brgy. Kamaligan, Calamba City, Laguna

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Pandurata	*Ficus pandurata*	19	0.37	0.0025	13.87	16.28	13.87	44.02
Giant ipil-ipil	*Leucaena pulverulenta*	20	0.21	0.0026	14.60	9.30	14.60	38.50
Igyo	*Dysoxylum gaudichaudianum*	12	0.21	0.0016	8.76	9.30	8.76	26.82
Takip asin	*Macaranga grandifolia*	11	0.21	0.0014	8.03	9.30	8.03	25.36
Binunga	*Macaranga tanarius*	12	0.11	0.0016	8.76	4.65	8.76	22.17

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

3) Transect 3- Brgy. Kamaligan, Calamba City, Laguna

In Transect 3 of Barangay Kamaligan, Calamba City, 26 trees were recorded dominated again by pandurata (*Ficus pandurata*) with an importance value of 61.08 followed by hauili (*Ficus septica*), anabiong (*Trema orientalis*), kakawate (*Gliricidia sepium*), and igyo (*Dysoxylum gaudichaudianum*), with importance values of 31.75, 27.96, and 19.35%, respectively (**Table 2-16**). Simpsons's species diversity index is relatively high at 0.92.

Table 2-16: Importance Values of Top Five Tree Species Recorded in Transect 3- Brgy. Kamaligan, Calamba City, Laguna

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Pandurata	*Ficus pandurata*	100	0.36	0.0100	23.92	13.24	23.92	61.08
Hauili	*Ficus septica Burma f. var. septica*	80	0.28	0.0080	19.14	10.29	19.14	48.57
Anabiong	*Trema orientalis (L.) Blume*	51	0.20	0.0051	12.20	7.35	12.20	31.75
Kakawate	*Gliricidia sepium*	40	0.24	0.0040	9.57	8.82	9.57	27.96
Igyo	*Dysoxylum gaudichaudianum*	22	0.24	0.0022	5.26	8.82	5.26	19.35

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

4) Transect 4- Brgy. San Bartolome, Sto. Tomas, Batangas

Transect 4 in Barangay San Bartolome, Sto. Tomas, Batangas recorded 24 species of trees, dominated by kakawate (*Gliricidia sepium*) with importance value of 53.45, followed by Hauili (*Ficus septica*), Alim (*Melanolepsis multiglandulosa*), Anabiong (*Trema orientalis*), and prickly narra (*Pterocarpus indicus*) with importance values of 53.45,43.93, 39.70, 25.11, and 23.01, respectively (**Table 2-17**). Simpson's species diversity index is relatively high at 0.91.

Table 2-17: Importance Values of Top Five Tree Species Recorded in Transect 4- Brgy. San Bartolome, Batangas

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Kakawate	*Gliricidia sepium*	80	0.58	0.0105	21.05	11.34	21.05	53.45
Hauili	*Ficus septica Burma f. var. septica*	58	0.68	0.0076	15.26	13.40	15.26	43.93
Alim	*Melanolepsis multiglandulosa (Reinw ex Blume)*	48	0.74	0.0063	12.63	14.43	12.63	39.70
Anabiong	*Trema orientalis (L.) Blume*	34	0.37	0.0045	8.95	7.22	8.95	25.11
Prickly narra	*Pterocarpus indicus Willd. Forma echinatus*	30	0.37	0.0039	7.89	7.22	7.89	23.01

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

5) Transect 5- Brgy. San Bartolome, Sto. Tomas, Batangas

Transect 5 in Barangay San Bartolome, Sto. Tomas, Batangas revealed 24 species of trees dominated by kakawate (*Gliricidia sepium*) with importance value of 64.71, followed by Hauili (*Ficus septica*), Alim

(*Melanolepsis multiglandulosa*), giant ipil-ipil (*Leucaena pulverulenta*), and prickly narra (*Pterocarpus indicus*) with importance values of 33.60, 32.68, 31.13, and 21.00, respectively (**Table 2-18).** Simpson's species diversity index is moderately high at 0.88.

Table 2-18: Importance Values of Top Five Tree Species Recorded in Transect 5- Brgy. San Bartolome, Batangas

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Kakawate	*Gliricidia sepium*	118	0.44	0.0118	27.06	10.58	27.06	64.71
Hauili	*Ficus septica Burma*	46	0.52	0.0046	10.55	12.50	10.55	33.60
Alim	*Melanolepsis multiglandulosa*	44	0.52	0.0044	10.09	12.50	10.09	32.68
Giant ipil-ipil	*Leucaena pulverulenta*	49	0.36	0.0049	11.24	8.65	11.24	31.13
Prickly narra	*Pterocarpus indicus*	29	0.32	0.0029	6.65	7.69	6.65	21.00

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

6) Transect 6- Brgy. San Miguel, Sto. Tomas, Batangas

In Transect 6 of Brgy. San Miguel, Sto. Tomas, Batangas, 25 trees were recorded dominated again by kakawate (*Gliricidia sepium*) with an importance value of 40.09 followed by hauili (*Ficus septica*), giant ipil-ipil (*Leucaena pulverulenta*), pandurata (*Ficus pandurata*), and alim (*Melanolepsis multiglandulosa*), with importance values of 34.47, 29.77, 29.75, and 28.57, respectively (**Table 2-19**). Simpsons's species diversity index is relatively high at 0.92.

Table 2-19: Importance Values of Top Five Tree Species Recorded in Transect 6- Brgy. San Miguel, Sto. Tomas, Batangas

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Kakawate	*Gliricidia sepium*	53	0.35	0.0078	15.63	8.82	15.63	40.09
Hauili	*Ficus septica Burma f. var. septica*	36	0.53	0.0053	10.62	13.24	10.62	34.47
Giant Ipil-ipil	*Leucaena pulverulenta*	38	0.29	0.0056	11.21	7.35	11.21	29.77
Pandurata	*Ficus pandurata*	28	0.53	0.0041	8.26	13.24	8.26	29.75
Alim	*Melanolepsis multiglandulosa*	26	0.53	0.0038	7.67	13.24	7.67	28.57

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

7) Transect 7- Brgy. San Miguel, Sto. Tomas, Batangas

Transect 7 in Brgy. San Miguel, Sto. Tomas, Batangas identified about 35 species dominated by giant ipil-ipil (*Leucaena pulverulenta*) with an importance value of 30.89, followed by hauili (*Ficus septica*) at 30.84, and kakawate (*Gliricidia sepium*) at 19.92 (**Table 2-20**). Pandurata (*Ficus pandurata*) and Palosanto (*Triplaris cumingiana*) were also abundant in this transect with importance values of 19.82 and 17.20, respectively. Simpsons's species diversity index is relatively high at 0.94.

Table 2-20: Importance Values of Top Five Tree Species Recorded in Transect 7-Brgy. San Miguel, Sto. Tomas, Batangas

Common Name	Scientific Name	Density	Frequency	Coverage	Relative Abundance (%)	Relative Frequency (%)	Relative Coverage (%)	Importance Value
Giant ipil-ipil	*Leucaena pulverulenta*	35	0.25	0.0044	12.11	6.67	12.11	30.89
Hauili	*Ficus septica*	33	0.3	0.0041	11.42	8.00	11.42	30.84
Kakawate	*Gliricidia sepium*	23	0.15	0.0029	7.96	4.00	7.96	19.92
Pandurata	*Ficus pandurata*	19	0.25	0.0024	6.57	6.67	6.57	19.82
Palosanto	*Triplaris cumingiana*	21	0.1	0.0026	7.27	2.67	7.27	17.20

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

c) Undergrowth Flora

As shown in the **Table 2-21**, creeping grass species such as carpet grass and carabao grass have the highest importance values amongundergrowth flora recorded in seven transects. The plant species attaining the third to fifth highest Importance Values are broad leaf shrubs commonly found in open areas.

Table 2-21: Importance Values of Undergrowth Flora Recorded in Seven Transects Across All Sites

Common Name	Scientific Name	T1	T2	T3	T4	T5	T6	T7	Total
Carpet grass	*Axonopus compressus*		15.72	31.94	44.93	37.03	42.87	40.64	213.13
Carabao grass	*Paspalum conjugatum Berg.*	28.06	38.36		19.91	36.03	38.85	41.8	203.01
Coronitas	*Lantana camara L.*	22.68	23.9	14.75	28.23	22.16			111.72
Calopogonium	*Calopogonium mucunoides Desv.*	33.87	53.79						87.66
Kolotkolotan	*Triumfetta rhomboidea*				22.51	25.52	25.29		73.32
Kamkamote	*Ipomoea triloba*	31.89	33.83						65.72
Hagonoy	*Chromolaena odorata*					21.4	24.72	15.78	61.9
Payang-payang	*Moghania strobilifera (L.)J. St. ex Jack*	20.19					19.53		39.72
Golondrina	*Euphorbia hirta L.*				18.84			14.36	33.2
Urai	*Amaranthus spinosa*			20.67					20.67
Paragis	*Eleusine indica (L.) Gaertn.*			17.36					17.36

Common Name	Scientific Name	T1	T2	T3	T4	T5	T6	T7	Total
Sabilau	*Commelina benghalensis*			16.43					16.43
Amorseco	*Chrysopogon aciculatus*							16.26	16.26

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

d) Economic Importance

Table 2-22 shows the economic importance and uses of plant species with the highest importance values.

Table 2-22: Economic Importance and Uses of Significant Flora

Common Name	Scientific Name	Economic importance/uses
Alim	*Melanolepsis multiglandulosa (Reinw ex Blume)*	Pioneer species (ecological)
Anabiong	*Trema orientalis (L.) Blume*	Medicinal ; bird feed; for pole and pulp
Bangkal	*Nauclea orientalis*	Ornamental; fruits edible; food for mammals; light construction material
Binunga	*Macaranga tanarius*	Ornamental; medicinal
Giant Ipil-ipil	*Leucaena pulverulenta*	Firewood (introduced to serve as fuelwood)
Hauili	*Ficus septica Burma f. var. septica*	Food for some birds and mammals
Igyo	*Dysoxylum gaudichaudianum*	Medicinal
Kakawate	*Gliricidia sepium*	Firewood; medicinal
Palosanto	*Triplaris cumingiana*	Ornamental and construction material
Pandurata	*Ficus pandurata*	Ornamental
Prickly narra	*Pterocarpus indicus Willd. forma echinatus*	For furniture making
Takip asin	*Macaranga grandifolia*	Pioneer species (ecological)

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

2.1.4.3.1.2 TR4 Re-Alignment

1. General Conditions

For the sections along the TR4-A re-alignment, the sites are composed of matrix of varied plots ranging from residential areas, developed and underdeveloped subdivision, farm lots, and brushlands along the roadside. It is 800m away from the nearest buffer zone of Mt. Makiling Forest Reserve. The canopy is composed of agroforestry species such as *Cocos nucifera*, *Coffea sp.,Swietenia macrophylla, Poacea*. Soil cover mainly composed of weeds such as Saccharum, Centrosema, shrubs and wildlings Macaranga. Most sampling plots in this transect are bounded by mango, mahogany, plantation, corn, and/or coffee lots.

The proposed TR4-E realignment also runs parallel to the Maharlika Highway and is entirely situated at the northern side of the highway which is closer to the footslope of Mt. Banahaw. An assemblage of various land-use such as farmlots, agricultural farms and residential constitute the brushlands and grassland vegetation of this transect. The canopy of sampling plots within farmlots and agricultural lands are covered with agroforestry such as *Lansiumdomesticum, Mangiferaindica, Musasapientum, Cocos nucifera, Coffea sp,Sandoricumkoetjape* and forest pioneer species such as *Macaranga*, among others. Vegetation cover within backyards and those near residential areas include *Cocos nucifera, Mangifeera* *indica, Pithecellobium dulce, Macaranga and Ficus septica*. The surrounding areas were mostly plantations of mango, banana and/or coconut. Weeds, grasses, vines, shrub and wildlings dispersed within the area make up the undergrowth and ground cover. Two plots were also located adjacent to waterways and creeks.

The general vegetation and representative plots are shown in **Plates 2-21 to 2-23**.

Plate No. 2-21: General Vegetation Cover at the Proposed TR4-A and TR4-E Re-alignment

Plate No. 2-22: Representative Plots Within the TR4-A Re-alignment

Plate No. 2-23: Representative Plots Within the TR4-E Re-alignment in Candelaria to Tayabas City

2. Survey Results

***a)* Species Richness and Diversity**

A total of 108 species belonging to approximately 46 families constitute the terrestrial vegetation cover of the TR4 re-alignment (**Table 2-23**). The canopy vegetation in TR4-A Transect has a total of 10 species belonging to 7 genera representing 6 families. On the other hand, a total of 17 canopy species belonging to 17 genera representing 13 families were recorded in TR4-E Transect.

Table 2-23: List of Floral Recorded in TR4-A and TR4-E Re-alignment

***Scientific* name**	**Family**	**Ecological Distribution**	**Conservation Status**	**Dao 2007-01**
Justicia brandegeana Wassh. & L.B.Sm.	Acanthaceae	Indigenous	Not assessed	Not listed
Pachystachys lutea Nees.	Acanthaceae	Introduced	Not assessed	Not listed
Cyathula prostrata (Linn.) Blume	Amaranthaceae	Indigenous	Not assessed	Not listed
Achyranthes aspera (Linn.)	Amaranthaceae	Indigenous	Not assessed	Not listed
Amaranthus spinosus L.	Amaranthaceae	Indigenous	Not assessed	Not listed
Mangifera indica L.	Anacardiaceae	Indigenous	Not assessed	Not listed
Centella asiatica (L.) Urban	Apiaceae	Indigenous	Not assessed	Not listed
Tabernaemontana pandacaquiBlanco	Apocynaceae	Indigenous	Near Threatened ver. 3.1	Not listed
Colocasia esculenta (L.) Schott	Araceae	Indigenous	Least Concern ver 3.1	Not listed
Amorphophalluspaeoniifolius (Dennst.) Nicolson	Araceae	Indigenous	Least Concern ver 3.1	Not listed
Raphidophora merrillii Engl.	Araceae	Indigenous	Not assessed	Not listed
Cocos nucifera L.	Arecaceae	Indigenous	Not assessed	Not listed
Areca catechu L.	Arecaceae	Indigenous	Not assessed	Not listed
Corypha elata Roxb	Arecaceae	Indigenous	Not assessed	Not listed
Pseudelephantopus spicatus (Juss. ex Aubl.) C.F. Baker	Asteraceae	Indigenous	Not assessed	Not listed
Mikania micrantha Kunth ex H.B.K..	Asteraceae	Indigenous	Not assessed	Not listed
Synedrella nodiflora (L.) Gaertn	Asteraceae	Indigenous	Not assessed	Not listed
Ananas comosus (L.) Merr.	Bromeliaceae	Introduced	Not assessed	Not listed
Commelina benghalensis L.	Commelinaceae	Indigenous	Least Concern ver.3.1	Not listed
Commelina diffusa Burm. f. var. diffusa	Commelinaceae	Introduced	Least Concern ver.3.1	Not listed
Operculina turpethum (L.) Silva Manso.	Convolvulaceae	Indigenous	Not assessed	Not listed
Melothria indica Lour.	Cucurbitaceae	Indigenous	Not assessed	Not listed
Cyperus rotundus L.	Cyperaceae	Indigenous	Least Concern ver.3.1	Not listed
Macaranga grandifolia Linn.	Euphorbiaceae	Endemic to Phils.	Vulnerable A1cd ver 2.3	Not listed
Macaranga tanarius (Linn.)	Euphorbiaceae	Indigenous	Not assessed	Not listed

Scientific name	Family	Ecological Distribution	Conservation Status	Dao 2007-01
Melanolepis multiglandulosa (Reinw. ex Blume) Rchb. f.& Zoll.	Euphorbiaceae	Indigenous	Not assessed	Not listed
Clerodendrum intermedium Cham.	Lamiaceae	Indigenous	Not assessed	Not listed
Urena lobata Linn	Malvaceae	Indigenous	Not assessed	Not listed
Sida acuta Burm.	Malvaceae	Indigenous	Not assessed	Not listed
Dysoxylum gaudichaudianum (A.Juss.) Miq	Meliaceae	Indigenous	Not assessed	Not listed
Lansium domesticum Corr.	Meliaceae	Indigenous	Not assessed	Not listed
Sandoricum koetjape Merr.	Meliaceae	Indigenous	Not assessed	Not listed
Mimosa pudica L. (Laajvanti)	Mimosaceae	Introduced	Least Concern ver.3.1	Not listed
Ficus pseudopalma Blanco.	Moraceae	Endemic to Phils.	Not assessed	Not listed
Ficus ulmifolia (Lam.) Gasp.	Moraceae	Endemic to Phils.	Vulnerable A1cd ver 2.3	Not listed
Ficus septica Burm.	Moraceae	Indigenous	Not assessed	Not listed
Streblus asper Lour. (Shakhotaka)	Moraceae	Indigenous	Not assessed	Not listed
Ficus nota (Blanco) Merr	Moraceae	Indigenous	Not assessed	Not listed
Artocarpus blancoi(Elmer) Merr.	Moraceae	Endemic to Phils.	Vulnerable A1d ver 2.3	Not listed
Musasapientum	Musaceae	Indigenous	Not assessed	Not listed
Ardisia elliptica Thunb.	Myrsinaceae	Indigenous	Not assessed	Not listed
Phyllanthus virgatus G. Forster	Phyllanthaceae	Indigenous	Not assessed	Not listed
Plumbago zeylanica (with white flower)	Plumbaginaceae	Indigenous	Not assessed	Not listed
Saccharum spontaneum Linn	Poaceae	Indigenous	Least Concern ver 3.1	Not listed
Setaria palmoflia (Koenig) Stapf	Poaceae	Indigenous	Not assessed	Not listed
Imperata cylindrica (L.)	Poaceae	Indigenous	Not assessed	Not listed
Paspalum sp.	Poaceae	Indigenous	Not assessed	Not listed
Sorghum bicolor (L.) Moench	Poaceae	Introduced	Least Concern ver 3.1	Not listed
Paspalum conjugatum Berg.	Poaceae	Introduced	Least Concern ver 3.1	Not listed
Coffea sp.	Rubiaceae	Indigenous	Not determined	Not listed
Solanum biflorum Lour.	Solanaceae	Indigenous	Not assessed	Not listed
Amphineuron terminans (J. Sm.) Holttum	Thelypteridaceae	Indigenous	Not assessed	Not listed
Wikstroemia ovata	Thymeliaceae	Indigenous	Not assessed	Not listed
Laportea meyeniana Warb.	Urticaceae	Indigenous	Not assessed	Not listed
Stachytarpheta jamaicensis Linn.	Verbenaceae	Indigenous	Not assessed	Not listed
Dieffenbachia amoena W. Bull	Araceae	Introduced	Not assessed	Not listed

Scientific name	Family	Ecological Distribution	Conservation Status	Dao 2007-01
Epipremnum aureum Linden & André) Bunting	Araceae	Introduced	Not assessed	Not listed
Dracaena fragrans (L.) Ker Gawl.	Asparagaceae	Introduced	Not assessed	Not listed
Dracaena surculosa Lindl.	Asparagaceae	Introduced	Not assessed	Not listed
Chromolaena odorata Linn.	Asteraceae	Introduced	Not assessed	Not listed
Ageratum conyzoides L.	Asteraceae	Introduced	Not assessed	Not listed
Sphagneticola trilobata L.	Asteraceae	Introduced	Not assessed	Not listed
Ceiba pentandra L.	Bombacaceae	Introduced	Not assessed	Not listed
Cleome rutidosperma DC.	Capparidaceae	Introduced	Not assessed	Not listed
Ipomoea batatas (L.) Lam.	Convolvulaceae	Introduced	Not assessed	Not listed
Coccinia grandis (L.) Voigt.	Cucurbitaceae	Introduced	Not assessed	Not listed
Cyperus kyllingia Endl.	Cyperaceae	Introduced	Not assessed	Not listed
Manihot esculenta Crantz	Euphorbiaceae	Introduced	Not assessed	Not listed
Gliricidia sepium (Jacq.) Steud	Fabaceae	Introduced	Not assessed	Not listed
Centrosema pubescens Benth.	Fabaceae	Introduced	Not assessed	Not listed
Calopogonium mucunoides Desv.	Fabaceae	Introduced	Not assessed	Not listed
Leucaena leucocephala Lam	Fabaceae	Introduced	Not assessed	Not listed
Tamarindus indica L.	Fabaceae	Introduced	Not assessed	Not listed
Persea americana Mill.	Lauraceae	Introduced	Not assessed	Not listed
Macroptilium atropurpureum (DC.) Urb. var. atropurpureum.	Moraceae	Introduced	Not assessed	Not listed
Pithecellobium dulce (Roxb.) Benth	Mimosaceae	Introduced	Not assessed	Not listed
Artocarpus heterophyllus Lam.	Moraceae	Introduced	Not assessed	Not listed
Averrhoa carambola L.	Oxalidaceae	Introduced	Not assessed	Not listed
Macropiper excelsum (G.Forst.) Miq.	Piperaceae	Introduced	Not assessed	Not listed
Citrus maxima (Burm.) Merr.	Rutaceae	Introduced	Not assessed	Not listed
Chrysophyllum cainito L.	Sapotaceae	Introduced	Not assessed	Not listed
Datura metel Linn.	Solanaceae	Introduced	Not assessed	Not listed
Lantana camara L.	Verbenaceae	Introduced	Not assessed	Not listed
Bryophyllum pinnatum (Lam.)	Crassulaceae	Introduced	Not determined	Not listed
Swietenia macrophylla King	Meliaceae	Introduced	Vulnerable A1cd+2cd ver 2.3	Not listed
Desmodium sp.	Fabaceae	Not determined	Not assessed	Not listed
Hypoestes sp. 1	Acanthaceae	Not determined	Not determined	Not listed
Hypoestes sp. 2	Acanthaceae	Not determined	Not determined	Not listed
Acanthaceae sp. 3	Acanthaceae	Not determined	Not determined	Not listed
Acanthaceae sp. 4	Acanthaceae	Not determined	Not determined	Not listed

***Scientific* name**	**Family**	**Ecological Distribution**	**Conservation Status**	**Dao 2007-01**
Amaranthus sp.	Amaranthaceae	Not determined	Not determined	Not listed
Apocynaceae	Apocynaceae	Not determined	Not determined	Not listed
Begonia sp.	Begoniaceae	Not determined	Not determined	Not listed
Ipomea sp.1	Convolvulaceae	Not determined	Not determined	Not listed
Ipomea sp.2	Convolvulaceae	Not determined	Not determined	Not listed
Ipomea sp	Convolvulaceae	Not determined	Not determined	Not listed
Lauraceae 1	Lauraceae	Not determined	Not determined	Not listed
Unknown 1	Phyllanthaceae	Not determined	Not determined	Not listed
Bamboo	Poaceae	Not determined	Not determined	Not listed
Paspalum (poaceae 3)	Poaceae	Not determined	Not determined	Not listed
Paspalum sp. 2	Poaceae	Not determined	Not determined	Not listed
Poaceae	Poaceae	Not determined	Not determined	Not listed
Paspalum sp.	Poaceae	Not determined	Not determined	Not listed
Poaceae 2	Poaceae	Not determined	Not determined	Not listed
Unknown	Unknown	Not determined	Not determined	Not listed
Unknown 1	Unknown 1	Not determined	Not determined	Not listed
Vine	Vine	Not determined	Not determined	Not listed
Tetrastigma sp.	Vitaceae	Not determined	Not determined	Not listed

The proposed site is dominated by *Poaceae* with 12 species, followed by *Moraceae* and *Fabaceae* with 7 species, and *Amaranthaceae* and *Araceae* both with six species representatives. Twenty–four (24) families have the least species representative having one recorded for each family (**Figure 2-22**).

The canopy for both sites yielded 23 species representing 14 families and 21 genera while the undergrowth vegetation comprised of 94 species belonging to 41 families and 77 genera. The data showed that the vegetation of the area is generally characteristic of undergrowth vegetation composed of saplings, shrubs, herbs, vines and grasses.

A total of 23 canopy species belonging to 14 families and 21 genera were recorded in the re-alignment site. Results show that the canopy species with the highest IV value include *Pithecellobium dulce (*Fabaceae*), Cocos nucifera (*Arecaceae*) and Ficusseptica (*Moraceae*)*with 29.07, 25.87 and 25.57 IV values, respectively (Table 2.1-24). The first two species are agroforestry and farm species while *Ficusseptica* is a pioneer species usually found in degraded forests and open areas. The least IV value belongs to *Citrus maxima (*Rutaceae*)* with 4.82 IV value.

The area has moderate biodiversity based on Fernando's biodiversity scale at H' = 2.987 and very high evenness at J'= 0.952. The results indicated a moderately diverse plant species with 10cm dbh that are evenly distributed within the sampling sites.

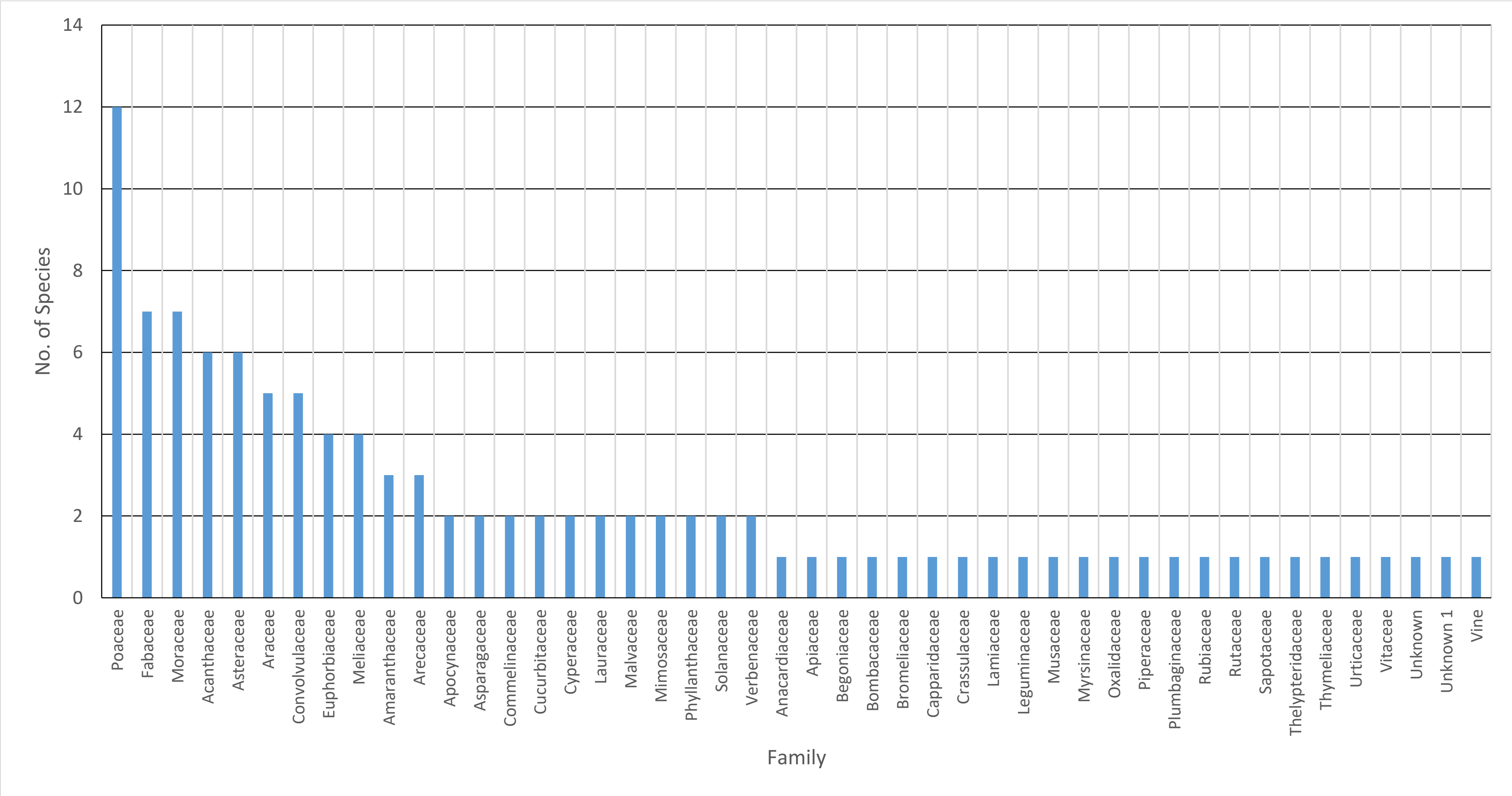


Figure 2-22: Distribution of Species Per Family in the Proposed TR4-A and TR4-E Re-alignment

Table 2-24: The Importance Value (IV) of the Canopy Species Recorded in TR4-A and TR4-E Project Site.

Species	Family	Mean Basal Area	% COVER	IV
Pithecellobium dulce	Fabaceae	0.292	24.67	29.07
Cocos nucifera	Arecaceae	0.096	8.07	25.87
Ficus septica	Moraceae	0.037	3.16	25.57
Mangifera indica	Anacardiaceae	0.160	13.49	23.82
Sandoricum koetjape	Meliaceae	0.095	8.04	24.31
Artocarpus heterophylla	Moraceae	0.024	2.03	19.83
Coffea sp.	Rubiaceae	0.013	1.13	13.21
Swietenia macrophylla	Meliaceae	0.033	2.80	13.13
Ceiba pentandra	Bombacaceae	0.040	3.40	12.19
Musa sapientum	Musaceae	0.027	2.28	11.29
Dysoxylum gaudichaudianum	Meliaceae	0.080	6.79	11.19
Artocarpus blancoi	Moraceae	0.071	5.97	10.36
Macaranga tanarius	Euphorbiaceae	0.011	0.91	9.70
Melanolepis multiglandulosa	Euphorbiaceae	0.015	1.28	8.75
Ficus ulmifolia	Moraceae	0.011	0.97	8.44
Chrysophyllum cainito	Sapotaceae	0.045	3.82	8.22
Unknown 1	Unknown 1	0.040	3.42	7.81
Poaceae	Poaceae	0.014	1.22	7.16
Gliricidia sepium	Fabaceae	0.010	0.84	6.78
Averrhoa carambola	Oxalidaceae	0.027	2.25	6.64
Areca catechu	Arecaceae	0.021	1.76	6.16
Lansium domesticum	Meliaceae	0.015	1.30	5.70
Citrus maxima	Rutaceae	0.005	0.42	4.82

(i) TR4-A

Among the 10 species recorded in this transect, *Ficus septica (Moraceae)* yield the highest IV value of 58.31 followed by *Dysoxylum gaudichaudianum (Meliaceae)* with 35.48 and *Swietenia macrophylla* together with *Artocarpus blancoi*, both with 32.88. *Macaranga tanarius* has the least computed IV value of 18.17. (**Table 2-25**).

Table 2-25: The Importance Value (IV) of the Canopy Species Recorded in TR4-A Project Area

Species	Family	Mean Basal Area	% COVER	IV
Ficus septica	Moraceae	0.046	12.20	58.31
Dysoxylum gaudichaudianum	Meliaceae	0.08	21.41	35.48
Swietenia macrophylla	Meliaceae	0.071	18.82	32.88
Artocarpus blancoi	Moraceae	0.071	18.82	32.88
Melanolepis multiglandulosa	Euphorbiaceae	0.015	4.03	27.19
Ficus ulmifolia	Moraceae	0.011	3.06	26.22

Species	Family	Mean Basal Area	% COVER	IV
Ceiba pentandra	Bombacaceae	0.042	11.06	25.13
Bamboo	Poaceae	0.014	3.86	22.47
Gliricidia sepium	Fabaceae	0.01	2.66	21.27
Macaranga tanarius	Euphorbiaceae	0.015	4.10	18.17

The biodiversity level recorded for this transect is H' = 2.11 which is a low biodiversity on Fernando's biodiversity scale and a very high evenness at J'= 0.91. The results indicated a low diverse plant species with 10cm dbh that are evenly distributed within the sampling sites. The low measure of biodiversity can be attributed to the current land-use of the sampling sites as mostly residential and covered with grassland and scarcely forested.

(ii) TR4-E

The canopy of TR4-E Transect consisted of 17 species belonging to 13 families and is dominated by *Pithecellobiumdulce (Fabaceae)* with 36.71 IV value. This is followed by *Cocos nucifera (Arecaceae)* and*Sandoricum koetjape (Meliaceae)* with 36.33 and 33.98 IV values, respectively (**Table 2-26**). *Citrus maxima (Rutaceae)* yielded the lowest IV value at 7.01.

Table 2-26: The Importance Value (IV) of the Canopy Species Recorded inTR4-E Project Area

Species	Family	Mean Basal Area	%COVER	IV
Pithecellobium dulce	Fabaceae	0.292	30.22	36.71
Cocos nucifera	Arecaceae	0.096	9.88	36.33
Sandoricum koetjape	Meliaceae	0.095	9.85	33.98
Mangifera indica	Anacardiaceae	0.160	16.52	31.83
Artocarpus heterophylla	Moraceae	0.024	2.48	28.93
Coffea	Rubiaceae	0.011	1.15	19.27
Musa	Musaceae	0.027	2.79	16.26
Ceiba pentandra	Bombacaceae	0.080	8.32	14.81
Chrysophyllum cainito	Sapotaceae	0.045	4.68	11.17
Unknown 1	Unknown	0.040	4.18	10.68
Swietenia macrophylla	Meliaceae	0.014	1.48	10.30
Ficus septica	Moraceae	0.008	0.80	9.62
Averrhoa carambola	Oxalidaceae	0.027	2.75	9.24
Areca catechu	Arecaceae	0.021	2.16	8.65
Lansium domesticum	Meliaceae	0.015	1.59	8.08
Macaranga tanarius	Euphorbiaceae	0.006	0.63	7.12
Citrus maxima	Rutaceae	0.005	0.52	7.01

This transect had a relatively moderate biodiversity which recorded H' = 2.66 on Fernando's biodiversity scale and a very high evenness at J'= 0.94. Moderate biodiversity is recorded as it is more forested with agroforestry and other forest forming species. The site is characterized of agricultural' and farm lots' patches wherein forest trees are used as shade for the agricultural crops and as bio-fence. The results indicated that a moderate biodiversity composition of vegetation with >10 cm diameter trees constituted the cover of the sampling areas with highly even distribution.

b) Undergrowth Species

A total of 94 species representing approximately 41 families and 77 genera constituted the undergrowth at TR4-E. Poaceae dominated the area with 11 species followed by *Asteraceae,* Acanthaceae and Fabaceae with 6 species each, and Araceae and Convolvulaceae with 5 species each. Twenty-one (21) families were the least with one species per family recorded (**Figure 2-23**).

Moreover, the most frequently occurring species in the undergrowth include *Centrosema pubescens* with relative frequency (RF) value of 9.5 followed by Benth., Paspalum sp. with 4.75 RF value and *Achyranthesaspera* (Linn.) together with Urena lobata Linn yielding RF values of 4.5 (**Table 2-27**). Results also showed that approximately 39% or 37 species were recorded with 0.25 RF values. While most of the recorded species are considered weeds or those species that vigorously grow in open and disturbed areas, the most frequently occurring species were those that are highly successful in invading an area compared to the other species such as *Centrosema pubescens*, a vine and an invasive one. *Achyranthesaspera* and *Paspalum* on the other hand are species that can reproduce asexually making it more successful in colonizing open areas.

In summary, the assessment of the re-alignment yielded results that are not exactly the same as the previously 2013 assessment. However the results were almost similar to the latter in terms of composition and diversity indices.

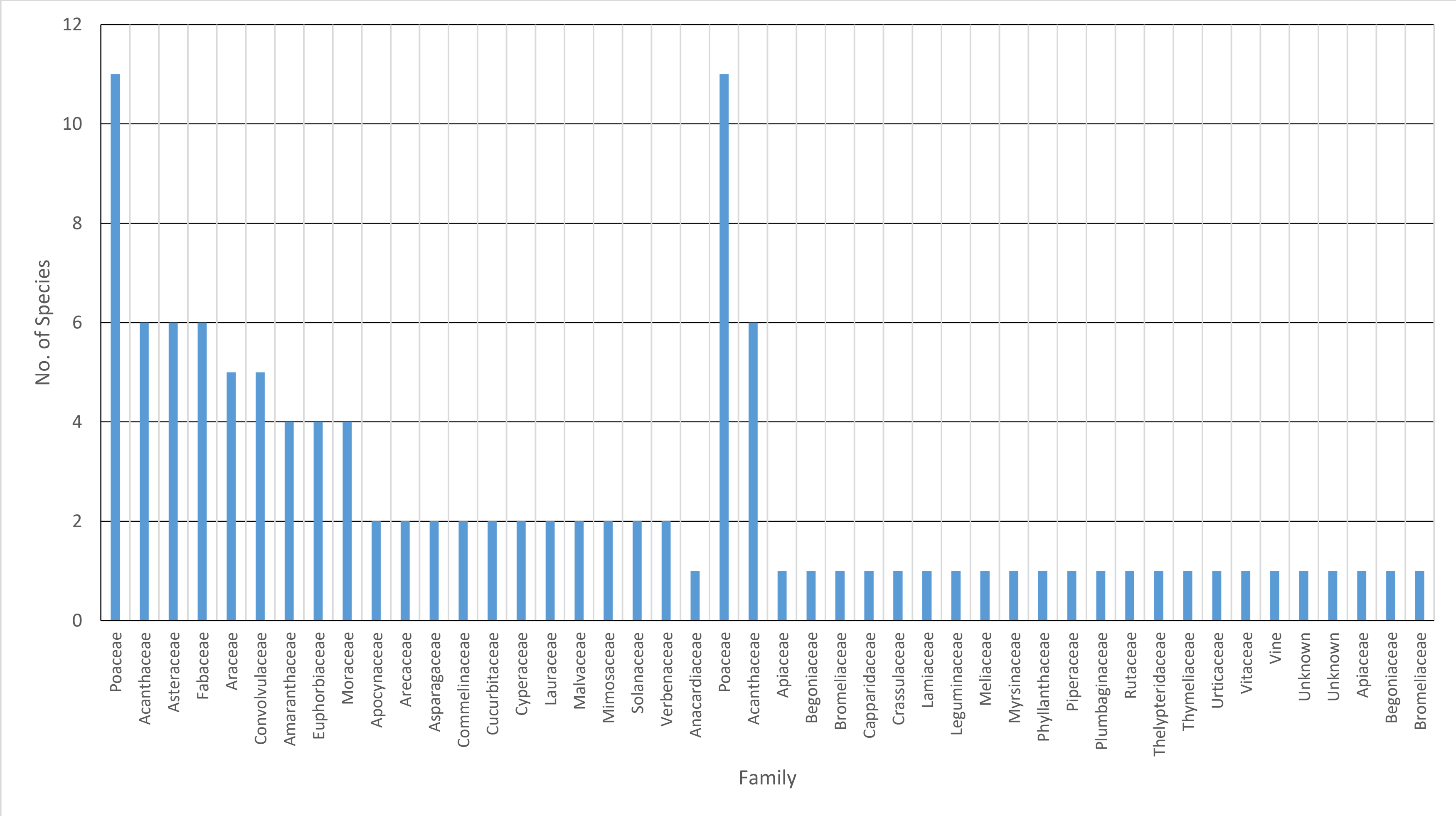


Figure 2-23: Distribution of Species Per Family in the Undergrowth Layer Within the Proposed Project Site.

Table 2-27: Relative Frequency of Undergrowth Species in the TR4 Re-alignment.

Scientific Name	Family	RF
Centrosema pubescens Benth.	Fabaceae	9.5
Paspalum sp.	Poaceae	4.75
Achyranthes aspera (Linn.)	Amaranthaceae	4.5
Urena lobata Linn	Malvaceae	4.5
Poaceae	Poaceae	4
Imperata cylindrica (L.)	Poaceae	3
Chromolaena odorata Linn.	Asteraceae	3
Synedrella nodiflora	Asteraceae	3
Paspalum conjugatum Berg.	Poaceae	2.75
Mimosa pudica L. (Laajvanti)	Mimosaceae	2.75
Lantana camara L.	Verbenaceae	2.5
Saccharum spontaneum Linn	Poaceae	2.5
Mikania micrantha Kunth ex H.B.K..	Asteraceae	2.25
Melothria indica	Cucurbitaceae	2
Ipomea sp.1	Convolvulaceae	1.75
Desmodium sp.	Fabaceae	1.75
Pseudelephantopus spicatus (Juss. ex Aubl.) C.F. Baker	Asteraceae	1.75
Colocasia esculenta Linn.	Araceae	1.75
Leucaena leucocephala Lam	Fabaceae	1.75
Macropiper excelsum (G.Forst.) Miq.	Piperaceae	1.75
Commelina benghalensis	Commelinaceae	1.5
Ipomoea batatas (L.) Lam.	Convolvulaceae	1.5
Cyperus kyllingia	Cyperaceae	1.5
Stachytarpheta jamaicensis Linn.	Verbenaceae	1.5
Cyathula prostrata (Linn.) Blume	Amaranthaceae	1.25
Amorphophallus paeoniifolius	Araceae	1.25
Calopogonium mucunoides Desv.	Fabaceae	1.25
Plumbago zeylanica (with white flower)	Plumbaginaceae	1.25
Acanthaceae sp. 3	Acanthaceae	1
Commelina diffusa	Commelinaceae	1
Mangifera indica L.	Anacardiaceae	1
Paspalum	Poaceae	1
Amaranthus sp.	Amaranthaceae	0.75
Solanum biflorum Lour.	Solanaceae	0.75
Ficus septica Burm	Moraceae	0.75
Macroptilium atropurpureum (DC.) Urb. var. atropurpureum.	Leguminaceae	0.75
Paspalum (poaceae 3)	Poaceae	0.75
Paspalum 2	Poaceae	0.75
Operculina turpethum (L.) Silva Manso.	Convulvolaceae	0.75
Persea americana	Lauraceae	0.5
Corypha elata Roxb	Arecaceae	0.5
Ipomea sp.2	Convolvulaceae	0.5

Scientific Name	Family	RF
Cyperus rotundus	Cyperaceae	0.5
Justicia sp.	Acanthaceae	0.5
Dieffenbachia amoena W. Bull	Araceae	0.5
Amphineuron terminans (J. Sm.) Holttum	Thelypteridaceae	0.5
Streblus asper Lour. (Shakhotaka)	Moraceae	0.5
Tabernaermontana laurifolia Blanco	Apocynaceae	0.5
Macaranga tanarius (Linn.)	Euphorbiaceae	0.5
Swietenia macrophylla King	Meliaceae	0.5
Phyllanthus virgatus G. Forster	Phyllanthaceae	0.5
Ananas comosus (L.) Merr.	Bromeliaceae	0.5
Sida acuta Burm.	Malvaceae	0.5
Ficus nota (Blanco) Merr	Moraceae	0.5
Vine	vine	0.5
Epipremnum aureum	Araceae	0.5
Wedelia trilobata	Asteraceae	0.5
Pachystachys lutea	Acanthaceae	0.25
Hypoestes sp. 1	Acanthaceae	0.25
Hypoestes sp. 2	Acanthaceae	0.25
Acanthaceae sp. 4	Acanthaceae	0.25
Amaranthus spinosus	Amaranthaceae	0.25
Raphidophora merrillii	Araceae	0.25
Apocynaceae	Apocynaceae	0.25
Setaria palmoflia (Koenig) Stapf	Poaceae	0.25
Begonia sp.	Begoniaceae	0.25
Areca catechu L.	Arecaceae	0.25
Cleome rutidospermaDC.	Capparidaceae	0.25
Coccinia grandis (L.) Voigt.	Cucurbitaceae	0.25
Dracaena fragrans (L.)	Asparagaceae	0.25
Dracaena surculosa Lindl.	Asparagaceae	0.25
Gliricidia sepium (Jacq.) Steud.	Fabaceae	0.25
Pithecellobium dulce (Roxb.) Benth	Mimosaceae	0.25
Manihot esculenta Crantz	Euphorbiaceae	0.25
Clerodendrum intermedium Cham.	Lamiaceae	0.25
Bryophyllum pinnatum (Lam.)	Crassulaceae	0.25
Lauraceae 1	Lauraceae	0.25
Laportea meyeniana Warb.	Urticaceae	0.25
Ardisia elliptica Thunb.	Myrsinaceae	0.25
Ficus pseudopalma Blanco.	Moraceae	0.25
Poaceae	Poaceae	0.25
Citrus maxima (Burm.) Merr.	Rutaceae	0.25
Tamarindus indica L.	Fabaceae	0.25
Melanolepis multiglandulosa (Reinw. ex Blume) Rchb. f.& Zoll.	Euphorbiaceae	0.25
Datura metel Linn.	Solanaceae	0.25
Macaranga grandifolia Linn.	Euphorbiaceae	0.25

Scientific Name	Family	RF
Centella asiatica(L.) Urban	Apiaceae	0.25
Tetrastigma sp.	Vitaceae	0.25
Sorghum bicolor (L.) Moench	Poaceae	0.25
Ageratum conyzoides	Asteraceae	0.25
Unknown		0.25
Unknown 1		0.25
Ipomea sp	Convulvolaceae	0.25
Wikstroemia ovata	Thymeliaceae	0.25

c) Conservation Status Distribution and Endemicity

Among the 108 species recorded in the TR4 re-alignment site, 3 species (3%) were identified as endemic or those that occur only in the Philippines. These species include *Macaranga grandifolia*(Linn.), *Ficus pseudopalma*(Blanco) and *Ficus ulmifolia* (Lam.) Gasp belonging to Moraceae and Euphrbiaceae families. On the other hand, 46 species (43%) belonging to 29 families were identified to be Indigenous, those that naturally grow in the country and in other countries as well. Moreover, exotic species or those that were Introduced to our country constituted 36 species (33%) belonging to 27 families while 23 species belonging to 13 families constituting to 21% were not determined as they were not identified to species level. **Figure 2-24** shows the distribution of species according to its endemicity.

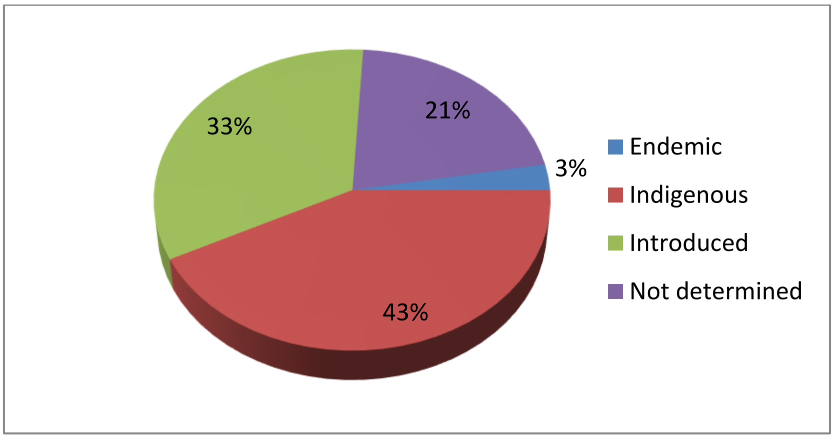


Figure 2-24: Distribution of Species Endemicity

Results showed that fourteen (14) of the total species recorded were listed in the IUCN Redlist of Threatened Species while none was cited in the DAO 2007 – 01 "Establishing the National List of Threatened Philippine Plants and their Categories, and the List of Other Wildlife Species". Of the 18 species, nine species representing nine families were listed in the Least Concern ver 13.1 category of IUCN Redlist as shown in **Figure 2-25** These include *Colocasia esculenta* (L.) Schott, *Amorphophallus paeoniifolius* (Dennst.) Nicolson, *Commelina benghalensisL. Commelina diffusa* Burm. f. var. diffusa, *Cyperus rotundus* L., *Mimosa pudicaL.* (Laajvanti), *Saccharum spontaneum* Linn, *Sorghum bicolorL.*(Moench), *Paspalum conjugatum*(Berg). These species usually thrive in degraded and open areas and grassland.

Four (4) species were identified to belong in the Vulnerable Category, namely: Macarangagrandifolia Linn. (Vulnerable A1cd ver 2.3); Ficusulmifolia (Lam.) Gasp. (Vulnerable A1cd ver 2.3); Artocarpus blancoi (Elmer) Merr. (Vulnerable A1d ver 2.3); and, Swietenia macrophylla King (Vulnerable A1cd+2cd ver 2.3). Seventy-one (71) species were Not Assessed in the IUCN Redlist while 24 were not determined as to its category.

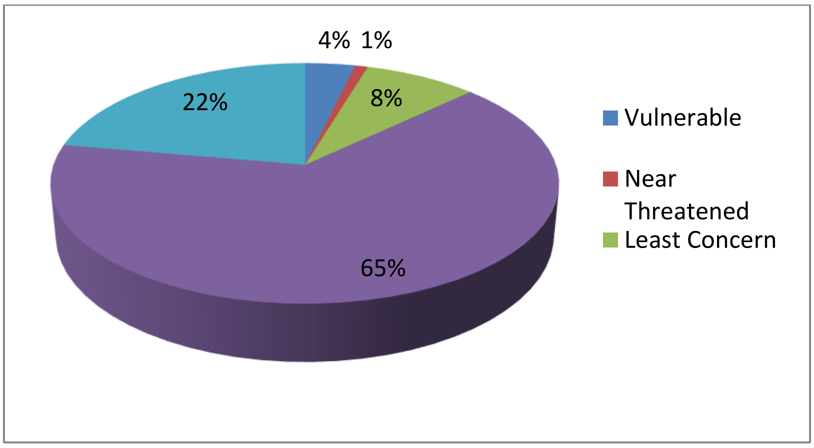


Figure 2-25: Distribution of Conservation Status

d) Historical occurrence of Fire and Infestation

During the conduct of the field study, there were no signs of recent forest or grass fires. There was no other infestation or natural in-balance recorded in the area except for the weeds invading the open areas.

2.1.4.3.2 Terrestrial Fauna

2.1.4.3.2.1 Initial TR4 Alignment[8]

The terrestrial fauna presented in this sub-section were taken from the 2014 EIS of the TR-4 Project. The TR4-B to TR4-D sections will remain the same while the TR4-A and TR-E will change due to the proposed re-alignment.

1. Avifauna

As shown in **Table 2-28**, bird species commonly found across all survey stations include *Passer montanus* (Eurasian Tree Sparrow),*Pycnonotus goiavier* (Yellow vented Bulbul), *Halcyon chloris*(White collared kingfisher) and *Collocalia troglodytes* (Pygmy Swiftlet). As declared by IUCN, all bird species recorded in the study area are of “Least Concern” with varying population trend.

a) **TR4-A Section (KM 57 to KM 67)**

Transects 1 to 5 (**Table 2-28**) and observation points were traversed in order to cover the whole section of TR 4A.

A total of 37 avifaunal species were observed and recorded within and around this section. Among those observed, two species occurred in all survey stations namely; Eurasian Tree Sparrow (*Passer montanus*),and Yellow Vented Bulbul (*Pycnonotusgoiavier*). These species are common in rural to urban areas and of least concern due to its stable population as declared by IUCN.

b) **TR4-B Section (KM 67 to KM 79)**

A total of 12 species of birds were observed in two transect lines of Transect 19 & 20 (**Table 2-28**). Species encountered included Pygmy swiftlet (*Collocalia troglodytes*), White-collared Kingfisher (*Halcyon chloris*), and Blue–tailed Bee-eater (*Meropsphilippinus*). All this are common in the area in terms of population trend and are likewise of least concern as to their status.

c) **TR4-C Section (KM 79 to KM 87)**

[8]*Adapted from 2014 EIS for the SLEX Phase II TR4 Project*

Seventeen (17) species of birds were encountered within and around two (2) transect routes or Transects 17 to 18 (**Table 2-28**). Four among these species were likewise observed in the previous two toll road sections (TR4-A &TR4-B). These were Eurasian Tree Sparrow (*Passer montanus*), Yellow Vented Bulbul (*Pycnonotusgoiavier*), Pygmy swiftlet (*Collocalia troglodytes*) and White-collared Kingfisher (*Halcyon chloris*), an indication that the locality possesses common to uniform site characteristics.

d) **TR4-D Section (KM 87 to KM 101)**

Considering the long stretch of the proposed road section, a total of 74 species were identified and recorded at six (6) transect lines from Transect 11 to Transect 16 (**Table 2-28**). Other than the four common bird species observed and/or encountered, four (4) more species were present in 3 out of the 6 stations along transect line. These are Philippine Coucal (*Centropusviridis*), Glossy swiftlet (*Collocaliaesculenta*), Zebra Dove (*Geopeliastriata*), and Tawny Grassbird (*Magalurustimoriensis*). Such presence is a good indication of species diversity and richness.

e) **TR4-E Section (KM 101 to KM 114)**

A total of 34 birds are recorded from 5 transect routes starting from Candelaria (Transect 6) to Sariaya, and ending at Tayabas City (Transect 10) (**Table 2-28**). Species recorded were Oriental Magpie Robin (*Copsychussaularis*), Black-naped Oriole (*Orioluschinensis*). This is in addition to the following: *Passer montanus*, *Pycnonotusgoiavier, Collocalia troglodytes*and *Halcyon chloris* which were common across all the sampling/observation points.

Table 2-28: Distribution of Avifauna Across All Survey Stations and Their Conservation Status (IUCN) at the Initial TR4 Alignment.

ScientificName	Common Name	IUCN Status & Population trend	Transect																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Acridotheres cristatellus	Asian Glossy Starling Crested Myna	Status: Least Concern ver 3.1 Pop. trend: stable						x							x	x						
Aplonis panayensis	Asian Glossy Starling	Status: Least Concern ver 3.1 Pop. trend: unknown						x														
Artamus leucorynchus	White-breasted Wood-swallow	Status: Least Concern ver 3.1 Pop. trend: stable				x		x					x					x	x			x
Batrachostomus septimus	Philippine Frogmouth	Status: Least Concern ver 3.1 Pop. trend: decreasing																x	x			
Bubulcus ibis	Cattle Egret	Status: Least Concern ver 3.1 Pop. trend: increasing		x																		
Centropus viridis	Philippine Coucal	Status: Least Concern ver 3.1 Pop. trend: stable		x											x	x		x				
Chalcophaps indica	Emerald Dove	Status: Least Concern ver 3.1 Pop. trend: decreasing													x			x		x		
Collocalia esculenta	Glossy Swiftlet	Status: Least Concern ver 3.1 Pop. trend: stable											x				x	x				
Collocalia troglodytes	Pygmy Swiftlet	Status: Least Concern ver 3.1 Pop. trend: stable		x	x	x	x		x	x			x	x	x	x	x	x	x	x	x	x
Copsychus saularis	Oriental Magpie-Robin	Status: Least Concern ver 3.1 Pop. trend: stable							x		x		x						x			

ScientificName	Common Name	IUCN Status & Population trend	Transect																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Corvus macrorhynchos	Large-billed Crow	Status: Least Concern ver 3.1 Pop. trend: stable	x	x												x		x	x			x
Coturnix chinensis	Blue-breasted Quail	Status: Least Concern ver 3.1 Pop. trend: stable		x																		
Dicaeum australe	Red-keeled Flowerpecker	Status: Least Concern ver 3.1 Pop. trend: stable							x				x	x								
Dicaeum trigonostigma	Orange-bellied Flowerpecker	Status: Least Concern ver 3.1 Pop. trend: stable				x	x	x									x					
Gallirallus torquatus	Barred Rail	Status: Least Concern ver 3.1 Pop. trend: unknown															x		x			
Geopelia striata	Zebra Dove	Status: Least Concern ver 3.1 Pop. trend: stable				x		x			x		x		x			x				
Halcyon chloris	White-collared Kingfisher	Not assessed		x	x	x		x	x		x	x	x	x	x	x	x	x	x	x		x
Halcyon smyrnensis	White-throated Kingfisher	Status: Least Concern ver 3.1 Pop. trend: increasing		x																		
Haliastur indus	Brahminy Kite	Status: Least Concern ver 3.1 Pop. trend: increasing																x				
Hirundo tahitica	Pacific Swallow	Status: Least Concern ver 3.1 Pop. trend: increasing			x																	
Hypsipetes philippinus	Philippine Bulbul	Not assessed			x				x				x					x				

ScientificName	Common Name	IUCN Status & Population trend	Transect																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Lalage nigra	Pied Triller	Status: Least Concern ver 3.1 Pop. trend: stable										x	x					x				
Lanius cristatus	Brown Shrike	Status: Least Concern ver 3.1 Pop. trend: decreasing		x	x		x											x				
Lanius schach	Long-tailed Shrike	Status: Least Concern ver 3.1 Pop. trend: unknown														x						
Loriculus philippensis	Colasisi	Status: Least Concern ver 3.1 Pop. trend: decreasing																x				
Megalaima haemacephala	Coppersmith Barbet	Status: Least Concern ver 3.1 Pop. trend: increasing													1			x				
Megalurus timoriensis	Tawny Grassbird	Status: Least Concern ver 3.1 Pop. trend: stable											x		x			x				
Merops philippinus	Blue-tailed Bee-eater	Status: Least Concern ver 3.1 Pop. trend: stable			x										x	x		x				x
Nectarinia jugularis	Olive-backed Sunbird	Status: Least Concern ver 3.1 Pop. trend: stable	x		x													x	x			
Oriolus chinensis	Black-naped Oriole	Status: Least Concern ver 3.1 Pop. trend: unknown					x	x	x			x	x			x		x				x
Orthotomus derbianus	Luzon tailorbird	Status: Least Concern ver 3.1 Pop. trend: stable										x			x			x				x

ScientificName	Common Name	IUCN Status & Population trend	Transect																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Passer montanus	Eurasian Tree Sparrow	Status: Least Concern ver 3.1 Pop. trend: stable	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Phapitreron leucotis	White-eared Brown-dove	Status: Least Concern ver 3.1 Pop. trend: stable		x							x				x			x	x			x
Pycnonotus goiavier	Yellow-vented Bulbul	Status: Least Concern ver 3.1 Pop. trend: stable	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Tyto capensis	Grass Owl	Status: Least Concern ver 3.1 Pop. trend: decreasing																x				
Zosterops meyeni	Lowland White-eye	Status: Least Concern ver 3.1 Pop. trend: stable							x		x		x					x	x			

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

2. Herpetofauna and Mammalian Fauna

Almost all herpetofaunal and mammals recorded within the study area are either "common" or of "Least Concern"). While several individuals of Musky fruit bat (*Ptenochirus jagori*) were also recorded within the study area, this bat species is endemic to the Philippines but occurs widely. This species of bat have large population which are generally stable (IUCN, 2008). **Table 2-29** shows the list of herpetofauna and mammals recorded in study sites within the vicinity of the proposed TR4 alignment.

Table 2-29: List of Herpetofauna and Mammalian Fauna Recorded in the Proposed TR4 (Sites Nearby the Mt. Makiling Buffer Zones) Between 15 - 20 May 2013.

FAMILY	Scientific Name	Common Name	Total Individuals	Distribution and Conservation Status
Geckonidae (lizards)	*Gecko gecko*	Tuko	3	Common
Scincidae (skinks)	*Eutropis multicarinata borealis* *Eutropis multifasciata*	East Indian Brown Mabuya	4 7	Common Common
Varanidae (varanids)	*Varanus salvator nuchalis*	Monitor Lizard	1	Least Concern
Colubridae (snakes)	*Ahaetulla pracina preocularis*	Whip snake	1	Least Concern
Bufonidae	*Bufo marinus*	American Bullfrog	9	Common
Muridae (Mice and Rats)	*Rattus exulans* *Rattus tanezumi*	Polynesian rat Oriental house rat	2 3	Common Common
Pteropodidae	*Cynopterus brachyotis*	Short-nosed fruit bat	27	Common
	Eonycteris spelaea	Cave nectar bat	1	Common
	Ptenochirus jagori	Musky fruit bat	17	Endemic, Common
	Rosettus amplexicaudatus	Geoffroy's Rousette fruit bat	1	Common
Vespertilionidae	*Tylonycteris robustula*	Greater Bamboo bat	1	Common
Viverridae (wild cats)	*Paradoxurus hermaphroditus*	Palm Civet Cat	1	Common

Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

2.1.4.3.2.2 TR4 Re-Alignment

1. Species Richness and Abundance

A total of 40 vertebrate species consisting of 363 individuals belonging to 29 families are recorded (**Table 2-30**).

Table 2-30: Diversity of terrestrial vertebrate species recorded

Taxa	No. of species recorded	No. of individuals recorded	No. of Families	Endemic species	Resident species	Migrant species
Birds	32	338	22	6	22	4
Mammals	2	13	2	-	2	-
Amphibians	3	8	3	1	2	-
Reptiles	3	4	2	-	3	-
Total	40	363	29	7	29	4

Thirty-two (32) species of birds belonging to 22 families and 338 individuals were observed. In terms of number of individuals recorded, site 4 recorded the most number of birds with 46, followed by site 9 (42 species) and the least from site 1 with 9 individuals. The list of bird species observed and recorded during the assessment study is shown in **Table 2-31**. Representative photo of observed species is presented in **Figure 2-26**.

Eurasian Tree Sparrow (*Passer montanus*) is the only species found present in all sampling sites which also recorded the most number at 92 individuals. Other species with abundant numbers are the: Pygmy swiftlet (*Collocalia troglodytes*) (32); Black headed Munia (*Lonchura atricapilla*) (30); and, Yellow-vented Bulbul (*Pycnonotus goiaiver*) (27).

For non-bird species, one species of fruit bat - Short-nosed Fruit-bat (*Cynopterus brachyotis*) and rodent species - Oriental House Rat (*Rattus tanezumi*) were recorded. However, insectivorous bats (*Rhinolopus sp. and Hipposideros sp.*) were observed flying near the mist nets though no individuals were captured in the mist nets.

Three species of amphibians were recorded through opportunistic method. These species are: the conspicuous Cane Toad (*Rhinella marina*), Common Puddle Frog (*Occidozyga leavis*) and Variable-backed Frog (*Rana similis*). Moreover, three species of reptiles were also recorded in shrubs near the streams in Lower Naglatore namely: Tokay gecko (*Gekko gecko*), and two species of skink,the *Spenomorphos sp*. and *Eutropis multicarinata borealis*.

Table 2-31: List of birds species recorded in the area.

Family	Scientific Name	Common Name	Ecological / Distributional Status	1	2	3	4	5	6	7	8	9	10	11
Ardeidae	*Egretta garzetta*	Little egret	Migrant				2				1			
Artamidae	*Artamus leucorynchus*	White-breasted Wood-swallow	Resident		2	3	1	2			1			1
Alcedinidae	*Todiramphus chloris*	Collared Kingfisher	Resident				1	1		1	2			
Apodidae	*Collocalia esculenta*	Glossy Swiftlet	Resident		6	10	2	2		1	2	2		
	Collocalia troglodytes	Pygmy Swiftlet	Endemic	6	2	1	7	2	3		7		2	
Campephagidae	*Lalage nigra*	Pied Triller	Migrant			1						2		
Columbidae	*Chalcopaps indica*	Common Emerald-dove	Resident			1		2			1			
	Geopelia striata	Zebra Dove	Resident		2	2	1	3	2	3	2	1	1	1
	Streptopelia chinensis	Spotted Dove	Resident				2	1					1	
	Phapitreron leucotis	White-eared Brown Dove	Resident					1						
Corvidae	*Corvus enca*	Slender-billed Crow	Resident		1	1	2	1			1		1	1
Cuculidae	*Centropus viridis*	Philippine Coucal	Endemic		1		1	1		1			1	
	Cacomantis variolusos	Brush cuckoo	Resident		1						1			
Dicaeidae	*Dicaeum australe*	Red-keeled Flowerpecker	Endemic			1		2		1			2	
	Dicaeum hypoleucum	Buzzing Flowerpecker	Endemic									1		1
Estrildidae	*Lonchura atricapilla*	Black-headed Munia	Resident		8		4			6		12		
	Lonchura punctulata	Scaly-breasted Munia	Resident					5				6		2
	Passer montanus	Eurasian Tree Sparrow	Resident	2	6	4	5	12	18	22	4	6	5	8
Hermiprocnidae	*Hermiprocne comata*	Whiskered Treeswift	Resident			2								
Hirundinidae	*Hirundo tahitica*	Pacific Swallow	Resident		2									
Lanidae	*Lanius cristatus*	Brown Shrike	Migrant			1	2		2				1	
Locustellidae	*Megalurus palustris*	Striated Grassbird	Resident				2				1			
Megalaimidae	*Megalaima haemacephala*	Coppersmith Barbet	Resident						1					
Montacillidae	*Montacilla cineria*	Gray Wagtail	Migrant								1			

Family	Scientific Name	Common Name	Ecological / Distributional Status	1	2	3	4	5	6	7	8	9	10	11
Muscicapidae	*Rhipidura javanica*	Pied Fantail	Resident				1		1					
	Saxicola caprata	Pied Bushchat	Resident		4		5					2		
	Cyornis rufigastra	Mangrove Blue Flycatcher	Resident				1							
Nectariniidae	*Nectarinia jugularis*	Olive-backed Sunbird	Resident			4	1			1		2	1	1
Oriolidae	*Oriolus chinensis*	Black-naped Oriole	Endemic				1	1				1		
Picidae	*Dendrocopus maculatus*	Philippine Pygmy Woodpecker	Endemic				1				1	1		
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	Resident		2	3	2	4	2	5	2	4	1	2
Sylviidae	*Cisticola exilis*	Black-capped Cisticola	Resident	1			2					2		

Figure 2-26: Representative faunal species recorded in the area

2. Species Diversity

The diversity indices of birds observed and recorded during the survey is presented in **Table 2-32**. Species richness and abundance is highest in site 4 and site 5. Species diversity was highest in site 4 (H'=2.82) and lowest in site 1 (H'=0.85). Based on Fernando Biodiversity Scale, relative values recorded in site 4 is moderate, while very low for site 1. Average species diversity was also very low at H' = 1.98. Species evenness is highest in site 10 with e'=0.81 and lowest in site 7 at e'= 0.51. Average species evenness is very high at e'=0.701.

Consistent to the site condition observed in the area, data shows that a low to very low bird diversity exists in the area. This can be attributed to the poor habitat quality observed in the area being located in Alienable and Disposal lands with various human activities.

Table 2-32: Diversity indices of bird species recorded in the area

Site	Species Richness (sp)	Species Abundance (ind)	Species Diversity (H')	Species Dominance	Species Evenness
1	3	9	0.85	0.49	0.78
2	12	37	2.24	0.87	0.79
3	13	34	2.25	0.86	0.73
4	21	46	2.82	0.93	0.80
5	15	40	2.35	0.86	0.70
6	7	29	1.32	0.59	0.53
7	9	41	1.52	0.67	0.51
8	14	27	2.38	0.88	0.77
9	13	42	2.22	0.85	0.71
10	10	16	2.10	0.84	0.81
11	8	17	1.69	0.73	0.68
Average	11.36	30.73	1.98	0.78	0.71

3. Conservation Status Distribution and Endemicity

Birds dominated the list because they are mobile, easy to observe and more abundant as compared to other vertebrates observed. In addition, other groups of animals are only active during the night making observation and recording more difficult to conduct.

In terms of species distribution, resident and common widespread species dominated the list with 29 species representing 72.5% of the total list, followed by endemic species with 7 species (17.5%) and four migrant species (10%) (**Figure 2-27**).

Seven (7) endemic species are native species that breed and are found only in the Philippines. Some endemic species are restricted-range species or species found only in selected islands of the country like mainland Luzon. However, no restricted-range species were recorded despite the proximity of TR4-A to Mt. Makiling Forest Reserve which is 800m from the nearest buffer zone boundary. Resident species on the other hand, are species with breeding population inside and outside the Philippines but do not migrate during rainy season such as the majority of the species observed in the area.

Migrant species are migratory species with substantial proportion of the members of its population regularly cross at least one boundary between countries.

No threatened wildlife species were recorded in the area based on existing local and international Redlist assessment. Most species observed in the area are either common or least concern status in the Philippines. Based on the interview with the locals particularly from Sariaya and Sto. Tomas Batangas, hunting of wildlife species such as birds in nearby mountain forest is observed.

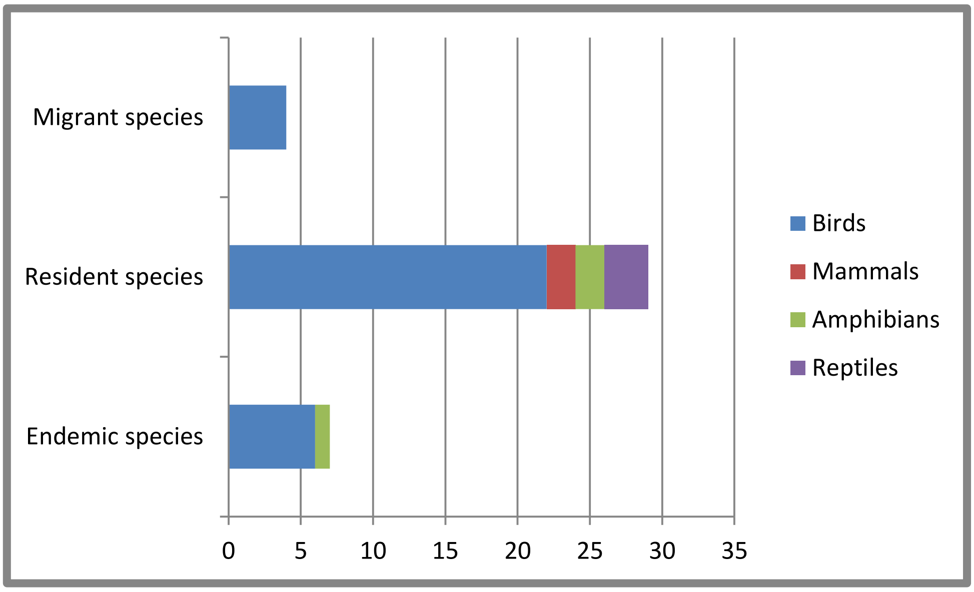


Figure 2-27: Distribution status of wildlife species recorded in the area

2.1.4.3.2.3 Historical Occurrences of Pest Infestation, Forest/Grass Fires

There were no reported occurrence of pest infestation and forest/grass fires in the study area. There were also no observations that recent pest infestation or a widespread forest or grass fires occurred within the study area. However, controlled burning is practiced in some agricultural farms within the vicinity of the project area.

2.1.4.4 Potential Key Impacts on Terrestrial Ecology and Mitigating Measures

2.1.4.4.1 Vegetation Displacement and Loss of Habitat

Vegetation displacement leading to habitat loss during the construction phase may be one of the most significant impacts of the project. Such reduction of vegetative cover can potentially reduce the ecological values of the area. To address this issue, SLTC will consider the following conservation and protection strategies:

Strategy 1: A tree nursery should be established as early as pre-construction phase to start the collection of saplings of trees. The tree nursery should house suitable species of trees identified in the current dendrological assessment and those that will be identified in future dendrological surveys.

Strategy 2: Develop suitable rainforestation-based approaches in the ecological rehabilitation of affected habitats wherein suitable local species of trees will be used as planting materials.

The SLTC will be working with UPLB to determine the areas within the buffer zone of Mt. Makiling Reserve for the implementation of the rainforestation plan (*see* Section 2.1.4.4.2). The operation of the rainforestation plan is the primary mitigation measure for the vegetation displacement and loss of habitat due to the project. In addition, SLTC will incorporate the planting of trees and other vegetation along the roadsides of TR4 to partly replace the vegetation loss in the area and to minimize disturbance of project operation to some animal species.

2.1.4.4.2 Threat to Existence and/or Loss of Important Local Species

Five plant species recorded was categorized either as "vulnerable" "threatened" or "endangered" under DAO 2007-01. Their loss in their natural habitat may be further threatened during the construction stage of the project. However, the project is not expected to cause significant loss of critical plant species since the project will mostly traverse agricultural lands and open areas which is about 800 m distance from the nearest boundary of Makiling Forest Reserve.

Two of the “endangered” plant species (i.e., narra and molave) are widely propagated and used in reforestation activities. Thus, these could be incorporated in the conservation and protection strategy to be implemented by SLTC. Similarly, other critical and important species will be incorporated in the ecological rehabilitation of affected habitats or in biodiversity offset sites.

Within critical areas at the Mt. Makiling Reserve (MFR), seeds and other sources of propagules may be collected prior to any disturbance. These in turn will be properly propagated in nurseries and will be eventually prepared for re-introduction after the road construction.

The main reforestation strategy or restoration strategy to mitigate the impacts to flora and fauna during the road construction will be based on suitable agroforestry-based “rainforestation” approaches. Rain forestation is a reforestation strategy based on the concepts of natural processes in a rainforest or natural ecological succession. Developed by Visayas State University (VSU) and the German Agency for Technical Cooperation (GTZ), the main goal of agroforestry-based rain forestation is to use native tree species to rehabilitate degraded landscape and restore key ecosystem services and functions, while providing forest-dependent communities with alternative source of livelihood. This system was then adopted by the DENR through the issuance of Memorandum Circular 2004-06 as an official reforestation strategy of the agency in implementing its reforestation efforts throughout the country. The operational framework for rain forestation are habitat restoration, biodiversity conservation and provision of ecological functions/services. Its main features include the following:

- It uses native/local trees within the area to be reforested;
- Gives importance on the structural habitat to support wildlife;
- Support sustainable development through organic practices in agricultural and forestry production; and
- Provides ecological services including watershed conservation.

The SLTC aims to develop and implement its rain forestation plan by working in close partnership with relevant local organizations, primarily the University of the Philippines at Los Baños (UPLB). This will include the drafting of a rainforestation plan for areas within the buffer zone of Mt. Makiling Reserve. This is required considering that the UPLB has the management jurisdiction of Mt. Makiling.

2.1.4.4.3 Threat to Abundance, Frequency and Distribution of Important Species

The construction and operation of the project is not expected to cause significant irreversible adverse impacts to the abundance, frequency and distribution of important flora and faunal species. Re-introduction of important floral and faunal species is possible after the construction phase of the project.

The disturbance due to construction activities (i.e., high noise and movement) may cause temporary displacement of mobile animals. During operation, a lower level of noise and movement from plying vehicles may be a source of disturbance to some animal species. To mitigate this impact, SLTC will incorporate the planting of trees and other vegetation (including important plant species identified in this study) along the roadside to reduce noise from plying vehicles.

2.1.4.4.4 Hindrance to Wildlife Access

Vegetation displacement further leads to habitat fragmentation, i.e., habitats that were once continuous become divided into separate fragments isolated from each other (Lindenmayer and Fischer, 2006). These new habitat types are often artificial and inhospitable to the faunal species remaining within the fragments (Bennett, 1990). Increase in sound levels during construction and operation is another source of wildlife disturbance in the area. This could possibly threaten the ability of native birds to reproduce, hence, affecting their abundance, frequency, and distribution.

Nearby habitat refuges outside the project site provide alternative habitats to affected avifauna, the area being contiguous with a broad expanse of grassland ecosystems. However, a well-implemented reforestation program on both sides of the road is a realistic strategy to recover or rehabilitate habitats lost to road construction and also provide vegetative barriers to minimize long-term sensory disturbance.

Proper revegetation of the road side will create a suitable corridor to animal species, thus providing access to wildlife that may require movement from one habitat patch to another along the same side of the road.

Table 2-33: Key Potential Impacts to Flora and Fauna and Mitigating Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement
Vegetation displacement and loss of habitat		x	x		• Initiate reforestation of potential impact areas prior to ground preparation. • Use suitable indigenous species for reforestation of impact areas and/or offset areas • Implementation of rainforestation plan • Planting on both sides of the TR4 alignment
Threat to existence and/or loss of important local species • Displacement of important species from their natural habitat		x	x		• Within critical habitat (i.e. MFR), seeds/propagules may be collected prior to any disturbance for propagation and re-introduction.
Threat to abundance, frequency and distribution of important species • Sensory disturbance to faunal species due to increase in noise level		x	x		• Properly designed reforestation on both sides of the road to reduce sensory disturbance
Hindrance to Wildlife Access		x	x		• Maintain vegetative barriers via initial reforestation early in the project phase. • Properly designed reforestation to create a suitable corridor for wildlife

P = Pre-Construction; C= Construction, O = Operation; A = Abandonment or Closure

2.1.4.4.5 Summary of Reforestation Plan and Strategies

This section presents the actions and approaches that the proponent will undertake to ensure that the commitment on reforestation is accomplished. These are:

1. Drafting a rain forestation plan. The advice and guidance of the Los Baños-based Ecosystems Research and Development Bureau (ERDB) of the DENR and the UPLB College of Forestry and Natural Resources will be sought particularly on nursery care, outplanting and maintenance to ensure high rate of survival.
2. Rain forestation as main reforestation strategy. This means using native tree species as provided in DENR Memorandum Circular 2004-06.
3. Establishment of a tree nursery as early as pre-construction phase to house and prepare saplings of indigenous forest tree species that were identified during the faunal survey. The design of the nursery will follow the guidelines adopted by the DENR.
4. Procurement of available cloned native species from ERDB which will be housed and hardened in the nursery prior to actual planting.
5. Roadside planting – which may alternatively use fruit-bearing trees to attract avifauna, volant mammals and indigenous tree species.

The planting of trees along the roadsides also aim at making travels more visually pleasant, absorb heat and dust from the road, sequester air pollutants and provide resting places for certain wildlife.

For the buffer zone in the Makiling Reserve, the proponent has indicated its willingness to develop and implement a rain forestation plan by working in close partnership with relevant local organizations, primarily the University of the Philippines at Los Baños (UPLB) through the College of Forestry and Natural Resources (CFNR). The CFNR will be requested to identify appropriate areas for reforestation. A memorandum of agreement (MOA) between CFNR and the SLTC and/or the latter's contractor may be forged to ensure that rain forestation work and the necessary funding are put in place. The Local Government Unit/s (LGUs) that have political jurisdiction over the plantation area may be invited to join the agreement.

Tree guards will be provided to protect the trees from external harm or disturbance.

Replacement of deceased planting stocks will be undertaken regularly, i.e., during the first months after planting or as often as necessary. The planting stocks will come from the nursery.

Post-planting maintenance and protection, particularly during the first three years, will be conducted by SLTC and/or its partners as this is important for the trees to grow to self-sufficiency.

Maintenance and protection will include pest control.

Like in the present SLEX, SLTC will invite other government agencies, civic organizations and local communities to conduct annual tree planting, either along the roadsides or in designated reforestation areas.

Planted trees will be plotted in maps and will be monitored at least once a year, in collaboration with the partner/s.

The SLTC, or thru its contractors, will provide the necessary expense budget which will ensure that the rainforestation activities are amply funded, particularly during the first three years of the life of the trees.

The compliance monitoring report will include periodic assessment of the performance of the Project in its rainforestation commitment.

2.2 The Water

2.2.1 Hydrology / Hydrogeology

2.2.1.1 Scope

The study conducted investigation on the hydrology and limnology of the potentially-affected water bodies. The determination of water quality of the river systems is also a part of the study. In particular, this section addressed the following:

- Site drainage assessment including mapping of the catchment area, flooding effect, and effect of subsidence on drainage;
- Review of existing water quality and recommendations of further analysis, if required; and
- Assessment of groundwater availability and usage.

2.2.1.2 Methodology

A site investigation is conducted to identify the hydrologic process of the water bodies to be traversed/affected by the project. This is done to establish the erosion and flooding potential at the project site. Water sampling for laboratory analysis is also conducted to determine the baseline water quality for the assessment of the waterways' possible contamination from the project construction until its operation.

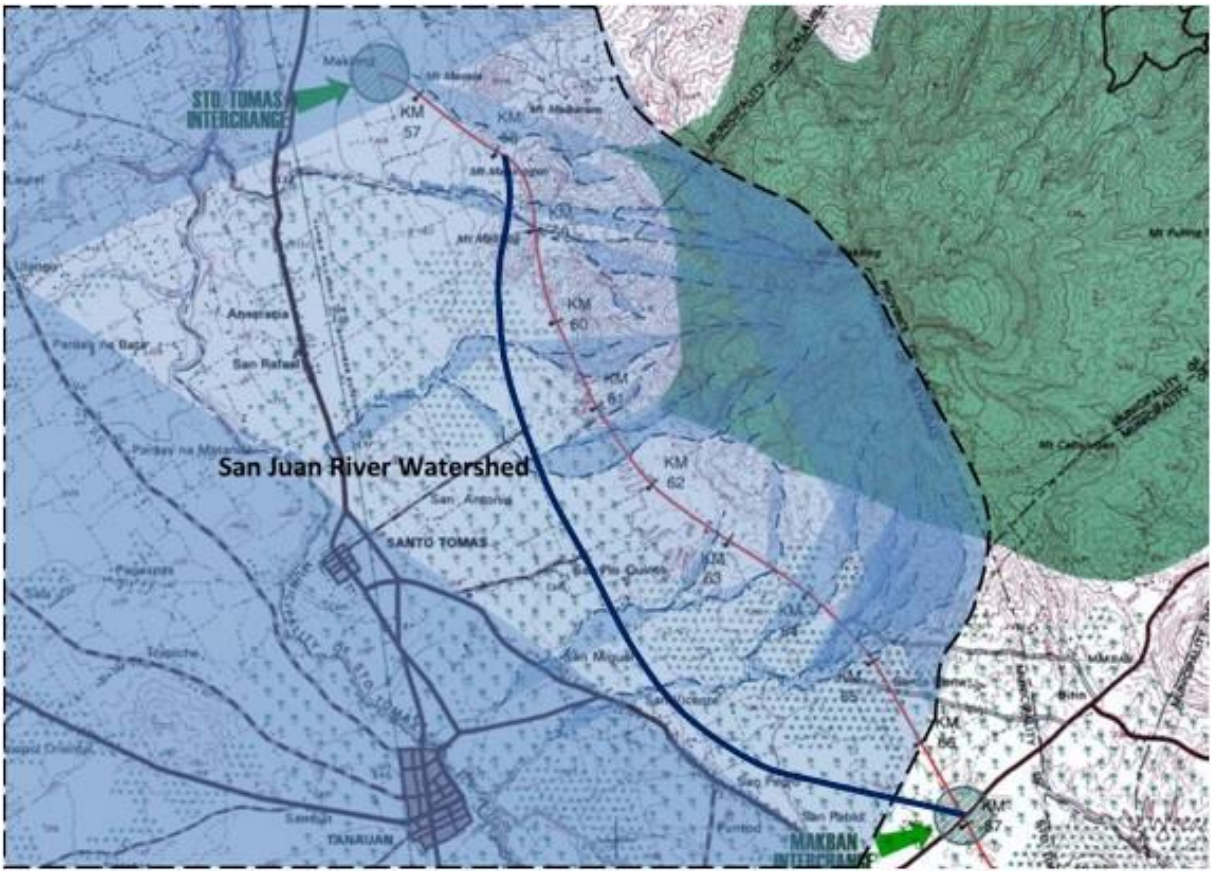
Secondary data such as reports from the DENR Region 4A and geohazard map generated by the Mines and Geosciences Bureau (MGB) were utilized as supplemental information on the water quality and flooding history. This is further supported by interview of local residents to determine the water usage and flooding history in the area.

2.2.1.3 Baseline

2.2.1.3.1 Hydrology

TR4-A is generally located within the watershed of the San Juan River system, which drains on the west and south-western slopes of the Mount Makiling (**Figure 2-28**). The watershed comprising the sub-catchments of the Siam-siam and Munting Rivers with the San Miguel and San Vicente Creeks, and several unnamed creeks drain the upper slopes, which eventually merges into the main San Juan River on the lower rolling to undulating terrain. The channels of San Juan River system and the ridges and valleys that form part of the watershed follow the general west-southwest elongation. The basin is curved around Mount Makiling whose deposits caused the landforms to skirt around the western-southwestern slopes of the mountain.

From its connection with TR4-A, TR4-B is traversing a portion of San Juan River and Bay River watershed. However, most of the section of TR4-B is within the Malaking Ilog Watershed (**Figure 2-28**). The alignment is crossing 3 tributary creeks flowing northeast towards Tigas River, a tributary of Bay River. On the other hand, the 3 rivers to be traversed at Malaking Ilog watershed such as Tarac, Makampongo and Balatuin River are flowing south.



Note: —— *New Alignment* —— *Old Alignment*

Figure 2-28: Watershed and Drainage Systems along TR4-A
(*Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)*

TR4-C and TR4-D are entirely within the Malaking Ilog Watershed. There are several rivers and their confluent creeks that will be crossing the TR4 alignment at these sections (**Figure 2-29 and Figure 2-30**). Majority of the rivers are radial at the south-western foot slopes of Mt. Banahaw and braided further south of the TR4 alignment. The rivers are dendritic and mostly intermittent, thus the streams are either dry or have stagnant water during the fieldworks.

A portion of TR4-E is still located at Malaking Ilog Watershed but a greater part of the road section is within the Sariaya-Lucena Watershed **(Figure 2-31**). The river systems at TR4-E are also dendritic and flowing south to south-east. Most of the rivers have deeply incised river channel.

In summary, the TR4 alignment is traversing 4 watersheds with more than half of the road section located at Malaking Ilog Watershed (**Figure 2-32**). The alignment is mostly within the footslope of either the Mt. Makiling or Mt. Banahaw. Thus, there are several waterways draining the mountains that will be traversed by the Project.

The general drainage pattern is medium to course dendritic except for the north-northeast flowing rivers / creeks of Tigas, Buboy, Bucal and Matandan Rivers in TR4-B where the semi-annular pattern is being reflected. **Table 2-34** presents a summary of hydrologic characteristics in the project area.

Majority of the creeks in the project area are intermittent and during the conduct of the fieldworks, almost all water bodies (rivers and creeks) have stagnant water while some are dry. Thus, streamflow measurement was not possible.

Table 2-34 and **Table 2-35** present the hydrologic system in the project area and the characteristics of the watershed, respectively.

Table 2-34: Hydrologic Characteristics along the TR4 Alignment

Findings	
TR4-A: Sto. Tomas, Batangas to Makban, Laguna	San Juan River Watershed (SJWS) defines the general area traversed by the TR4-A road segment. Tributaries are the rivers of Siam-siam and Munting, and creeks of San Miguel and San Vicente, all of which flows from the slopes of Mt. Makiling.
TR4-B: Makban to San Pablo City, Laguna	TR4-B traverses 3 watersheds: the SJRWS, the Bay River Watershed (BRW), and Malaking Ilog Watershed (MIW). SJRWS divide cuts thru Mt. Olila which also define the boundary to the BRW. The rest of the segment is within the MIW. BRW constitutes of Tigas, Buboy, Bucal, and Matandan Rivers which all connect to Mabulog River, thence to Bay River. These river systems flow in a general north-northeast direction towards the south-eastern coast of Laguna de Bay.
TR4-C: San Pablo City, Laguna to Tiaong, Quezon	TR4-C lies within the MIW with a general drainage coarse dendritic pattern. River systems are Tarac River, Balatuin River, Macampongo River, Banedero River, Malaonod River, and Balanga River, and intermittent creeks of Panluan, Casaheyan and Labasin all of which join the Matanag River on the south.
TR4-D: Tiaong, Quezon to Candelaria, Quezon	TR4-D is traversed by the Cabatan, Taguna, Maasin, and Quaipo rivers, and several intermittent streams. All of these water channels flow in a general south-southeast direction toward MalakingTubig River, thence to the main Quipot River.
TR4-E: Candelaria, Quezon to Tayabas City	Mamala and Sariaya Rivers with several intermittent streams define the natural water channels traverse by TR4-E from Candelaria Interchange to Sariaya until the Tayabas Roundabout in Calumpang, Tayabas City.

Table 2-35: Characteristics of Watershed and River Systems

TR4 Alignment	KMStation	Length (km)	Watershed	River System	Creek	Drainage Pattern	General Geology	General Observation/Stream Flow
TR4-A: Calamba City to Makban, Sto. Tomas, Batangas	56+518 to 67+835	11.32	San Juan River Watershed	Upper Siam-siam River, a tributary of San Juan River	Intermit-tent	Medium Dendritic	The general geology is defined by the Quaternary Volcanics (Qv) and the Quaternary Taal Tuff (Qtt). Andesitic to basaltic volcanic flows with associated pyroclastic deposits of the Qv occur along Km 58 and Km61. The rest of the road alignment is underlain by the Qtt consisting of thin to medium bedded welded volcanic breccias, vitric tuff with tuffaceous shale / sandstone. Quaternary Alluvium (Qal) consisting of loosely consolidated gravel, sand, silt and clay materials blankets the river beds and flood plains.	Except for Siam-siam River and San Vicente Creek, most of the waterways are dry during field investigation.
				Upper Munting River, a tributary of San Juan River				
				San Miguel River, a tributary of San Juan River				
				San VicenteCreek, a tributary of San Juan River				
TR4-B: Makban, Sto. Tomas to San Pablo City	67+835 to 79+953	12.12	San Juan River Watershed; Bay River Watershed; MalakingIlog Watershed.	3 tributary creeks of Tigas River	Intermit-tent	Generally braided towards the north.	Underlain by the Qtt except between Km 68-69 where the road cuts through the Quaternary Volcanics (Qv). Qal is confined along the river / creek beds and floodplains.	Most creeks are dry during the field investigation. Localized water flow very slowly and oftentimes stagnant.
				Tarac River andMakampongo River,		Medium Dendritic, Generally		

TR4 Alignment	KMStation	Length (km)	Watershed	River System	Creek	Drainage Pattern	General Geology	General Observation/Stream Flow
				tributariestoMatinag River Balatuin River		braided towards the south.		
TR4-C: San Pablo City to Tiaong, Quezon	79+953 to 87+450	7.50	MalakingIlog Watershed.	Banedero River and its tributary, Macopa Creek Malagnod River Confluence of Panluan Creek and Casaheyan Creek Balanga River Labasin Creek	Intermit-tent	Dendritic, Radial at the south-western foot slopes of Mt. Banahaw. Generally braided towards the south.	Qtt underlies the general area traversed by TR4-C alignment with Qal deposits along the river / creek beds and floodplains.	Localized water flow very slowly and oftentimes stagnant.
TR4-D: Tiaong, Quezon to Candelaria, Quezon	87+450 to 102+450	15.00	MalakingIlog Watershed	Cabatan River, a tributary to Lagnas River 2 creeks, tributaries of Gamarella River TaguanRiver and its tributary Masin River and its 2 creek tributaries Qiuapo River and its 2 creek tributaries	Intermit-tent	Dendritic, Radial at the south-western foot slopes of Mt. Banahaw. Generally braided towards the south.	TR4-D cuts through the area underlain by the Qtt with Qal deposits along the river / creek channels and floodplains.	Intermittent creeks. Deeply incised river channel. Stagnant to almost dry waterways during site investigation

TR4 Alignment	KMStation	Length (km)	Watershed	River System	Creek	Drainage Pattern	General Geology	General Observation/Stream Flow
TR4-E: Candelaria, Quezon to Tayabas City	102+450 to 113+550	11,10	MalakingIlog Watershed; and, Sariaya-Lucena Watershed	Mamala River Gibanga River, Sariaya River and a tributary	Intermit-tent	Coarse dendritic	Blanketed by the Laguna Formation (Qvp) consisting of thin to medium bedded tuff, agglomerates, volcanic breccias, and associated tuffaeous sediments	Intermittent creeks. Deeply incised river channel. Stagnant to almost dry waterways during site investigation

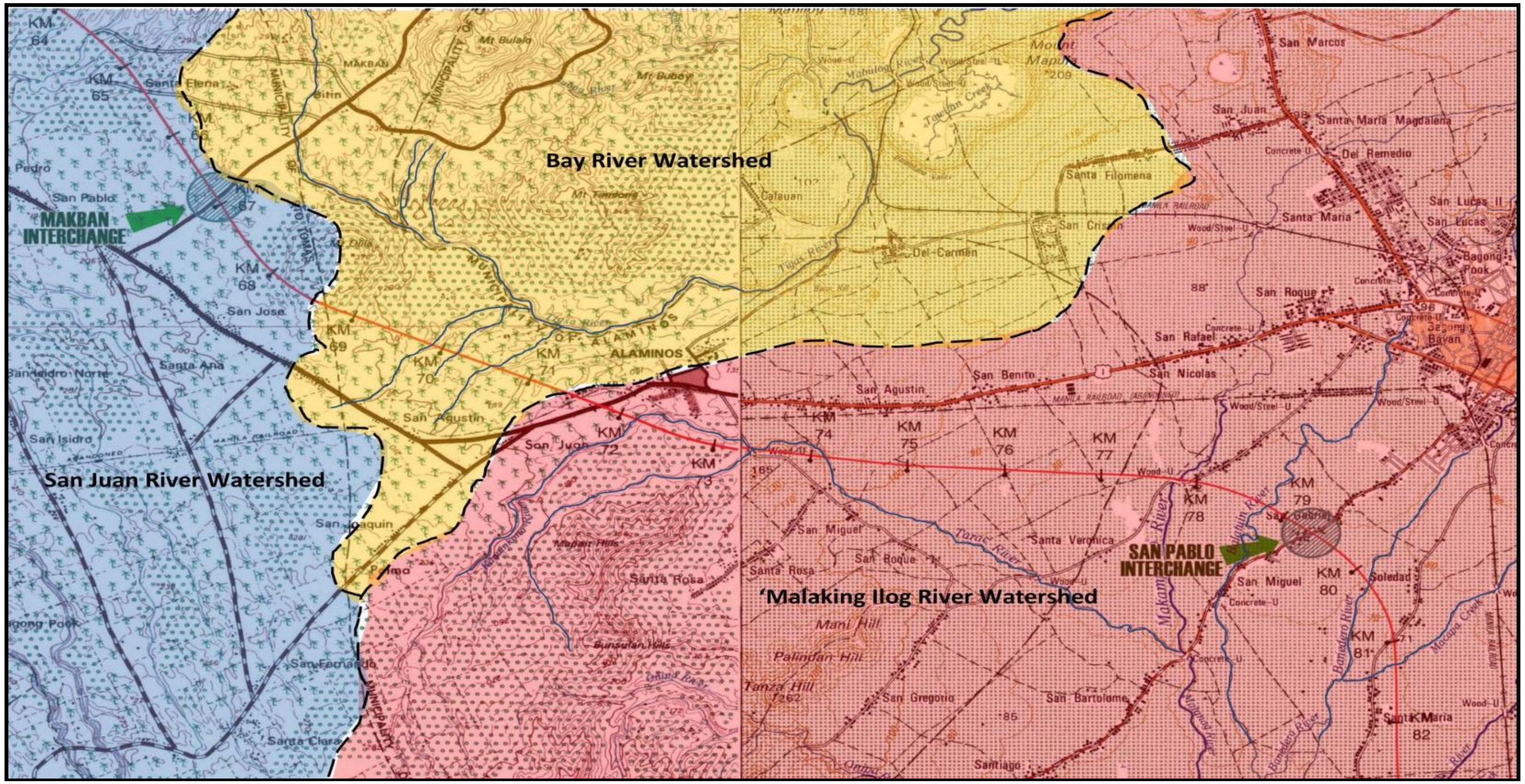


Figure 2-29: Watershed and Drainage Systems along TR4-B
Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project

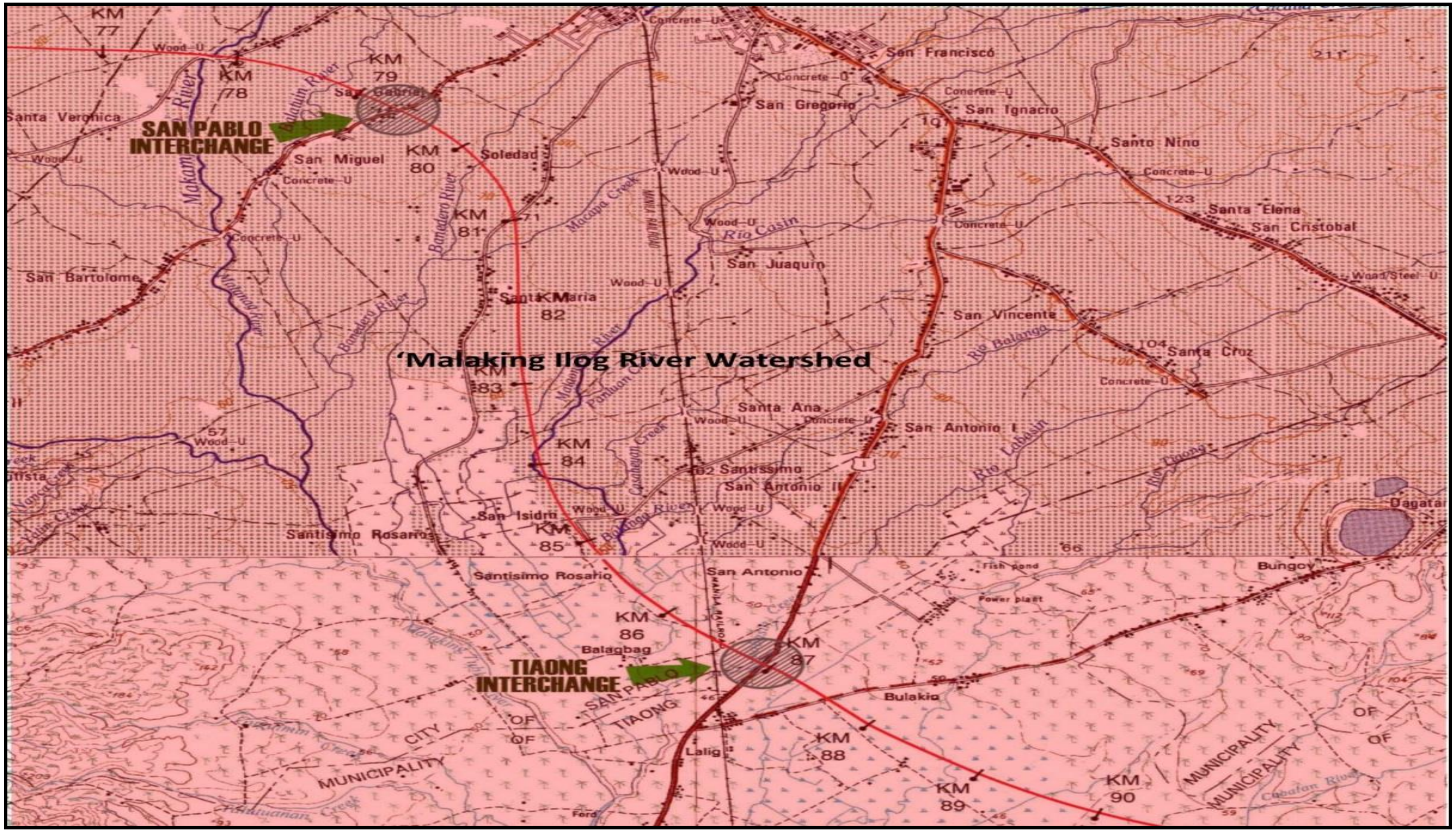


Figure 2-30: Watershed and Drainage Systems along TR4-C
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

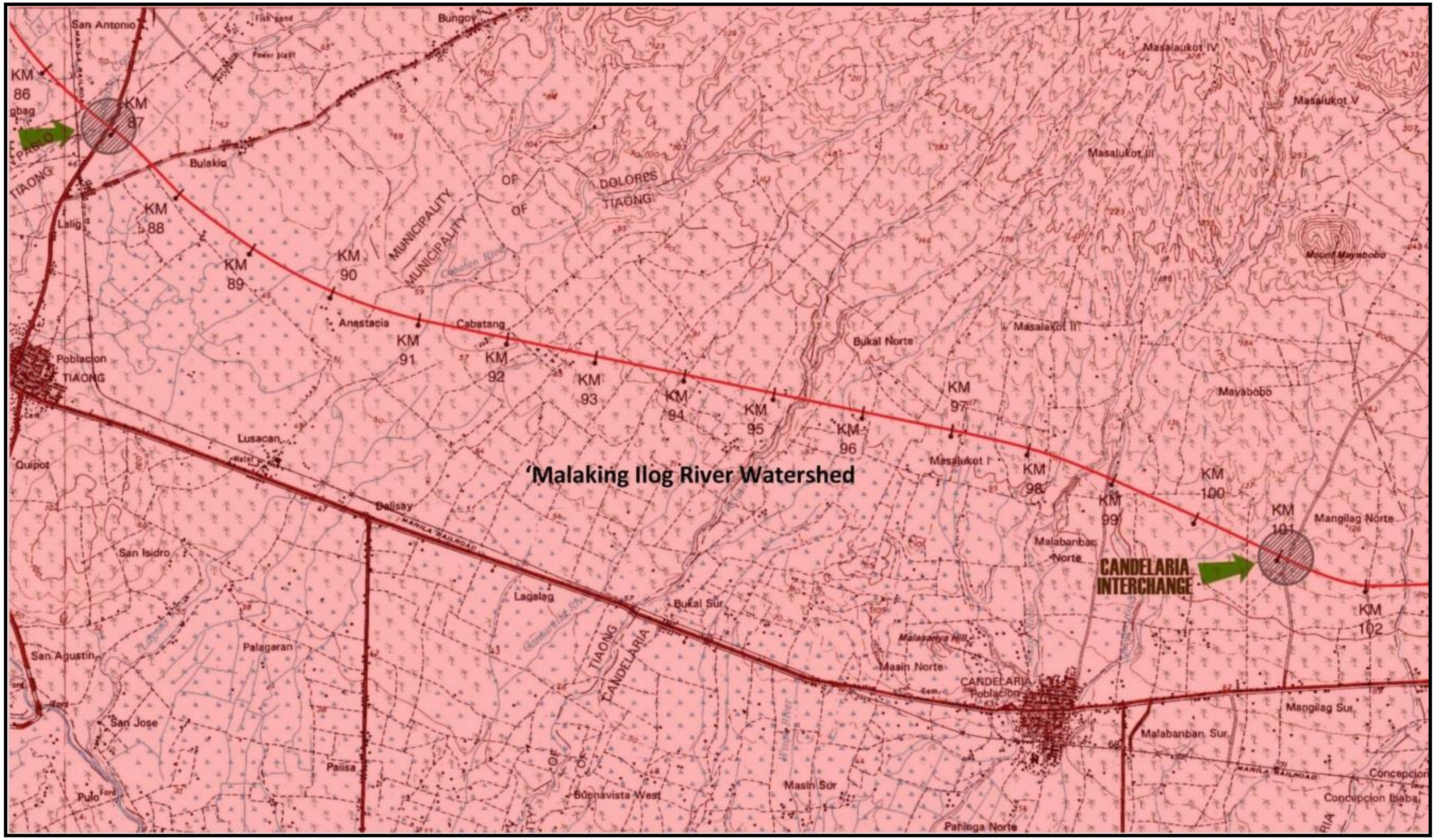
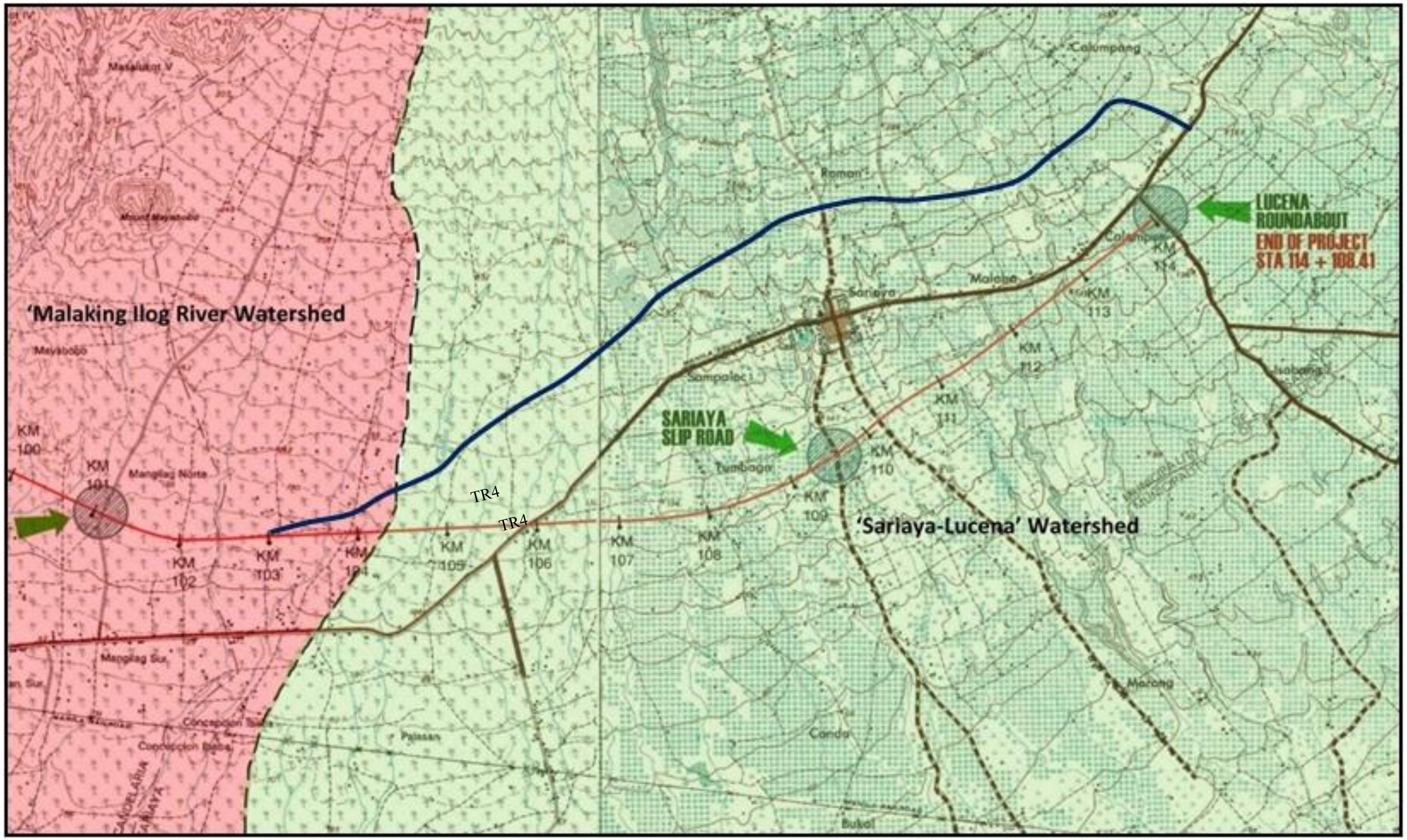


Figure 2-31:Watershed and Drainage Systems along TR4-D
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)



Note: —— *New Alignment* —— *Old Alignment*

Figure 2-32: Watershed and Drainage Systems along TR4-E
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

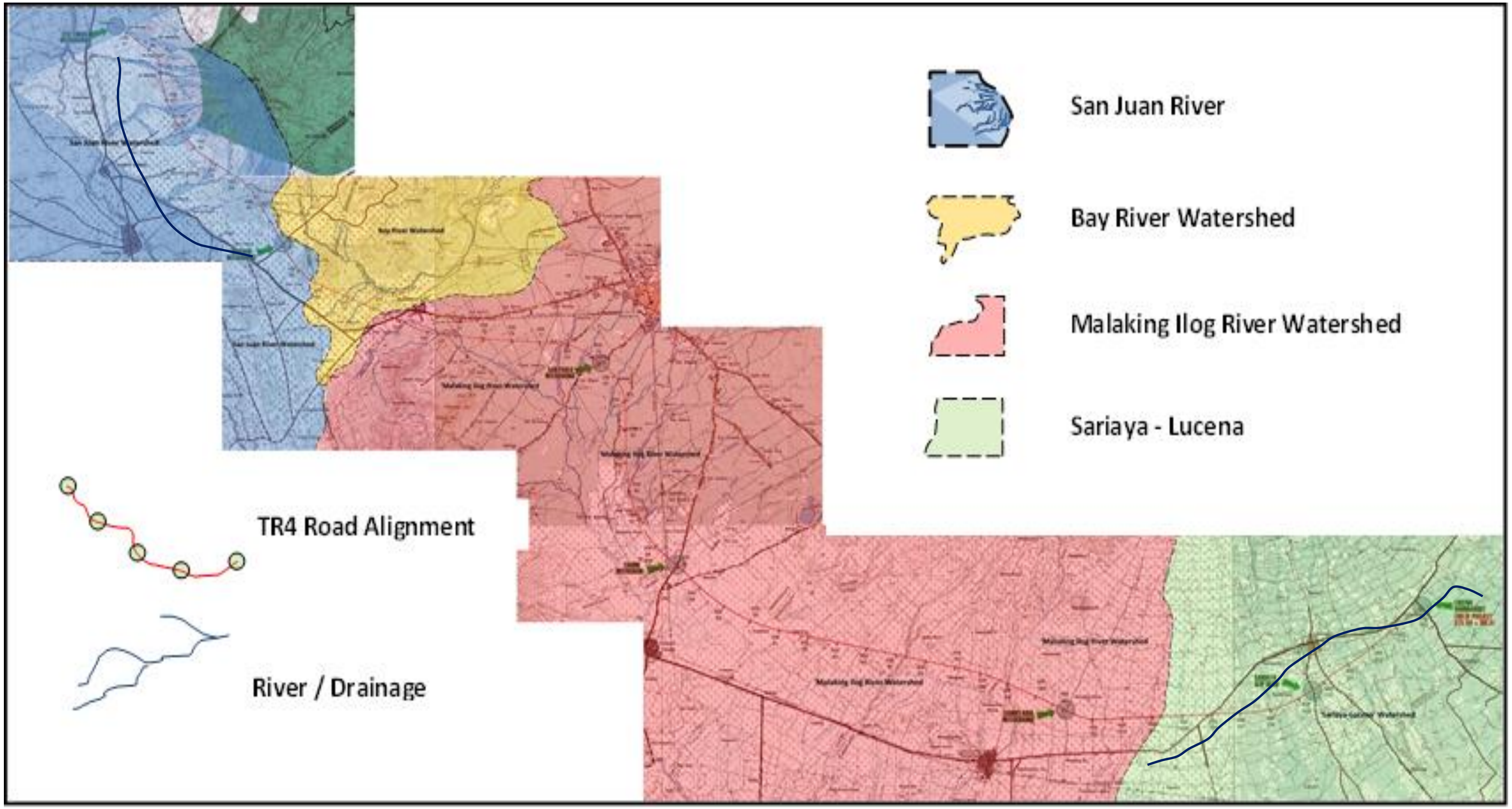


Figure 2-33: Composite Watershed Map of TR4 Alignment
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

2.2.1.3.2 Hydrogeology

The TR4 alignment is in the watershed areas that cut through the various rock units of the Quaternary Taal Tuff (QTT) except for a small portion on the north-eastern side that is underlain by the Quaternary Volcanics (**Figure 2-33**).

In general, the project transects an area that has low to less productive aquifer systems. Localized more productive groundwater supply occurs farther south from the road alignment where the blanketing materials are the Quaternary Alluvial deposits (**Figure 2-34**).

2.2.1.3.3 Flooding Condition

The TR4 alignment is located in low to moderate susceptibility to flooding as per geohazard evaluation of the Mines and Geosciences Bureau (MGB) as shown in **Figure 2-35** to **Figure 2-38**. These areas are likely to experience up to less than 1.0 m flood height during prolonged and extensive heavy rainfall or extreme weather condition. However, certain sections of the project alignment, which traverses a relatively low relief including waterway crossings, are vulnerable to flooding resulting from either overflow or concentrated runoff.

Flood simulations for 6-, 25-, and 100-year return periods and performed by the Department of Science and Technology (DOST) Nationwide Operational Assessment of Hazards otherwise known as Project NOAH showed that the sections along TR4-C in the Municipality of Tiaong is likewise vulnerable to flooding (**Figure 2-39**). The lowland flood risk areas are where the rivers originating from Mt. Banahaw and Malepunyo Range converge.

Occurrences of floods in Calamba City have been reported in the past. This includes area along the national highway going to Los Baños, Laguna where water from Laguna de Bay may reach low lying areas. However, there were no reports of severe floods occurring in Barangays Makiling and Puting Bato where the proposed road project will traverse.

Some areas reported where flooding occurred in the past includes barangays in Sariaya, Quezon. Past flooding near the national highway about 0.5 meter high was reported in Barangay Sto. Cristo, while in Barangay Tumbaga I, the Mamala River Irrigation System collapsed in the year 2000, resulting in the relocation of approximately 80 families while further downstream, the main access during the downpour was impassable. In the nearby Barangay Tumbaga II, Lagnas River overflowed resulting in 1.5 meter level flood damaging houses and farms (DENR-R4A, 2011).

In San Vicente, Sto. Tomas, flooding at the residential community is expected during rainfall occurrence either at the site or at its upstream in Mount Makiling. This is possibly due to the constricted flow at the small and shallow river with built-up area dominating the floodplain which is discharging to a ravine just after crossing the access road. In most cases, the box culvert could not accommodate the flow causing the spreading of excess water on the road. This effected the subsidence and damage of the access road particularly at the section crossing the river and its immediate vicinity. Furthermore, depressions along the access road are created supporting the water stagnation almost throughout the year.

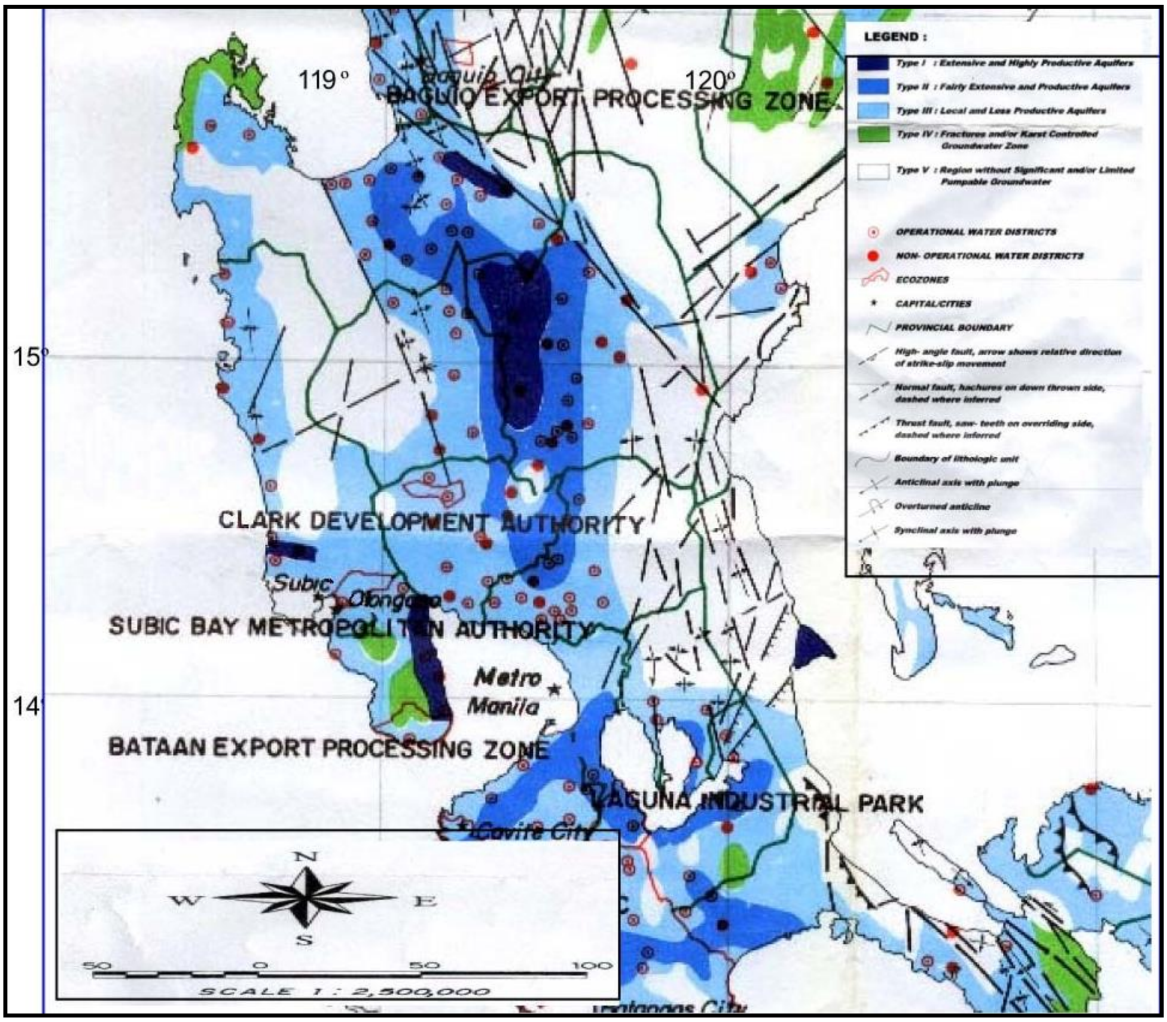
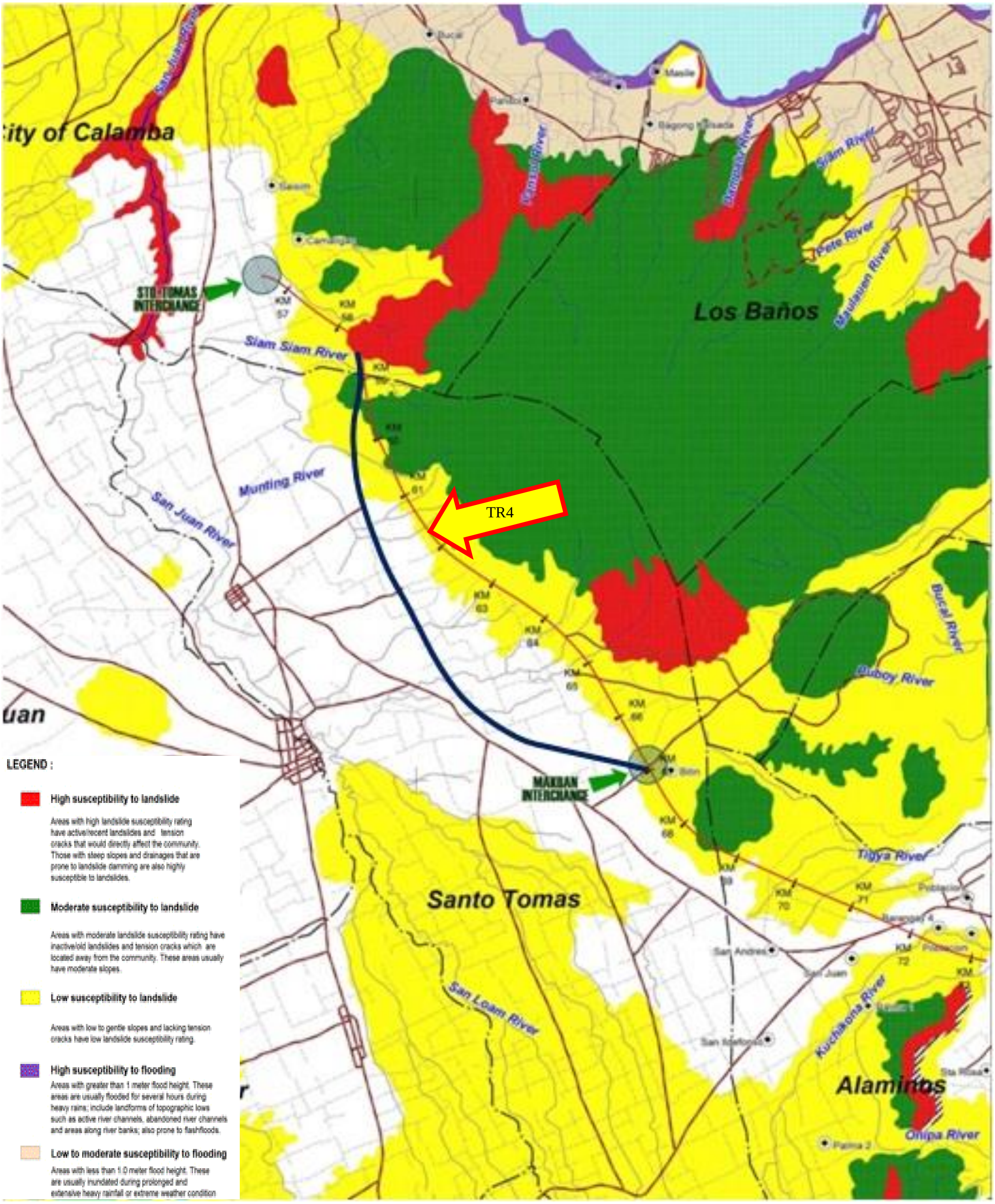


Figure 2-34: Groundwater Regions of Southern Luzon
(Source: DENR, Groundwater Regions of the Philippines, 1999)



Note: *New Alignment* *Old Alignment*

Figure 2-35: Landslide and Flood Susceptibility Map along TR4-A (Sto. Tomas to Makban Interchange)

(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

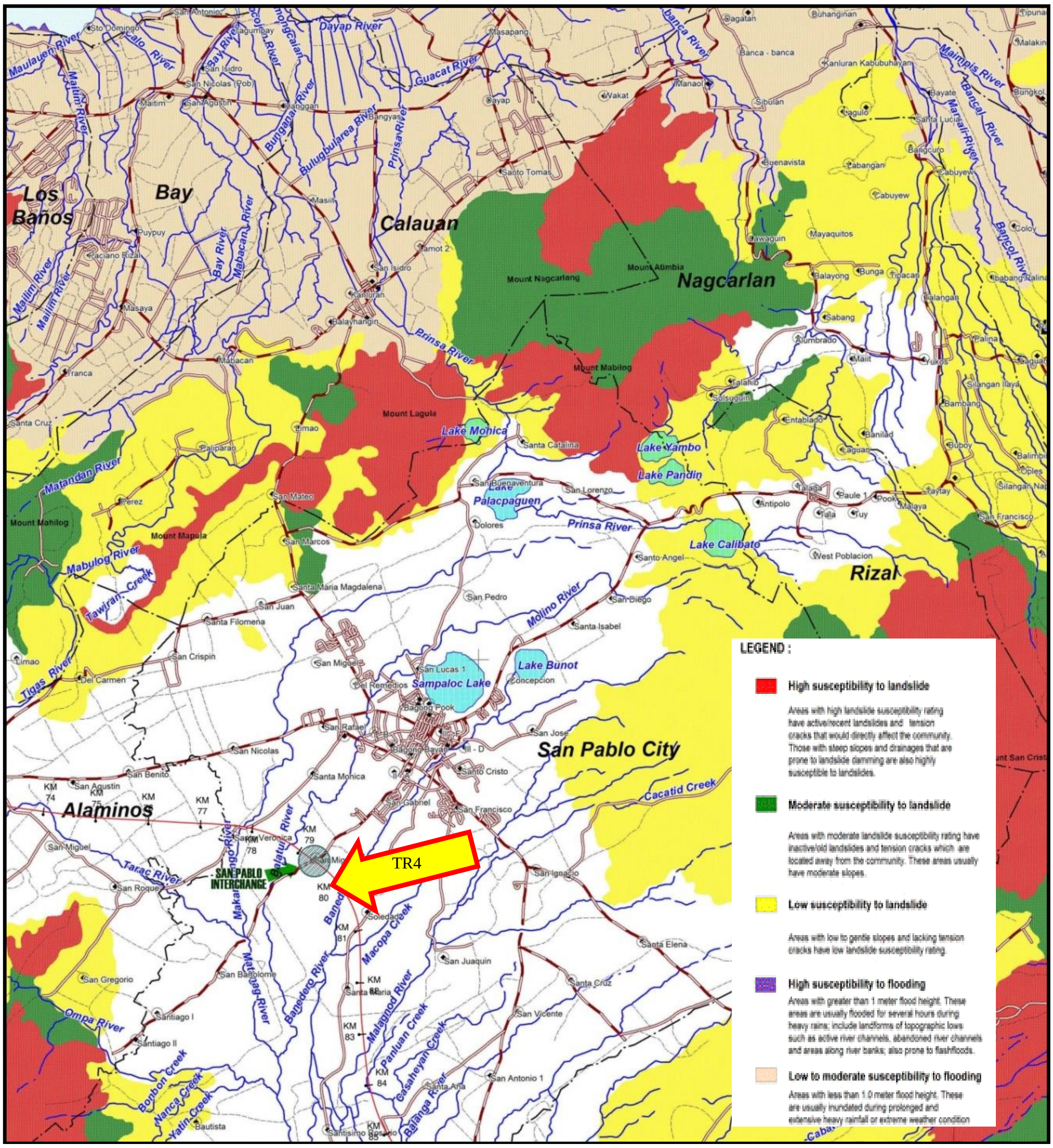
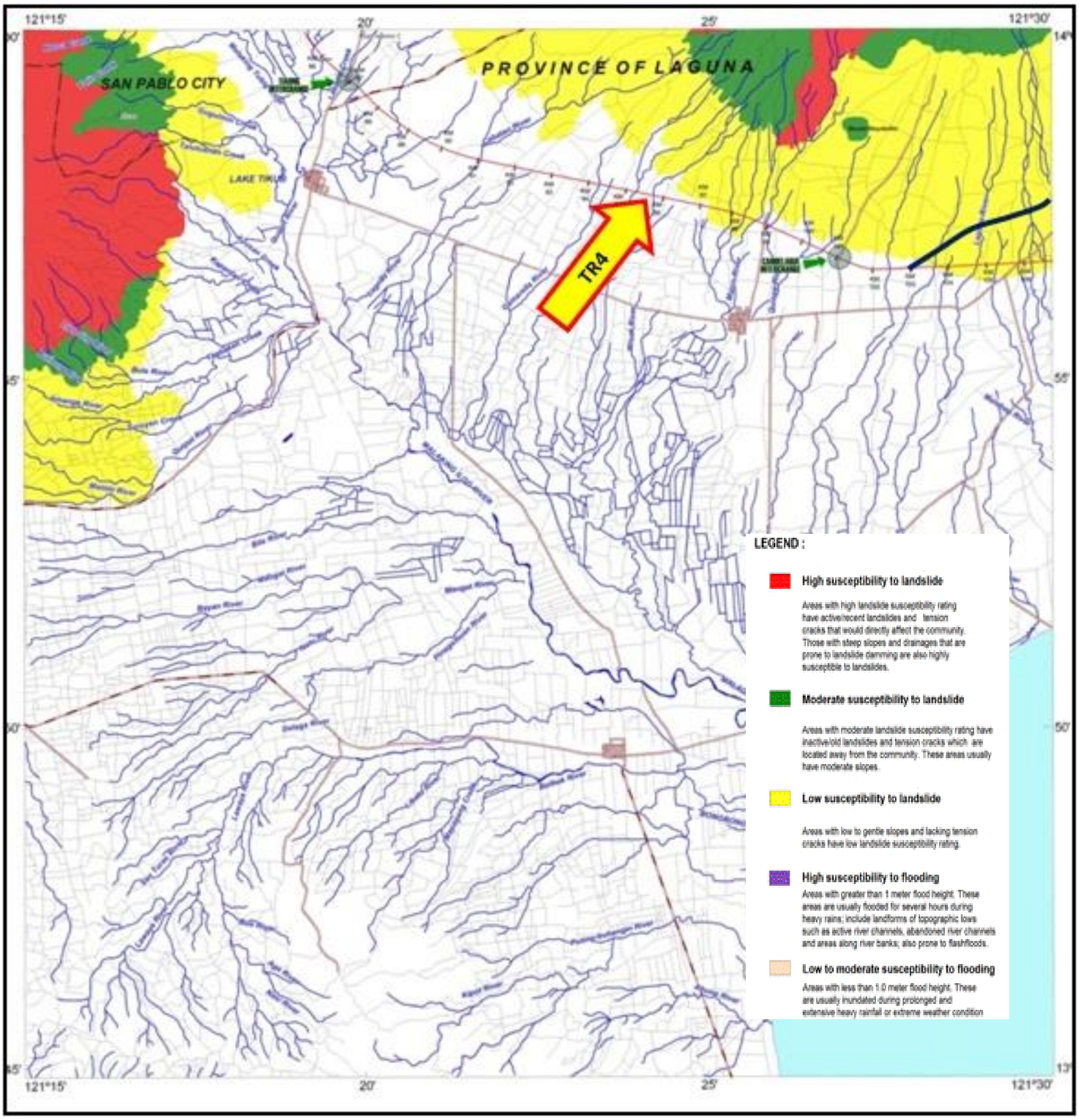
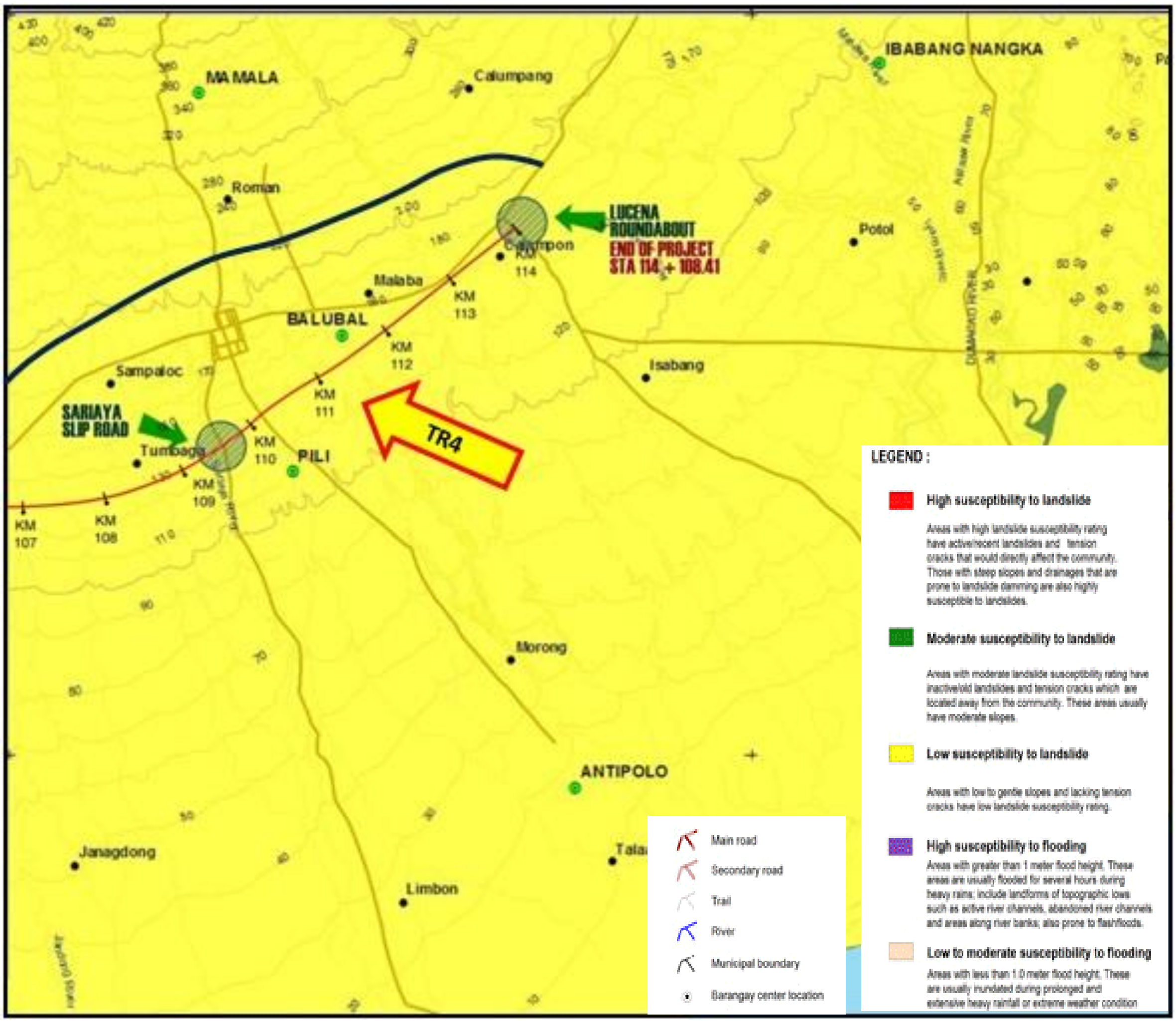


Figure 2-36: Landslide and Flood Susceptibility Map along TR4-B Segment (Makban to San Pablo Interchange)
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)



Note: New Alignment Old Alignment

Figure 2-37: Landslide and Flood Susceptibility Map along TR4-C and TR4-D Segments (San Pablo to Tiaong and Candelaria Interchange)
(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)



Note: — *New Alignment* — *Old Alignment*

Figure 2-38: Landslide and Flood Susceptibility Map along TR4-E Segment (Candelaria to Tayabas City)

(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

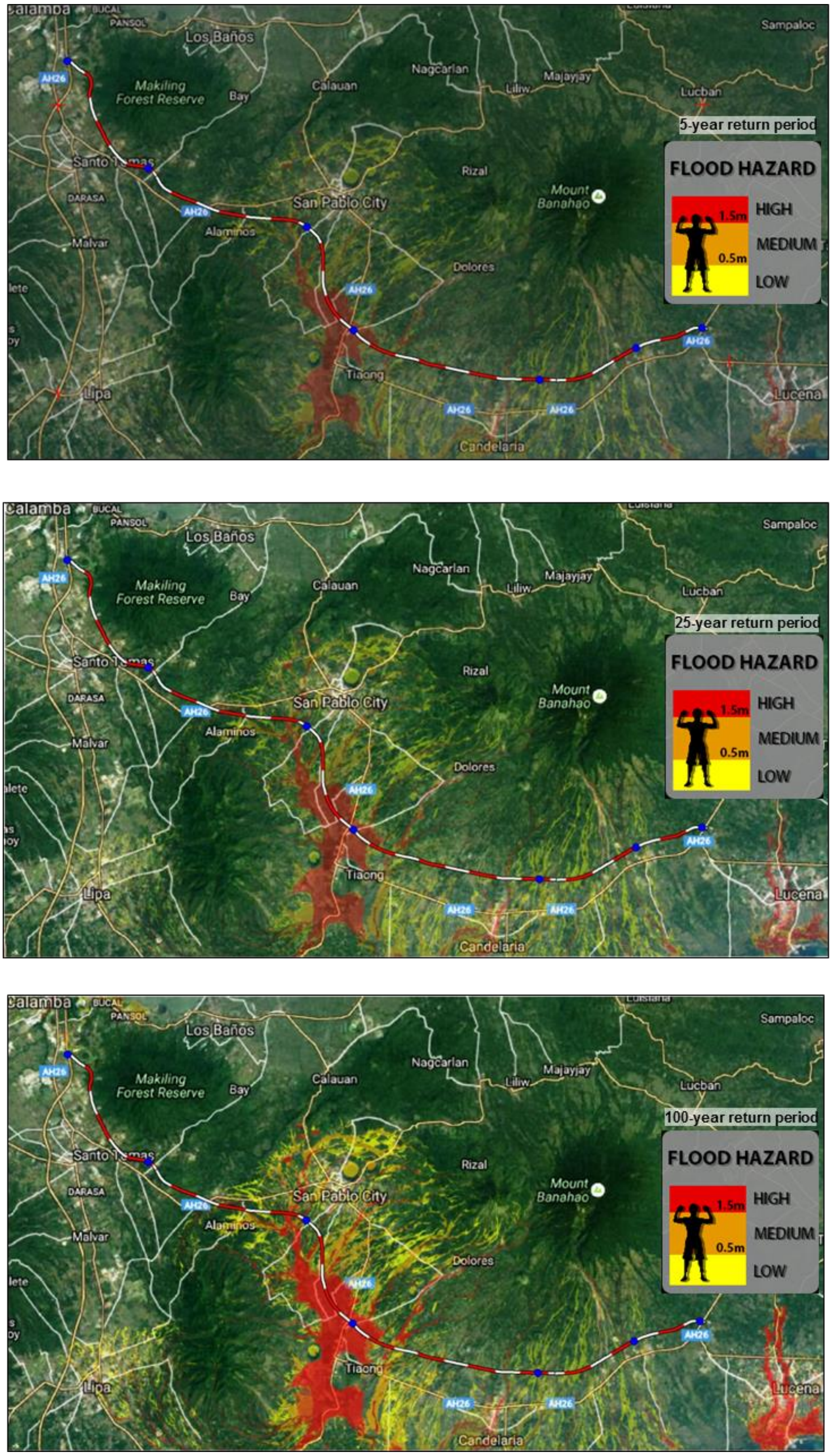


Figure 2-39: Flood Hazard Map for 6-, 25-, and 100-Year Return Period (Source: DOST – Project NOAH)

(Source: Reprinted Basemap from 2014 EIS for the SLEX Phase II TR4 Project)

2.2.1.4 Climate Change

The PAGASA projection on climate change at the project area in 2020 and 2050 under the medium-range emission scenario shows a decrease in rainfall for the dry season and its intensification during the wet season (**Table 2-36**). The increase in the amount of rainfall in 2020 and 2050 during the wet season is projected along the entire alignment of the TR4. In addition, the 2020 occurrence of extreme rainfall event or rainfall of more than 200 mm/day is expected to be more than twice at the northern portion of the project as compared to the observed number of days (**Table 2-36**).

Table 2-36: Seasonal Rainfall Change and Extreme Events in 2020 and 2050

Location	Observed Baseline (1971-2000) mm				Change in 2020 (2006-2035) mm				Change in 2050 (2036-2065) mm				No. of Days w/ Rainfall >200mm		
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	Obs.	2020	2050
Sto. Tomas,	231.0	280.4	856.5	746.4	161.9	212.8	934.4	750.1	205.4	215.6	1003.8	793.4	6	14	9
Calamba City Alaminos San Pablo City	629.2	386.8	845.0	1066.5	502.1	265.0	820.5	1035.6	629.8	252.2	902.5	1109.2	6	14	9
Tiaong Candelaria, Sariaya Tayabas City	827.7	382.7	670.0	1229.3	773.9	311.5	689.4	1293.2	882.3	303.9	713.6	1240.4	17	9	12

Source: PAGASA, 2011

Notes: DJF - December, January, February
MAM - March, April, May
JJA - June, July, August
SON - September, October, November

2.2.1.5 Potential Impacts and Mitigating Measures

2.2.1.5.1 Change in Drainage Morphology

The project operation will not alter the drainage morphology. It is the continuous deposition of sediments / silt during the development or construction that will subsequently affect the drainage morphology in the long run. Unchecked deposition of silt to the river / creek channels will cause overflowing of the river water especially during heavy rains. If this happens, the original drainage pattern will be diverted into lines of water channels finding their ways to the lower ground.

Progressive rehabilitation and tree plantation at the disturbed slopes and water channel banks will stabilize the surface morphology. This could be done during construction until the project operation. In the course of time, water will find its way following the course where nature dictates. A temporary drainage system that will discharge to a sedimentation pond will be constructed during construction. Regular de-silting of the sedimentation pond will be implemented and the subsequent deposition of the excavated sediments to localized depressed areas where nursery and tree planting program could be initiated later. De-silting of ponds will be done whenever necessary especially after heavy rains.

2.2.1.5.2 Change in Stream Depth

Siltation problem will be associated with the scrapping of topsoil during the road construction. Subsequent to uncontrolled siltation, sediments will later fill the stream beds, thus reducing the water depth. Other effect of uncontrolled siltation will be the erosion of channel banks.

In order to address the siltation and erosion impact, slope stability measures should be undertaken together with the development of silt dams / sumps, and through the use of riprap or gabion baskets where applicable. Regular de-siltation should be done on sumps / dams especially after heavy rainfall.

Creeks must be free from any backfilling activity. Any backfilling will adversely dam the creek posing potential intense erosion of backfill materials. Any backfilling beside the creek channel should be provided with retaining wall along the property boundary to protect from flooding, erosion and lateral spread.

The slope stabilization measures could be implemented up to the operation phase or until such time that the waterways are fully stabilized.

2.2.1.5.3 Reduction in Stream Volumetric Flow

Increase in sediment deposition along creek and stream channels will cause reduction in its volumetric flow. As with the reduction in water depth, reduction in the volumetric flow will also adversely affect the aquatic habitat. This will result to decrease in dissolved oxygen, decrease in the area of aquatic habitat, and consequently an increase in resource competition among the aquatic organisms.

During construction, silt dams / ponds should be provided as well as appropriate drainage canals with silt catchment basins to address siltation of river channels. The slope stabilization measures to prevent erosion and siltation during construction could be extended up to operation to facilitate the return to normal condition of the waterways.

2.2.1.5.4 Inducement of Flooding

The stretch of TR4 is included under low susceptibility to flood hazards. However, increase in the surface runoff and subsequent sedimentation will cause overflow of the stream channels. Large amount of sediment and poor quality water after heavy downpour of rain may have detrimental effects downstream of the project site. Extreme rainfall could induce slope failure at the stream banks. If this happens, flooding at the lower grounds could occur.

Other factors that may contribute to flooding are the following:

- Possible increase in the sedimentation of the river / creek channels during construction;

- Vegetation removal resulting to watershed degradation, low infiltration rate, and high surface runoff; and
- Improper waste disposal may develop artificial damming of the waterways and clogging of waste debris in the streams and drainage systems.

The proposed mitigation measures to minimize flooding are the following:

- Conduct of major earthwork activities during summer;
- Establishment and maintenance of slope stabilization measures;
- Provision and regular de-silting of silt ponds during construction;
- Improvement and maintenance of roads and drainage canals; and,
- Proper waste disposal.

The design of TR4 alignment from San Pablo City to Tiaong takes into consideration the maximum flood level of the rivers, the topography of the barangays, farm roads crossings, and the existing railways.

SLTC should also assess the rivers and creeks traversing the flood-prone areas such as in San Vicente, Sto. Tomas and Sariaya for the design of drainage outlets. Reduction of surface runoff to these waterways could be considered by diverting some flow to adjacent waterways, if possible. In addition, SLTC may consider not using these waterways as drainage outlet to prevent or minimize flooding of the areas.

The effect of the projected climate change particularly the increase in the total amount of rainfall and increase occurrence of extreme rainfall should be considered in the structural design and project development. Any abnormal degree of rainfall during typhoons and the southwest monsoon could cause floods when the existing river floodplains overflow.

2.2.1.5.5 Reduction / Depletion of Groundwater

During construction, reduction in groundwater flow may be triggered by the loss of vegetative cover especially at the sloping terrain towards the south of Mt. Makiling and Mt. Banahaw. Removal of vegetation should be confined only to disturbed areas, as necessary. The SLTC should actively participate in the tree planting, and rehabilitation of disturbed areas.

On its operation phase, the project will not entail the use of groundwater as its operation will solely rely on water delivery for the water requirements in the toll plazas.

2.2.1.5.6 Impact on Water Supply

The project will be crossing the source and/or pipeline of the water supply in some areas, particularly in Sariaya and Tayabas City. This could result to blocking of the conveyance system of the water supply and potential degradation of water quality in case of open channel or natural waterways.

The SLTC will be constructing lined waterway if TR4 will be traversing a small stream. The flow will be diverted to a temporary channel that will cross the alignment to maintain the streamflow on both sides of TR4. Provision of silt pond during construction and revegetation of cleared area will be implemented upon construction completion. In case that the waterway is adjacent and flowing parallel to the road, a barrier will be provided to prevent access by the workers during construction.

For Sariaya, the TR4 alignment is adjacent to the water reservoir and will transect the latter's conveyance system. The SLTC will be coordinating and supporting the Sariaya LGU in the *provision of necessary support and/or protection of the existing pipeline*(~~replacement of the existing conveyance system and in locating the pipeline from the reservoir towards its crossing with the TR4 alignment).~~ A stabilization measures could be required to prevent possible rupture or collapse of the reservoir due the ground shaking and movement from the TR4 operation. Depending on the final design to be agreed by the concerned parties, stabilization measures such as provision of concrete lining either along the roadsides, at some sections of the reservoir, or on both facilities will be implemented.

The summary of key potential impacts and proposed mitigating measures are given in **Table 2-37**.

Table 2-37: Key Potential Impacts on Surface Waters and Mitigating Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement
Change in drainage morphology		x x	x		• Progressive rehabilitation and tree plantation at the break of slopes and water channel banks. • Construction and regular de-silting of silt ponds
Change in stream depth		x x x x	x		• Application of slope stability measures to prevent erosion and siltation. • Monitor deposition of silt to the river / creek channels. • Construction and regular de-silting of silt ponds • If possible, no backfilling along the creeks or provide retaining wall along the creek channel if it could not be avoided
Reduction in stream volumetric flow		x x x x	x		• Application of slope stability measures to prevent erosion and siltation. • Monitor deposition of silt to the river / creek channels. • Construction and regular de-silting of silt ponds • If possible, no backfilling along the creeks or provide retaining wall along the creek channel if it could not be avoided
Inducement of flooding		x x x x x x x	x x x x		• Schedule earthworks during summer • Improvement and maintenance of existing road / drainage canals. • Proper waste and garbage disposals • Construction and regular de-silting of silt ponds • Provision and maintenance of slope stabilization measures • The design should consider the topography, maximum flood level, existing structures, etc. • Possible reduction of flow in the waterways traversing flood-prone areas
Reduction of groundwater		x x	x		• Immediate rehabilitation of cleared areas. • Implement tree planting, reforestation and rehabilitation programs.
Obstruction / Reduction in water supply			x		• Provision of lined waterway if the alignment will be traversing a small stream • Diversion of flow to a temporary channel that will cross the road alignment to maintain the streamflow • Coordination and support to the Sariaya LGU *for the provision of necessary support and/or protection of the existing pipeline* • Provision of stabilization measures to prevent possible rupture or collapse of the reservoir due the ground shaking and movement from the TR4 operation
Pollution of water supply		x x			• Provision of barrier in case of adjacent open waterway and flowing parallel to TR4

					• Provision of silt ponds during construction and revegetation of cleared area upon construction completion

P = Pre-Construction; C= Construction, O = Operation; A = Abandonment or Closure

2.2.2 Water Quality

2.2.2.1 Scope

This section characterized the water quality of the major waterbodies along the proposed alignment of the TR4 project. It presents the physical and chemical conditions of the waterbodies based on primary and secondary information.

2.2.2.2 Methodology

Site inspection was conducted to determine the physical condition of the water bodies together with the existing land use and activities in its vicinity. Initially, water samples from ten (10) sampling points at different waterbodies were submitted for laboratory analysis. A second water sampling at 4 sampling points was conducted based on the final configuration of the TR4 re-alignment. **Table 2-38** shows the methods used in the analyses of water quality samples.

Results of water quality analysis (**Annex L**)are compared to applicable DENR guideline values/ standards. Potential key environmental impacts were determined using the World Bank EIA for Road Projects and WB-IFC Environmental Health and Safety Guidelines for roads.
Similar data on the physico-chemical analyses of surface waters that cut across the TR4 alignment have been utilized. These data are results of self- monitoring reports of different industries proximate to the proposed location of TR4.

Table 2-38: Laboratory Methods for the Analyses of Water Quality Samples

Parameter	Method
Total Suspended Solids	Gravimetric
Oil and Grease	Liquid-liquid, partition gravimetric
Dissolved Oxygen	Azide Modification
pH	Electrometric
Biological Oxygen Demand	5 day BOD Test (Azide Modification, Dilution Technique)
Total Coliforms ,MPN/100ml	Multiple-Tube Fermentation (Flurocult Broth, 35^{o}C, 24th)
Fecal Coliforms, MPN/100ml	Multiple-Tube Fermentation (Flurocult Broth, 35^{o}C, 24th)

2.2.2.3 Baseline Water Quality

For the initial water sampling, eight (8) of the 10 waterbodies studied are perennial while the two waterbodies located within Sto. Tomas, Batangas are intermittent. On the northern portion of the project site, majority of the adjoining areas of the waterbodies are residential while in the southern portion are forests. The predominant land use reflects the physical characteristics of the streams wherein the waterbodies located in the northern part are turbid and have slight foul odor, while those in the south are generally clear and odorless. The abovementioned characteristics of waterbodies on the northern and southern portions of the project site is also observed during the second water sampling. The location map of the water quality sampling stations is shown in **Figure 2-40** while the general descriptions of the sampling points are presented in **Table 2-39**.

Table 2-39: Water Quality Stations and Description

Station No.	Location	Main waterbody	Description

WQ01	Brgy. Pulang Lupa (Saimsim), Calamba City	Siam-siam River	Mixed residential and agricultural; near golf-course
WQ02	Brgy. San Antonio,Sto. Tomas, Batangas	Tributary (creek) Munting River	Slightly undisturbed area with nearby agricultural area
WQ03	Brgy. San Miguel, Sto Tomas, Batangas	Munting River	Mixed residential and agricultural area
WQ04	Brgy. San Antonio, Sto.Tomas, Batangas	Tributary (creek) Munting River	Pristine area at the foot of Mt Makiling
WQ05	Brgy. San Miguel, Alaminos, Laguna	Tarac River	Mixed residential slight dense and agricultural area
WQ06	Brgy. Kabatang, Tiaong, Quezon	Kabatang River	Near foot of Mt. Banahaw
WQ07	Brgy. Lagalag, Tiaong, Quezon	Tributary (creek) of Kabatang River	Near foot of Mt. Banahaw
WQ08	Brgy. Masalukot 1, Candelaria, Quezon	Toguan River	Near foot of Mt. Banahaw
WQ09	Brgy. Tumbaga 1, Sariaya Quezon	Mamala River	Largely agricultural land
WQ10	Brgy. Isabang, Tayabas, Quezon	Tributary (creek) at the foot of Mt. Banahaw	Largely agricultural land
WQ11	betweet Himlayo Road and Sampaloc Road, Sariaya, Quezon	Himlayo Creek, tributary of Sariaya River	Largely agricultural land with slight residential near the road
WQ12	Cabaong Bridge, Brgy. San Vicente, Sto. Tomas, Batangas	San Vicente Creek	Mixed residential and agricultural area
WQ13	Calumpang Road, Tayabas City	Unnamed creek	Largely agricultural land with slight residential near the road
WQ14	Brgy. Gibanga, Sariaya	Gibanga River, tributary of Mamala River	Largely agricultural land with slight residential near the road

Note: Stations in Italics were sampled for the 2014 EIS of TR4 Project.

All 10 waterbodies in the initial water sampling were in non-conformance with the standard for total coliform, while two exceeded the standard values of DO and BOD. The two waterbodies (i.e., WQ01 and WQ03) are located within residential areas where solid wastes are usually dumped in the waterbodies resulting in low DO and high BOD. All sampling stations also serve as main receiving bodies for manure/feces resulting in the high total coliform count. (**Table 2-40**).

For the 2nd water sampling, the 3 waterbodies to be traversed by TR4-E were in conformance with the standard for total coliform while only 1 waterbody showed conformance with the standard for dissolved oxygen. The other sampling point, which is along TR4-A, showed non-conformance with the standards for DO, BOD, and total coliforms just like the waterbodies in the northern section during the initial sampling. This sampling point also exceeded the standard for oil & grease.

Figure 2-40: Location of Water Quality Stations

Table 2-40: Result of Water Quality Analysis

Sampling Station and Location	Geographic Coordinates	Date of Sampling*	pH	DO (mg/L)	BOD (mg/L)	TSS (mg/L)	Oil & Grease (mg/L)	Total Coliform (MPN/100mL)	Fecal Coliform (MPN/100mL)
WQ01 Brgy. Pulang Lupa (Saimsim) Calamba City	N 14° 08' 33" E 121° 09' 01"	-	7.9	<0.1	67	10	<0.1	2.3 x 10^6	2.3 x 10^6
WQ02 Brgy. San Antonio,Sto. Tomas	N 14° 07' 37" E 121° 09' 44"	-	7.9	7.7	2	6.4	<0.1	6.8 x 10^4	2.0x10^4
WQ03 Brgy. San Miguel, Sto Tomas	N 14 05' 46" E 121° 10' 21"	-	7.8	<0.1	70	25	<0.1	2.8 x 10^6	1.7 x 10^6
WQ04 Brgy. San Antonio, Sto.Tomas	N 14° 07' 11" E 121° 09' 46"	-	7.8	5.2	6	1.3	<0.1	4.5 x 10^4	2.0 x 10^4
WQ05 Brgy. San Miguel, Alaminos	N 14° 03' 23.7" E 121° 15' 4.5"	-	6.9	6.1	4	5	<0.1	4.9x10^5	2.3 x 10^5
WQ06 Brgy. Kabatang, Tiaong, Quezon	N 13° 56' 27" E 121° 22' 48"	-	7.9	8.4	<0.1	9	<0.1	1.7x10^4	1.3 x 10^4
WQ07 Brgy. Lagalag, Tiaong, Quezon	N 13° 57' 37" E121° 21' 18"	-	7.7	8.8	2	3	<0.1	4.9 x 10^5	2.3 x10^4
WQ08 Brgy. Masalukot 1, Candelaria	N 13° 56 55.5 E121° 25 55.8	-	8	7.5	2	2	<0.1	3.3x10^4	2.3x10^4
WQ09 Brgy. Tumbaga 1, Sariaya	N 13° 56' 30" E 121° 31' 29"	-	7.9	8.3	<1	2.4	<0.1	2.3x10^4	2.3x10^4
WQ10 Brgy. Isabang, Tayabas City	N 13° 58' 7.2" E 121° 33' 8.8"	-	8	8.5	1	10	<0.1	7.9x10^4	4.9x10^4
WQ11 betweet Himlayo Road and Sampaloc Road, Sariaya, Quezon	N 13° 58' 3.9" E 121° 31' 7.5"	June 3, 2016	7.1	4.55	ND	ND	ND	3.3x10^3	7.9x10^2
WQ12 Cabaong Bridge, Brgy. San Vicente, Sto. Tomas	N 14° 5' 42.1" E 121° 10' 4.0"	June 3, 2016	7.9	3.2	27.9	28.8	2.58	3.5x10^6	2.8x10^5
WQ13 Calumpang Road, Tayabas City	N 13° 58' 24.9" E 121° 33' 15.3"	June 3, 2016	6.9	3.36	ND	14.0	ND	3.3x10^3	1.7x10^3
WQ14 Brgy. Gibanga, Sariaya	N 13° 58' 7.3" E 121° 32' 54.0"	June 2, 2016	6.7	6.49	2.67	ND	ND	4.9x10^3	2.3x10^3

Sampling Station and Location	Geographic Coordinates	Date of Sampling*	pH	DO (mg/L)	BOD (mg/L)	TSS (mg/L)	Oil & Grease (mg/L)	Total Coliform (MPN/100mL)	Fecal Coliform (MPN/100mL)
DENR Standard (Class C)			6.5-8.5	5	7(10)[a]	b	2	5000[c]	

Notes: a- maximum values
b-not more than30mg/L
c- Geometric mean during a 3 month period not to be exceeded in 20% of the samples.
*****- *Date of Sampling not indicated in the 2014 EIS of TR4 Project.*
WQ01 - Stations in Italics were sampled for the 2014 EIS of TR4 Project.

The results of the water sampling are supported by the secondary data information gathered from the DENR Region 4A monitoring (**Table 2-41**).

Table 2-41: Secondary Data on Water Quality of Surface Waters in the Study Area

Location	BOD_5	NH_3	Chlorides, mg/L	Color	DO, mg/L	pH	PO4	TSS
Calamba City – Sto.Tomas								
Siam-Siam	6.13	1.41	138	100	7.1	7.19	0.161	6
Munting River	5.24	1.413	57	100	6.3	8.05	0.211	2
Makban - San Pablo City								
Tigas	4.89	1.206	37	100	5.9	7.14	0.284	4
Buboy	5.28	0.926	40	100	6.2	7.81		
Bucal	6.34	1.446	23	100	6.4	7.62	0.094	1
Matandan	4.25	0.118	15	100	8.2	8.04	0.388	3
San Pablo-Tiaong								
Tarac	3.59	1.174	44	100	5.2	7.26	0.277	4
Balatuin	5.69	1.129	35	50	5.2	7.21	0.381	12
Macampongo	5.58	0.017	18	100	4.6	7.66	0.096	9
Banadero	4.97	0.094	14	100	7.4	7.95	0.112	6
Malaonod	5.03	<0.001	4	50	8	8.25	0.228	2
Balanga	5.66	0.269	32	50	6.26	8.15	0.339	10
Tiaong - Candelaria								
Cabatantaguna	5.66	0.375	59	25	5.23	7.59	0.354	8
Maasin	1.66	0.013	6	15	8.33	8.26	0.248	4
Quiapo	6	0.105	12	40	7.33	7.98	0.149	13.3
Candelaria – Tayabas City								
Lagnas	5.91	0.515	8	100	7.7	8.14	0.321	7
Guisguis	6.13	1.126	38	50	3.7	7.87	0.169	5

Source: DENR CALABARZON Self-Monitoring Record, 4th Quarter 2012

2.2.2.4 Potential Impacts and Mitigating Measures

During construction, the earthmoving activities could result to sedimentation of water bodies particularly during the rainy season. The influx of workers in the area may also affect the discharge of human waste and domestic wastewater to the streams. Improperly disposed garbage in the area may also be carried by surface runoff to the streams. There is also a possibility of increase in oil and grease due to accidental oil spill, oil leaks from vehicle and equipment, and improper disposal of oily materials including used oil during repair and maintenance.

2.2.2.4.1 Sedimentation of Surface Water

During construction phase, erosion along the river crossings is expected to intensify due to vegetation removal, soil disturbance and exposure of bare soil surface. In addition, soil erosion is anticipated at bridge and culvert construction sites. Furthermore, activities such as cuttings and fillings will initiate soil erosion within the road alignment and access roads to these areas. The problem will be more pronounced if these construction activities are conducted during rainy season.

The potential sedimentation of surface waters could be mitigated by:

- Avoid construction activities during monsoon;
- Maintain embankment slope ratio of 1:2;
- Compliance to design standards on treatment of embankment slopes for control of erosion;
- Stone pitching and retaining structures shall be provided to control soil erosion, whenever necessary;
- Turfing of embankment slopes particularly near bridge locations;
- Construction of silt traps at regular points along the road; and,
- Immediate cleaning of all construction debris to prevent the erosion of unconsolidated soil.

The project operation is not expected to contribute to sedimentation if the abovementioned design criteria will be implemented.

2.2.2.4.2 Contamination of Surface Water

Increased generation of solid wastes during construction may result from the temporary increase of workers. If proper waste management will not be implemented, the domestic wastes may eventually find its way to nearby waterbodies of the project. As such, the contractors and subcontractors during the construction period will be required to implement a waste management plan. The waste management plan will include provision for portable toilet facilities in areas where there is possible congregation of workers and construction personnel such as temporary office, workers' camps and work area.

To avoid contamination of waters, no wastewater will be disposed without treatment. This will include the treatment of sewage through septic tank and interception of all oil-contaminated wastewater for oil recovery prior to disposal. All petroleum-based storage and handling areas will be paved to prevent groundwater contamination and facilitate easy clean-up and recovery of spills. In addition, prohibition on the cleaning of tools and equipment on or near rivers, canals, and other waterbodies will be imposed. To conserve water and promote recycling, no potable water will be used for dust suppression.

The Contractor will arrange training program to all equipment operators, drivers, and warehouse personnel on immediate response for oil spill and eventual cleanup. In addition, emergency procedures and reports preferably written in easy to understand local dialect will be distributed to the equipment operators, drivers and warehouse personnel. Silt fencing and/or brush barrier will be installed for collecting sediments. Collected silt/sediment will be stockpiled for possible reuse. All wastes arising from the construction sites will be segregated and disposed of according to environmental regulations. Wastes will be collected, treated (e.g., sewage through septic tank) or stored (e.g. waste oil, lubricants, and paints) prior to disposal or transported to the approved disposal sites. No vehicle or equipment will be washed, parked or refueled near a waterway. All labor camps will be located at least 500 meters from rivers, and to the extent possible, laborers will be locally recruited to avoid large camps. Sewage from labor camps will be treated through septic tanks. No untreated sanitary wastewater will be discharged into the river.

Along the section of the road alignment with construction activity, all major waterbodies to be affected, will be monthly monitored. Upstream and downstream water quality parameters will be collected to determine the effectiveness of implemented mitigation measures.

During operation, waste generation that could contaminate the surface waters include domestic wastewater at toll plazas and possible oil spill and leaks at oil storage areas. The toll plazas will have toilet facilities with septic tank for regular siphoning while a paved used oil storage area will be designated for the storage of used oil and oil-contaminated materials that are used in the clean-up in case of oil spill or leak.

Table 2-42 is the summary of the potential impacts on water quality and the proposed mitigating measures.

Table 2-42: Potential Impact on Surface Water Quality and Mitigating Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement
Sedimentation of rivers		x			• Avoid construction activities during monsoon
		x	x		• Maintain embankment slope ratio of 1:2
		x			• Compliance to design standards on treatment of embankment slopes
		x	x		• Stone pitching and/or provision of retaining structures, if necessary
		x	x		• Turfing of embankment slopes particularly near bridge locations
		x			• Construction of silt traps at regular points along the road
		x			• Immediate cleaning of all construction debris to prevent erosion of unconsolidated soil
Water quality deterioration		x	x		• Training of concerned personnel on immediate response to oil spill contamination and cleanup
		x			• Provision of silt fence and/or brush barrier for collecting sediments
		x			• Stockpiling of collected silt/ sediment for possible reuse
		x	x		• Disposal of solid wastes according to environmental regulations
		x	x		• Collection and treatment of hazardous wastes prior to final disposal
		x			• Prohibit parking, cleaning and repair of vehicle or equipment near the waterbody
		x			• Location of labor camps at least 500 meters from a waterbody
		x			• Prioritize hiring of local residents
		x			• Provision of septic tanks in the labor camps
		x	x		• Provision of toilet facilities in the toll plazas
		x	x		• Designation of a paved used oil storage area for the storage of used oil and oil-contaminated materials

P = Pre-Construction; C= Construction, O = Operation; A = Abandonment or Closure

2.2.3 Freshwater Ecology[9]

The waterbodies investigated for the re-alignment were either intermittent or quite shallow and did not warrant the conduct of aquatic ecology assessment. Thus, the freshwater ecology presented in this section was taken from the 2014 EIS of TR4 Project.

2.2.3.1 Scope

Assessment of freshwater habitats in target locations to be traversed by the TR4 Project sought to:

- Describe stream fauna represented by fishes, macro-crustaceans, and other freshwater invertebrate faunal assemblages;
- Determine the density, diversity, and distribution of aquatic fauna within the study area;
- Assess the potential direct and indirect impacts of the project on aquatic ecology;
- Assess the conservation status of aquatic fauna based on national legislation.

2.2.3.2 Methodology

Sampling for freshwater fauna was conducted only in Lagnas River, Barangay Anastacia, Tiaong, Quezon (***Plate 2-24***) since majority of the sites had dry riverbeds during the time of sampling or there was little flowing water (***Plate 2-25*** and **Figure 2-41**).

2.2.3.2.1 Field Sampling

This study employed a standard D-frame Dipnet for sampling freshwater biota, following the guidelines suggested by the US Environmental Protection Agency Rapid Bio-assessment Protocol II (Barbour et al., 1999) using the combined single and multi-habitat approach with some modifications. Brief reconnaissance of the study area was first conducted. Presence of streams and other types of freshwater systems were recorded as the catchment sites. Sampling stations per sites were established starting from the most downstream part.

A transect belt was used to space successive sampling stations 50 meters apart. Establishment of new stations was made continuously until the boundary of the study area was reached. Coordinates of sampling stations were taken using a GPS. Prior to sampling, physical and other in-stream attributes were recorded. These include substrate type, velocity of water flow, depth, width, turbidity, and riparian vegetation cover.

2.2.3.2.1.1 Sample Processing and Identification

Silts and other fine sediments were removed from the samples with the use of a hand-held strainer with 0.5 mm pore size. Sieved specimens were then placed in a 4x4 plastic bags and filled with stream water. After all field collections were done, samples were sorted and placed in plastic cups and then fixed with 95% ethanol or 10% formalin solution. Samples were labeled properly taking into account unique morphological characters recorded since postmortem changes may pose problem during identification.

Species identification was done with the help of multi-volume Guide to Philippine Flora and Fauna and FAO field guide for species identification. Taxonomic keys available from the net were also used and some fishes were identified through the help of Fishbase (*www.fishbase.org*). Specimens were then sorted according to species and their abundance per station was noted.

[9]*Adapted from 2014 EIS for the SLEX Phase II TR4 Project*

2.2.3.2.1.2 Ecological Measurements

Ecological measurements for each catchment site were limited to *Total Density*, *Relative Density*, and *Species Diversity* calculations since there were generally zero catches in majority of the sampling stations (Brower, 1989). The ff. equations are used for the ecological measurements:

1. Density is the number of individuals per unit area, $Di = ni / Ai$, where Relative Species Density (RD_i) is the number of individuals (D_i) of a given species (n_i) as a proportion of the total number of individuals of all species ($\sum D_i$) in a given area:

$$RDi = \frac{Di}{\sum Di} x100$$

2. Species diversity was computed using Simpson's index of diversity, where a value close to 1.0 is considered highly diverse.

$$Ds = \frac{\sum ni(ni-1)}{N(N-1)}$$

Plate No. 2-24: Lagnas River, Brgy. Anastacia, Tiaong, Quezon
(N 13° 58' 21.0" E 121° 21' 42.8" Elevation: 76 m)
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

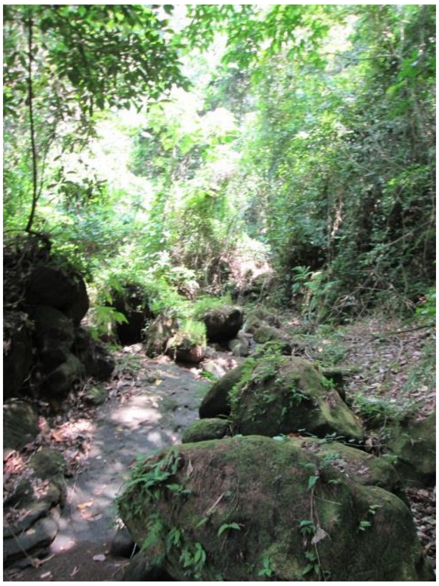
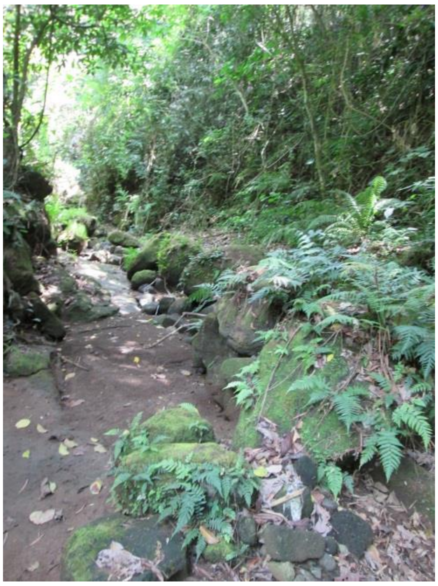

Upstream


Downstream


Upstream


Downstrea

Plate No. 2-25: Dry river/creek beds in sampling stations in Laguna and Batangas
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

Brgy. Camaligan, Calamba, Laguna
N 14° 09' 40.8" E 121° 09 18.0 Elevation: 112 m


Elat River, Calamba, Laguna
N 14° 09' 37.2" E 121° 08' 36.3" Elevation: 142 m


Brgy. San Miguel, Sto.Tomas, Batangas
N 14° 06' 20.2" E 121° 10' 37.1"Elevation 201 m

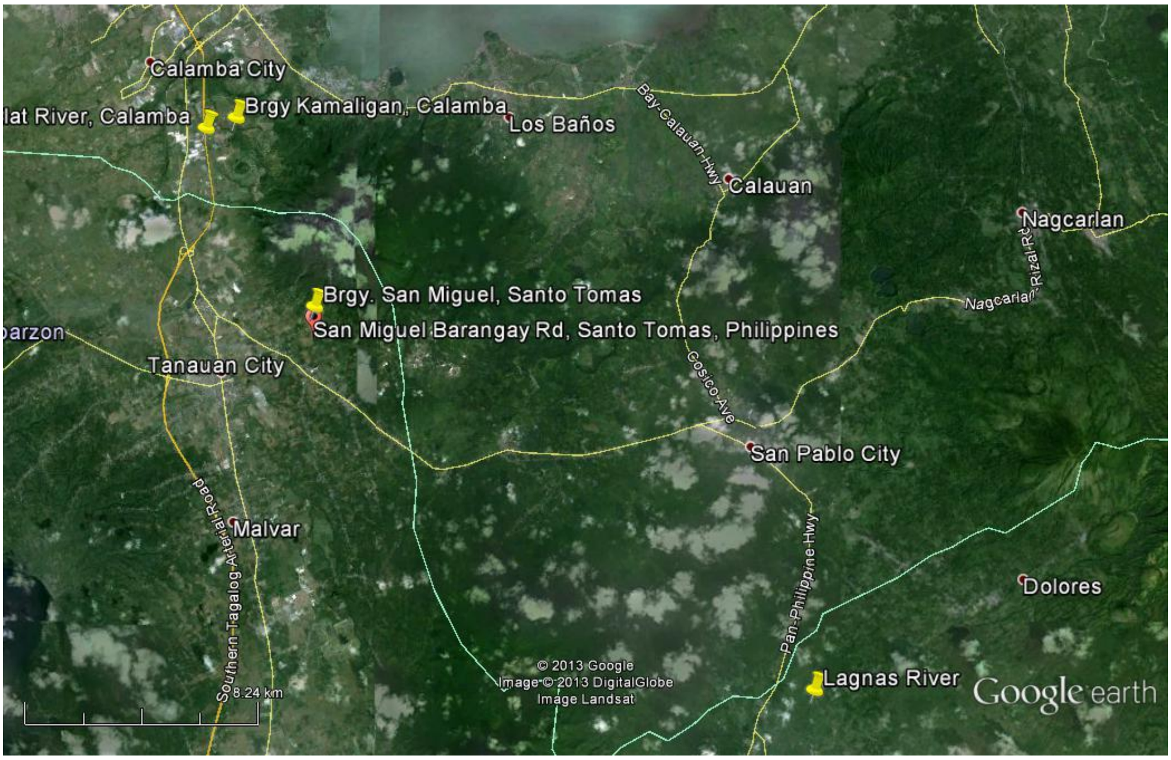


Figure 2-41: Location of Sampling Stations for Freshwater Ecology
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

2.2.3.3 Baseline

A total of 36 individuals of aquatic fauna were collected from Lagnas River, this includes five species of freshwater fish, one crab, one shrimp, and two species of molluscs (***Plate 2-26 to 27***). Across all stations, freshwater biota was dominated by suso (*Thiara sp*.) with a relative density of 28%, followed by bakuli hipon (goby) and “danglin”, with relative density values of 25% and 19%, respectively (**Figure 2-42**). Species diversity is low with an SID value of 0.78. The low density of freshwater biota in Lagnas River may be attributed to overfishing (***Plate 2-28***), wherein local fish population could not recover from heavy exploitation pressure.

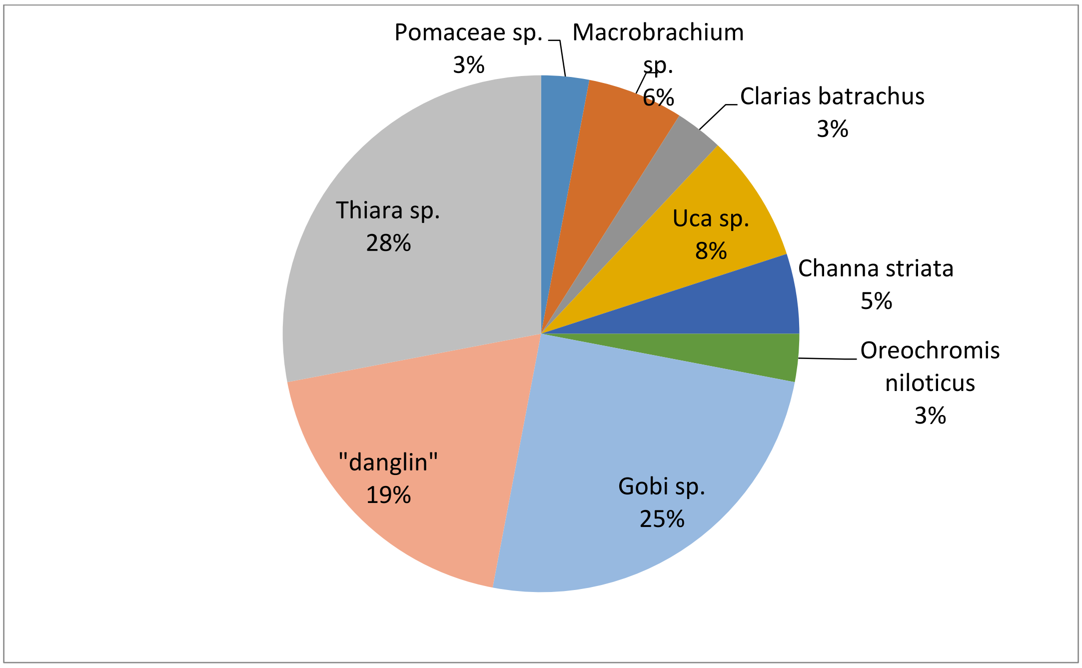


Figure 2-42: Relative density of freshwater biota collected from Lagunas River, Tiaong, Quezon
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

Plate No. 2-26: Representative freshwater biota from LagnasRiver, Tiaong, Quezon
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

Dalag (*Channa striata*)

Suso *(Thiara sp.)*

Kuhol *(Pomacea sp)*

Dalag (*Channa striata*)

Hito (*Clarias batrachus*)

Talangka *(Uca sp)*.

Plate No. 2-27: Representative freshwater biota from LagnasRiver, Tiaong, Quezon
(Source: Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

Hipon (Macrobrachium sp).

Bakuling Hipon (Goby)

Tilapia (*Oreochromis niloticus*)

Plate No. 2-28: Overfishing contributes to drying of river or creek beds in sampling stations in Laguna and Batangas

(Source:Adapted from 2014 EIS for the SLEX Phase II TR4 Project)

'Pamana' (handmade spear)

Residents using pamana (spear) for fishing

Drying of river bed to capture dalag and hito

2.2.3.3.1 Presence of Pollution Indicator Species

Lagnas River is generally pristine but species diversity and population density are very low. Tilapia, an exotic species and being generally pervasive in the country has already invaded Lagnas River. Presence and/or absence of bakuling hipon may be proposed as a bio-monitor to indicate pollution of Lagnas River. The absence of the most common freshwater fauna (*Thiara sp.*) suggests deterioration of the water quality of the river while the presence of rare freshwater fauna (bakuling hipon) is indicative of high water quality.

2.2.3.4 Potential Impacts and Mitigating Measures

Preliminary construction works such as road clearing can easily generate loose materials that could be carried by surface runoff during rainfall and causing the siltation of creeks, streams, and rivers. This may result in the reduction of light penetration subsequently limiting the growth of organisms. During actual construction of roads and support structures, more areas will be cleared increasing the volume of easily erodible loose earth materials. This may result to loading of organic materials in the freshwater bodies and may subsequently result to eutrophication, which is detrimental to freshwater organisms.

A drainage system should be properly constructed along strategic areas to minimize siltation during a heavy downpour. If possible, it should be supplemented with commercially available, silt curtains, geotextiles, or coconets. Silts that accumulate should be removed regularly and disposed of properly or buried and overlain with vegetation to minimize further mobilization.

In case of bridge construction or installation of culvert as stream passageway, regular sedimentation and blocking of fish passage could occur. For dry creek, the use of cofferdams with gravity bypass line will be constructed to bypass the flow. On the other hand, a piped flow bypass or isolation barrier will be installed depending on the flow rate and fish passage requirements for waterbody with regular baseflow. For sediment control, off-stream sediment trap/basin will be provided on both sides of the stream. The sediment basin will be operational during the bridge construction until the revegetation of the area.

No negative impact is expected during the project operation since there will be no discharge effluents in the waterbodies. However, long-term quarterly monitoring of aquatic fauna primarily during the construction phase will provide meaningful ecological information to determine the impacts of road operation on the faunal population dynamics of the river catchments.

Table 2-43: Potential Impact on Freshwater Ecology and Mitigating Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement
Siltation of freshwater bodies from road construction reducing the growth and development of organisms. High volume of organic materials in freshwater may result in eutrophication Blocking of fish passage during construction of brige or stream passageway		x x x x x	x		• Properly constructed drainage system along strategic areas to minimize siltation during a heavy downpour supplemented with commercially available silt curtains, geotextiles, or coconets. • Regular removal of accumulated silts and proper disposal or storage to minimize further mobilization. • Installation of cofferdam with gravity bypass line for dry creek • Installation of piped flow bypass or isolation barrier for stream with regular flow • Operation of off-stream sediment trap/basin on both sides of the stream

Notes: P = Pre-Construction; C= Construction, O = Operation; A = Abandonment or Closure

2.3 The Air

2.3.1 Meteorology

2.3.1.1 Scope

This section presents the description of the climate of the proposed TR4 project site considering the PAGASA-Synoptic Stations that likely represents the meteorological conditions of the proposed project route. This section also presents the climate change projections in 2020 and 2050 in the provinces of Batangas and Quezon based on PAGASA (2011) study.

2.3.1.2 Methodology

This study considered two (2) synoptic stations of PAGASA located in Ambulong, Batangas and Tayabas City, Quezon. These synoptic stations are selected because of its proximity to the proposed project site, as shown in **Figure 2-43**. PAGASA-Ambulong, Batangas is about 12 km from the proposed Sto. Tomas Interchange in Sto. Tomas, Batangas while PAGASA-Tayabas Station is about 5.7 km from Tayabas Interchange in Tayabas City, Quezon. The climatological normals and extremes at PAGASA-Ambulong Station and PAGASA-Tayabas Station are shown in **Table 2-44 to Table 2-45, and Table 2-46 to Table 2-47**, respectively.

The climate change study of PAGASA (2011) was used to determine changes of rainfall, temperature, and extreme weather events in the provinces (Batangas and Quezon) where the proposed project traverses.

Figure 2-43: Locations of the proposed TR4 project and PAGASA's synoptic stations

Table 2-44: Climatological Normals of PAGASA- Ambulong Synoptic Station (1981-2010)

Month	Rainfall		Temperature (°C)						Vapor Pressure (mbar)	%RH	MLSP (mbar)	Wind		Cloud Amt. (okta)	No. of Days	
	Amount (mm)	No. of Rainy Days	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Direction (16pt)	Speed (m/s)		TSTM	LTNG
JAN	22.7	5	30.4	22.2	26.3	25.9	23.1	22.0	26.3	79	1012.7	NE	2	5	0	0
FEB	16.0	3	31.6	22.1	26.9	26.4	23.3	22.1	26.5	77	1012.6	NE	2	4	0	0
MAR	21.5	3	33.2	22.9	28.1	27.7	24.1	22.8	27.5	74	1011.7	NE	2	4	1	1
APR	35.0	4	34.5	23.9	29.2	29.0	25.1	23.8	29.2	73	1010.2	NE	1	4	5	5
MAY	116.6	10	33.9	24.6	29.2	29.1	25.7	24.6	30.7	76	1008.5	NE	1	5	13	14
JUN	228.7	16	32.5	24.6	28.6	28.4	25.6	24.7	30.9	80	1008.3	SW	1	6	15	15
JUL	329.6	19	31.4	24.1	27.8	27.6	25.3	24.5	30.6	83	1008.2	SW	1	6	17	16
AUG	286.9	18	31.0	24.3	27.6	27.5	25.3	24.5	30.7	84	1007.6	SW	2	6	12	12
SEP	255.0	17	31.4	24.1	27.8	27.5	25.3	24.5	30.7	84	1008.5	SW	1	6	14	14
OCT	218.4	15	31.6	23.9	27.7	27.4	25.1	24.3	30.3	83	1009.4	NE	1	6	9	14
NOV	144.7	13	31.4	23.6	27.5	27.1	24.6	23.7	29.2	81	1010.3	NE	2	5	2	6
DEC	92.0	9	30.2	22.8	26.5	26.2	23.6	22.6	27.3	80	1011.8	NE	2	5	0	1
Annual	1767.0	132	31.9	23.6	27.8	27.5	24.7	23.7	29.2	80	1010.8	NE	2	5	88	98

Source: Climate and Agrometeorology Division, PAGASA

Latitude: 13°08'18" N
Longitude: 123°44'00" E
Elevation: 17.0 m

Notes:
VP – Vapor Pressure
mbs – millibar
MSLP – mean sea level pressure
Dir – direction
TSTM – thunderstorm
LTNG – lightning

Table 2-45: Climatological Normals of PAGASA-Tayabas City, Quezon (1981-2010)

Month	Rainfall		Temperature (°C)						Vapor Pressure (mbar)	%RH	MLSP (mbar)	Wind		Cloud Amt. (okta)	No. of Days	
	Amount (mm)	No. of Rainy Days	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Direction (16pt)	Speed (m/s)		TSTM	LTNG
JAN	163	18	27.7	21.9	24.8	24.2	22.5	21.8	26.1	86	1013	N	2	6	0	0
FEB	111.4	13	28.5	22	25.3	24.6	22.7	21.9	26.3	85	1013	NE	2	5	0	0
MAR	107.1	10	30	22.8	26.4	25.7	23.6	22.8	27.7	84	1012	NE	2	5	1	1
APR	109.5	9	31.8	23.8	27.8	27.2	24.6	23.7	29.1	81	1011	NE	1	4	4	5
MAY	161.2	10	32.4	24.2	28.3	27.6	25.1	24.2	30.1	82	1009	NE	1	5	15	17
JUN	225.5	15	31.7	24	27.9	27.3	25.1	24.3	30.3	84	1008	S	1	6	17	18
JUL	273.8	18	31	23.6	27.3	26.8	24.8	24.1	29.9	85	1008	SW	1	6	16	17
AUG	185.1	17	31.1	23.6	27.4	26.7	24.7	24	29.7	85	1007	SW	1	6	13	13
SEP	274.2	18	30.9	23.3	27.1	26.5	24.6	23.9	29.6	86	1008	SW	1	6	16	16
OCT	494.1	22	30.2	23.4	26.8	26.2	24.4	23.7	29.3	86	1009	N	1	6	11	12
NOV	529.7	23	29.3	23.3	26.3	25.7	24	23.4	28.7	87	1010	N	2	6	5	5
DEC	421	22	27.9	22.4	25.1	24.5	22.9	22.2	26.8	87	1012	N	2	6	1	1
Annual	3055.8	198	30.2	23.2	26.7	26.1	24.1	23.3	28.6	85	1010	N	1	6	99	105

Source: Climate and Agrometeorology Division, PAGASA

Latitude: 14°00’53.11” N
Longitude: 121°36’07.59” E
Elevation: 158.0 m

Notes:

VP – Vapor Pressure
mbs – millibar
MSLP – mean sea level pressure
Dir – direction
TSTM – thunderstorm
LTNG – lightning

Table 2-46: Climatological Extremes at PAGASA-Ambulong Synoptic Station (as of 2014)

MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (mm)		HIGHEST WIND (m/s)			SEA LEVEL PRESSURE			
	HIGH	DATE	LOW	DATE	AMT.	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN	34.9	01-03-1958	16.0/ 16.0	01-09-1985/ 01-14-2014	118.1	01-01-1960	20	ENE	01-29-1989	1022.1	01-30-1998	1004.1	01-05-1999
FEB	37.2	02-28-1985	16.1	02-03-1976	92.7	02-21-2013	24	NE	02-06-1982	1022.2	02-01-1962	1003.7	02-08-1985
MAR	38.0	03-30-1984	16.2	03-03-1963	60.6	03-24-1980	22	ENE	03-10-1989	1021.3	03-30-1958	1002.9	03-27-2001
APR	38.3	04-05-1987	17.5	04-05-1963	57.0	04-23-1996	18	SE	04-25-1989	1019.4	04-04-1998	1001.5	04-06-1994
MAY	38.8	05-15-1921	20.0	05-21-1974	499.2	05-21-1976	41	SW	05-17-1989	1015.8	05-02-1998	987.3	05-17-1989
JUN	38.0	06-14-1983	20.6	06-18-1976	301.5	06-27-1961	40	SW	06-23-1984	1016.2	06-07-1997	987.4	06-29-1964
JUL	36.8	07-15-1999	19.2	07-19-2014	218.5	07-13-2010	75	W	07-15-1983	1015.9	07-22-1959	972.1	07-04-2001
AUG	36.7	08-23-1969	20.5	08-11-1996	283.6	08-24-1990	40	NNE	08-12-1987	1015.3	08-23-1999	995.2	08-12-1987
SEP	35.7	09-14-1984	19.5	09-04-1991	270.8	09-05-1962	54	SSW	09-09-1982	1015.7	09-05-1953	987.7	09-09-1982
OCT	37.3	10-11-1975	18.9	10-31-1969	183.2	10-28-2000	70	S	10-11-1989	1017.3	10-28-1960	977.4	10-10-1989
NOV	36.5	11-02-1956	18.3/ 18.3	11-29-1974/ 11-22-1975	277.2	11-03-1995	45	NE	11-25-1987	1020.0	11-27-2001	978.6	11-03-1995
DEC	35.3	12-25-1962	16.8	12-16-1960	151.9	12-09-1971	54	NE	12-30-1950	1024.2	12-27-2001	996.2	12-05-1993
Annual	38.8	05-15-1921	16.0	01-09-1985/ 01-14-2014	499.2	05-21-1976	75	W	07-15-1983	1024.2	12-27-2001	972.1	07-04-2001
Period of Record	1919-2014				1949-2014		1950-2014			1949-2014			

Source: Climate and Agrometeorology Division, PAGASA

Table 2-47: Climatological Extremes at PAGASA-Tayabas Synoptic Station (as of 2014)

MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (mm)		HIGHEST WIND (m/s)			SEA LEVEL PRESSURE			
	HIGH	DATE	LOW	DATE	AMT.	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN	32.0	01-22-1988	17.5	01-20-1976	78.3	01-11-2013	17	NE	01-13-2000	1020.0	01-21-2005	1000.5	01-09-1972
FEB	32.5	02-25-2005	16.8	02-02-1982	137.2	02-21-2013	21	N	02-22-1977	1019.9	02-02-1993	993.4	02-08-1990
MAR	33.5	03-31-1983	17.9	03-05-1972	138.9	03-24-1980	15	NE	03-27-1994	1019.6	03-05-1977	1001.0	03-06-1985
APR	36.0	04-12-1990	18.3	04-14-1971	196.0	04-29-2009	13	NE	04-21-1976	1018.2	04-04-1998	1001.0	04-07-1985
MAY	36.0	05-14-1987	20.6	05-26-1971	557.7	05-21-1976	23	SE	05-26-1971	1015.7	05-05-1983	995.5	05-21-1976
JUN	35.5	06-06-1993	21.0	06-23-2012	182.4	06-29-2013	30	N	06-21-2008	1014.5	06-09-1971	976.2	06-21-2008
JUL	34.6	07-24-2007	18.9	07-27-1971	254.0	07-14-1983	36	W	07-14-1983	1014.5	07-20-1970	971.0	07-15-2014
AUG	35.6	08-27-1983	19.3	08-11-1971	126.5	08-12-1987	18	SW	08-13-1979	1014.7	08-31-1983	997.9	08-25-1978
-	35.6	08-11-2014	-	-	-	-	-	-	-	-	-	-	-
SEP	35.0	09-16-2006	19.4	09-12-1971	209.3	09-30-1995	35	S	09-28-2006	1015.8	09-18-2005	980.7	09-28-2006
OCT	35.0	10-16-1976	19.4	10-01-1976	306.2	10-13-1970	26	NW	10-26-1978	1016.7	10-27-1993	984.3	10-13-1970
NOV	33.2	11-03-2003	18.6	11-22-1975	359.7	11-06-1981	30	SW	11-03-1995	1021.0	11-30-1989	977.2	11-03-1995
DEC	32.4	12-01-2005	18.7	12-15-1981	289.1	12-05-2005	40	N	12-05-1993	1020.3	12-27-2001	993.7	12-05-1993
Annual	36.0	04-12-1990	16.8	02-02-1982	557.7	05-21-1976	40	N	12-05-1993	1021.0	11-30-1989	971.0	07-15-2014
-	36.0	05-14-1987	-	-	-	-	-	-	-	-	-	-	-
Period of Record	1970 - 2014				1970 - 2014		1970 - 2014			1974 - 2014			

Source: Climate and Agrometeorology Division, PAGASA

2.3.1.3 Climatological Normals, Extremes, and Climate Change Projections

2.3.1.3.1 Climate and Rainfall

Based on the Modified Coronas Classification of Philippine Climate, it appears that the proposed project site falls within Type I and Type III climate (**Figure 2-44**), although large section of the project site falls within Type III climate. Based on PAGASA's climate classification, Type III climate resembles Type I since it has a short dry season, and that it has no very pronounced maximum rain period, with a dry season lasting from 1 to 3 months, either during the period from December to February or from March to May.

As shown in **Figure 2-44**, PAGASA-Tayabas Station, which is the closest synoptic station from the easternmost point of the TR4 project, likely falls within Type II climate or along the boundaries of Type II and III climate. Thus, descriptions of the meteorological conditions of the proposed project also included data at PAGASA-Tayabas Station.

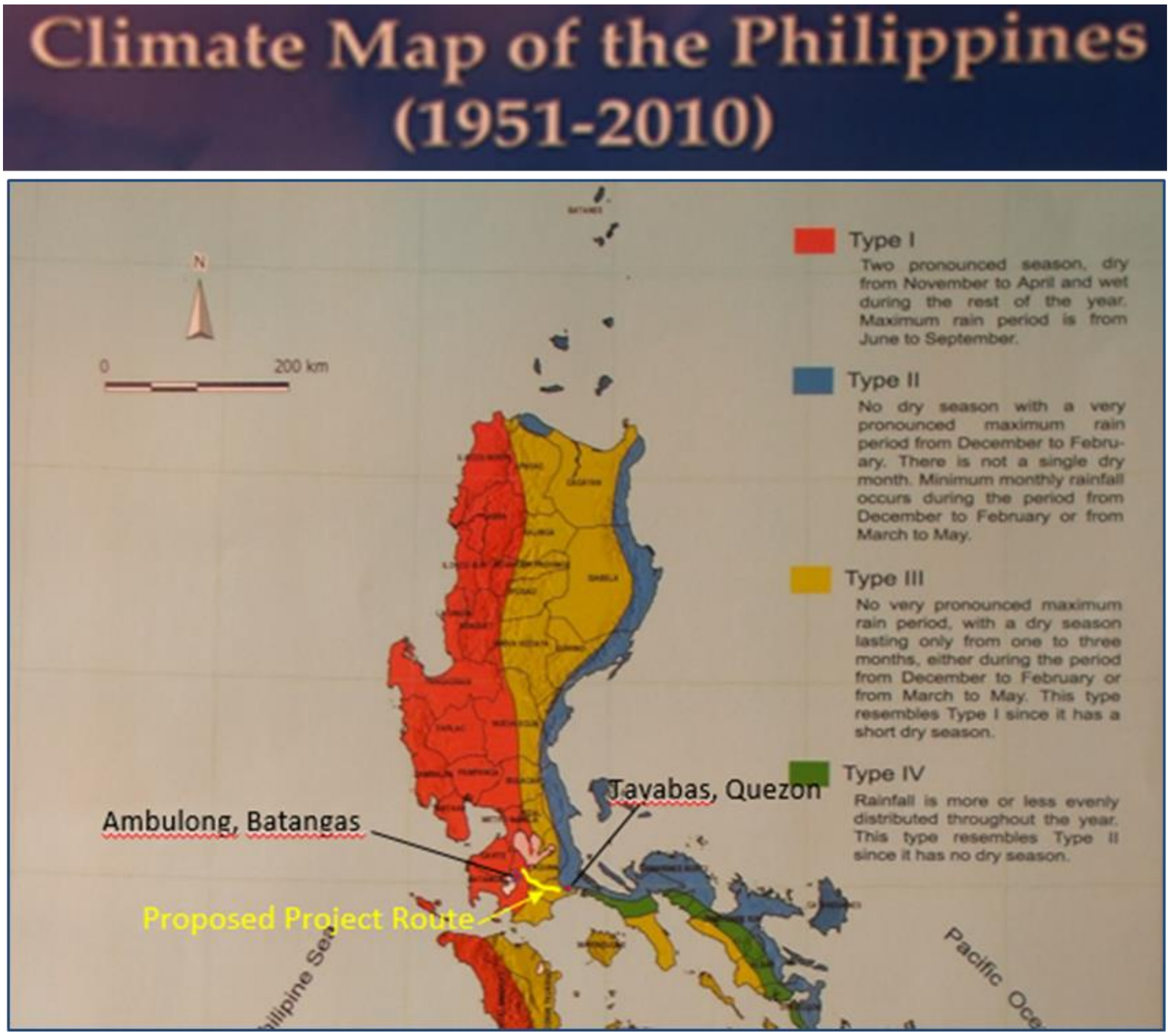


Figure 2-44: Climate map of the Philippines and locations of the proposed TR4 project and PAGASA-Ambulong and Tayabas Stations

2.3.1.3.1.1 Average Rainfall

Figure 2-45 shows the plot of monthly average rainfall at PAGASA-Ambulong and Tayabas Synoptic Stations. The annual rainfall at PAGASA-Tayabas Station is 3055.8 mm, which is higher than PAGASA-Ambulong Station with 1767 mm of annual rainfall. PAGASA-Tayabas Station, which likely falls within Type II climate, shows that monthly average rainfall from January to April (during dry season) are relatively higher than PAGASA-Ambulong Station, and that its maximum rain periods occur in October and November. During most months of southwest monsoon, however, rainfall at PAGASA-Ambulong Station are higher than those of PAGASA-Tayabas Station.

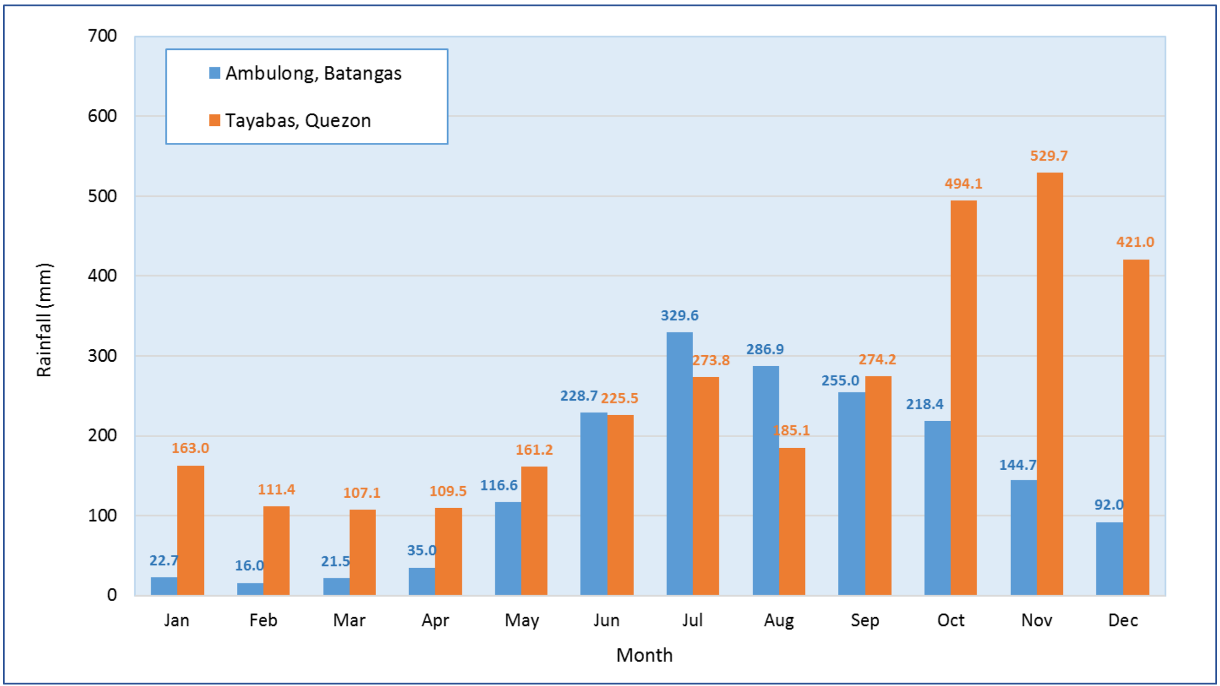


Figure 2-45: Monthly Average Rainfall at PAGASA's Ambulong and Tayabas Synoptic Stations (1981 to 2010)

2.3.1.3.1.2 Highest Recorded Rainfall

The highest recorded rainfall at PAGASA-Tayabas and Ambulong Stations occurred on May 21, 1976, which registered 557.7 and 499.2 mm of rainfall, respectively. This occurred during the passage of Typhon Olga (Didang).

2.3.1.3.1.3 Projected Rainfall in 2020 and 2050

In 2020 and 2050, there will be projected reduction of rainfall in most parts of the country during the summer months, however, an increase of rainfall in Luzon and Visayas is likely during the southwest monsoon (June, July and August) and until the transition periods (September, October and November). This projected trend is also noted in the provinces of Batangas and Quezon, as shown in **Figure 2-46**.

2.3.1.3.1.4 Projected Extreme Rainfall Events in 2020 and 2050

Figure 2-47 shows the projected number of days of rainfall greater than 200 mm from 2006 to 2035 (centered in 2020) and from 2036 to 2065 (centered in 2050). PAGASA-Tayabas Station show higher number of days with rainfall greater than 200 mm in the baseline years (1971 to 2000), though the occurrence of this extreme weather events appear lower from 2006 to 2035 (centered in 2020) and from 2036 to 2065 (centered in 2050). In Batangas province, the projected number of days greater than 200 mm tends to increase in 2020 and 2050.

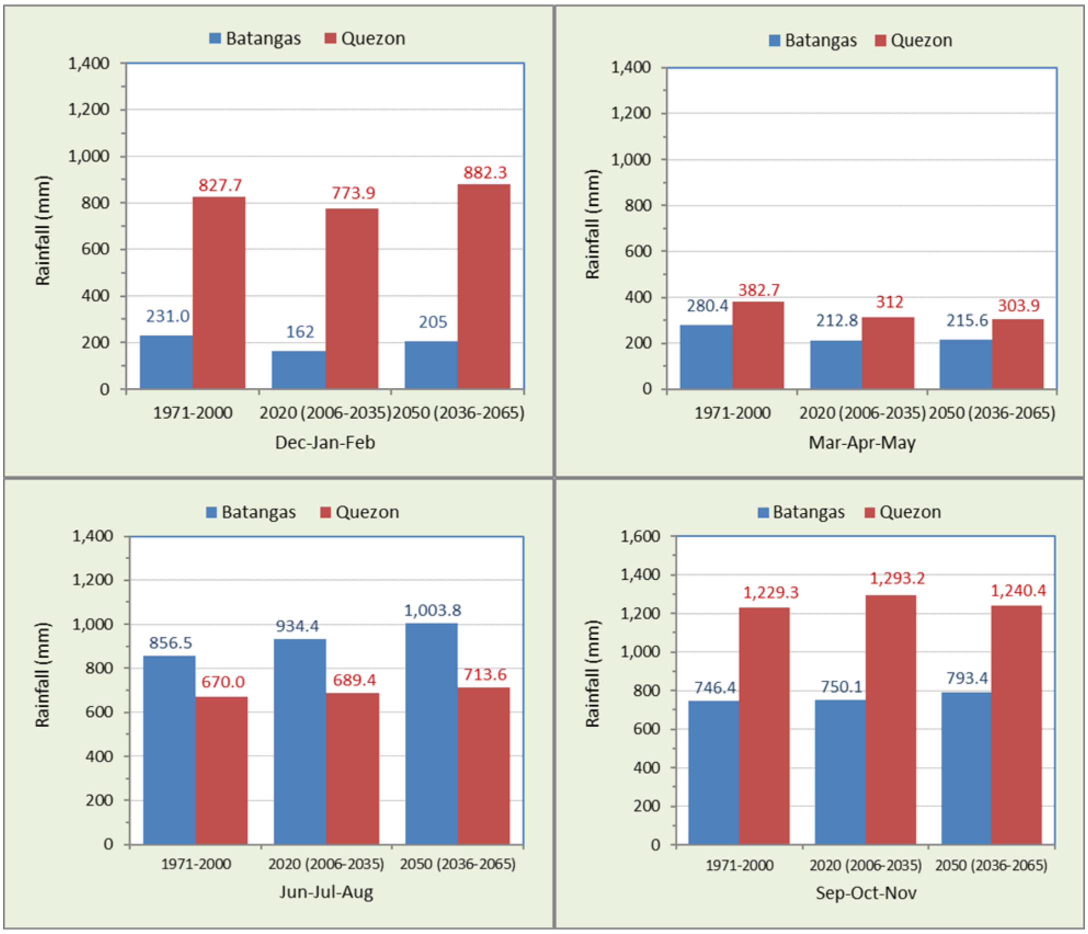


Figure 2-46: Projected changes of rainfall in Batangas and Quezon provinces 2020 and 2050 (Data Source: PAGASA, 2011)

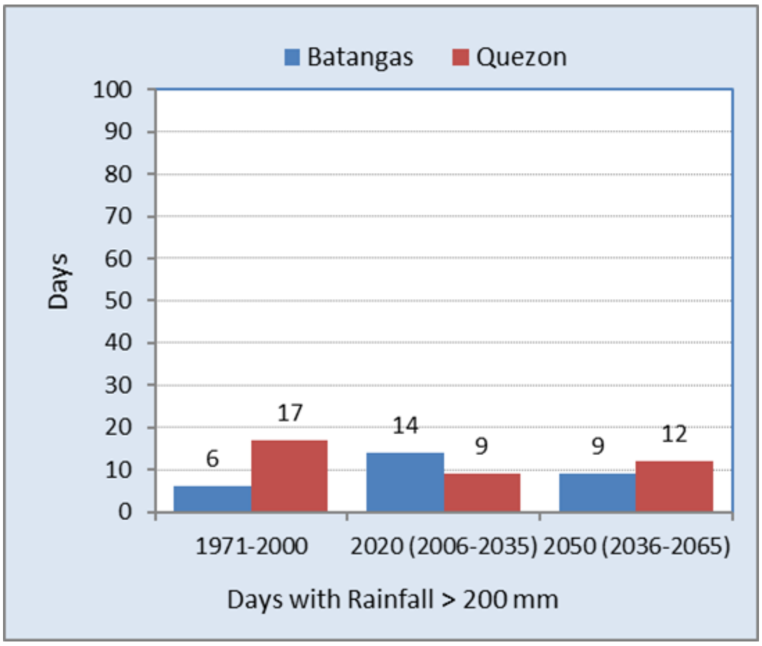


Figure 2-47: Projected days of rainfall greater than 200 mm in 2020 and 2050 (PAGASA 2011)

2.3.1.3.2 Ambient Air Temperature

2.3.1.3.2.1 Average Air Temperature

The monthly air temperatures at PAGASA-Tayabas Station are generally lower than those at PAGASA-Ambulong as the former is located at higher elevation (158 m above mean sea level) than the latter (17 m amsl) (**Figure 2-48**). May is the hottest month with monthly average temperatures of 29.1°C and 27.6°C (**Table 2-43**). The coldest month is January with monthly average temperatures of 25.9°C and 24.2°C.

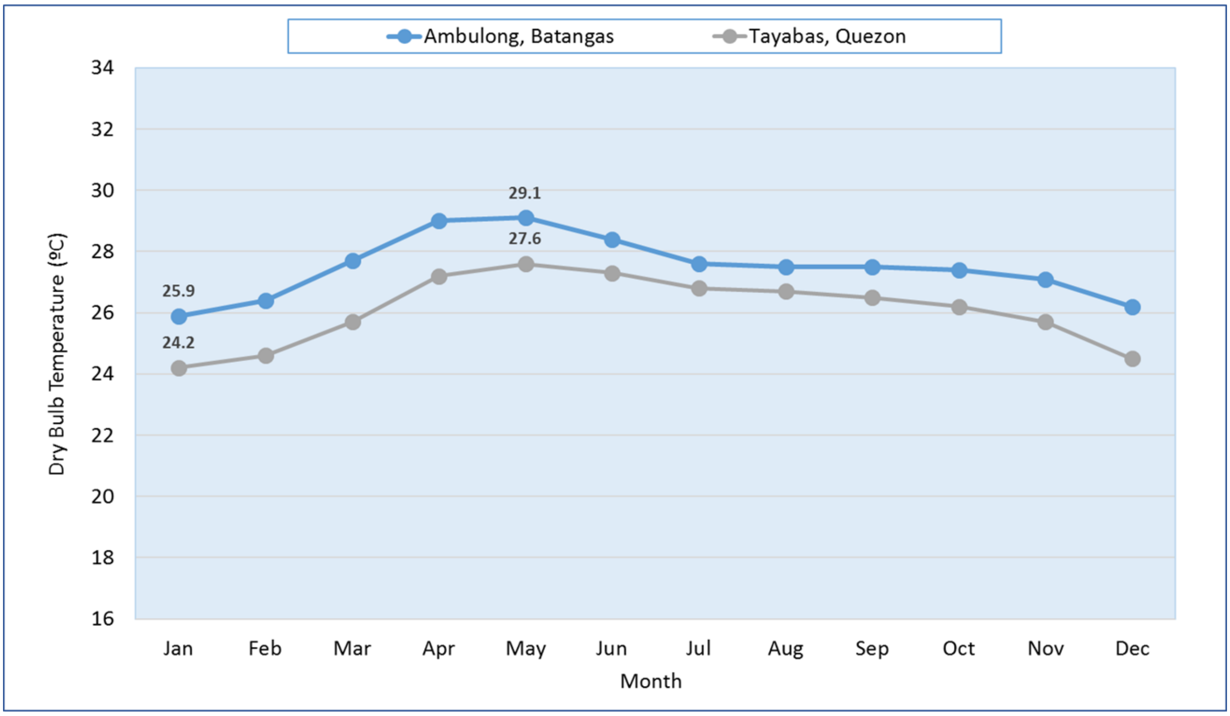


Figure 2-48: Monthly average air temperatures at PAGASA-Ambulong and Tayabas Stations (1981 to 2010)

2.3.1.3.2.2 Highest and Lowest Recorded Air Temperatures

At PAGASA-Ambulong and Tayabas Stations, the highest recorded air temperatures were 38.8°C and 36ºC, while the lowest recorded temperatures were 16°C and 16.8ºC, respectively (**Table 2-46** and **Table 2-47**).

2.3.1.3.2.3 Projected Change of Air Temperature in 2020 and 2050

The projected changes of air temperatures in the Philippines showed likely increase of mean temperatures in 2020 and 2050 of about 0.9°C to 1.1°C, respectively. Seasonal increases in temperature are also projected in 2020 and 2050 in the country. In the provinces of Batangas and Quezon where the proposed project is located, the monthly air temperatures will increase in all months and seasons of the year, as shown in **Figure 2-49**.

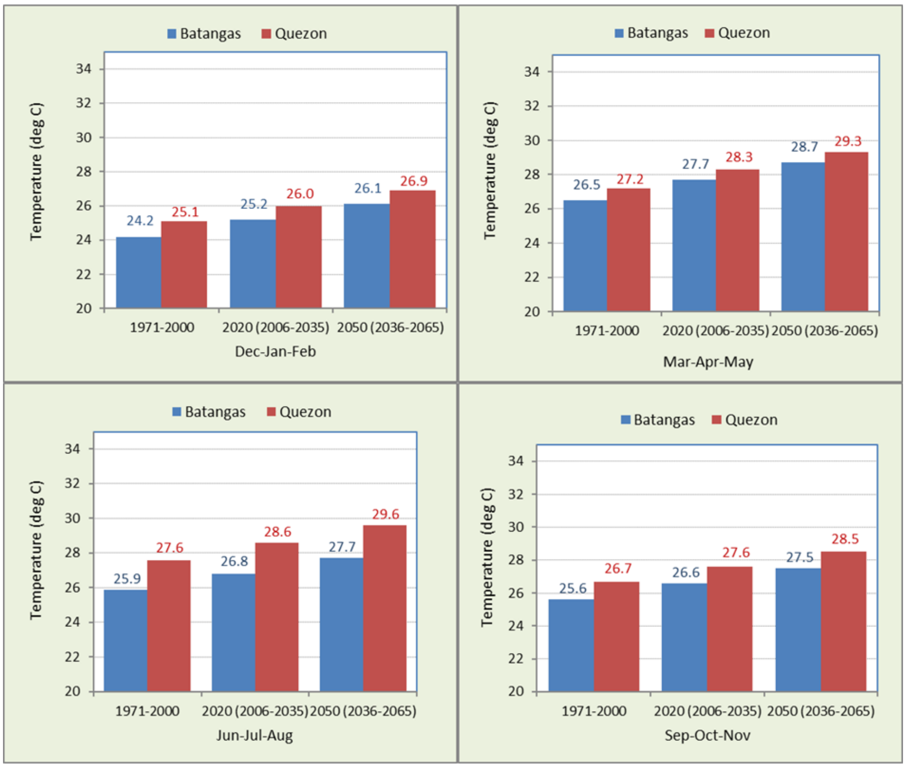


Figure 2-49: Projected changes of air temperatures in Batangas and Quezon provinces in 2020 and 2050 (Data Source: PAGASA)

2.3.1.3.2.4 <u>Projected Extreme Temperature Events</u>

In the province of Batangas, there appears an abrupt increase of air temperature greater than 35ºC from the baseline years (1971 to 2000) of 928 days to 8010 days from 2006 to 2035 (centered in 2020), and 8016 days from 2036 to 2065 (centered in 2050). Quezon province also shows an increase of the projected days with high air temperatures (**Figure 2-50**).

The number of dry days (days with rainfall less than 0.1 mm) appear to decrease from the baseline years in the provinces of Batangas and Quezon (**Figure 2-50**).

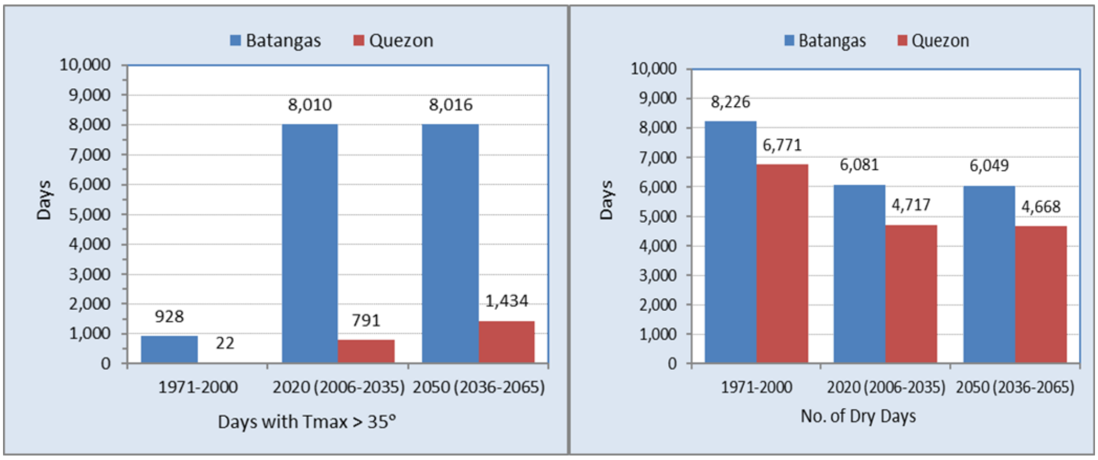


Figure 2-50: Projected a) number of days with temperature greater than 35ºC (left), and b) number of dry days (right) (Data source: PAGASA, 2011)

2.3.1.3.3 Prevailing Wind Flows

As the updated wind roses for PAGASA-Ambulong Station is not yet available from PAGASA, frequency table below (**Table 2-48**) is presented to show the frequency occurrences of prevailing wind flows. The prevailing wind flows are NE with 40% followed by SW (15.7%) and ENE (7.6%). This shows that two (2) dominant wind flows in the Philippines (northeast and southwest winds) are also observed at PAGASA-Ambulong Station.

Table 2-48: Annual frequency table for PAGASA-Ambulong Station (1981 to 2000)

FREQUENCY TABLE

Ambulong, Batangas

Wind Speed and Direction

Annual (1981-2010)

Direction / Speed (mps)	N	NNE	NE	ENE	E	ESE	SE	SSE
CALM								
1-4	0.9	4.0	39.7	7.5	4.2	0.4	0.2	0.2
5-8	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0
8-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**0.9**	**4.0**	**40.0**	**7.6**	**4.2**	**0.4**	**0.2**	**0.2**

Direction / Speed (mps)	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM									**10.8**
1-4	2.8	3.1	15.3	6.8	1.9	0.3	0.2	0.4	87.9
5-8	0.0	0.0	0.4	0.1	0.1	0.0	0.0	0.0	1.3
8-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**2.8**	**3.1**	**15.7**	**6.9**	**2.0**	**0.3**	**0.2**	**0.4**	**100.0**

Climate and Agromet Data Section, CAD, PAGASA CY2014

2.3.1.3.4 Tropical Cyclone

The greatest recorded wind speed was 75 m/s on July 15, 1983 during the passage of Typhoon Vera (named as Typhoon Bebeng in the Philippines). At PAGASA-Tayabas Station, the greatest recorded wind speed was 50 m/s on December 5, 1993.

The project site falls within a zone where about three (3) cyclones occur in two years.

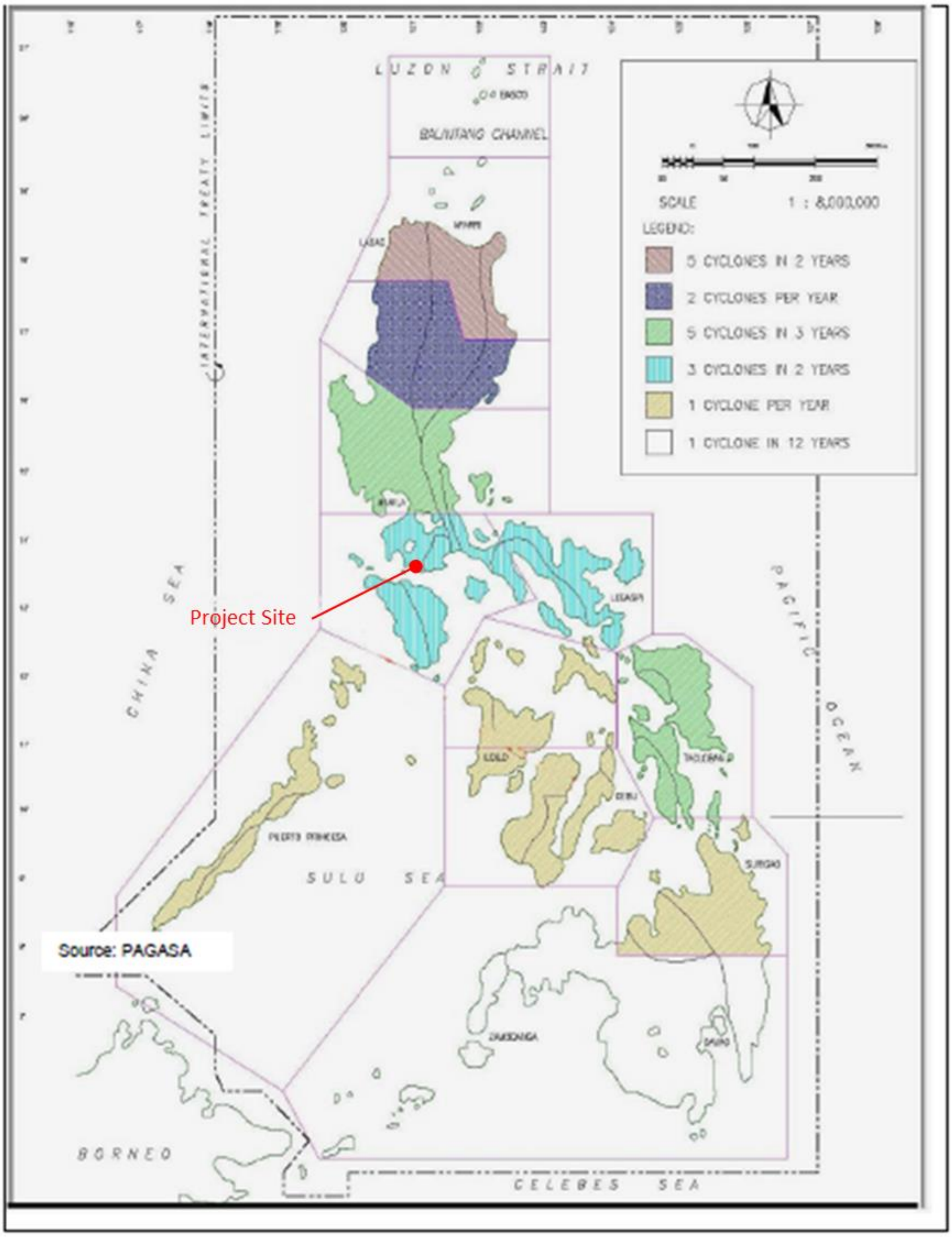


Figure 2-51: Tropical Cyclone Map of the Philippines

2.3.1.4 Potential Key Impacts on Meteorology/Climatology and Mitigation

The road project is not expected to significantly cause changes in the local climate of areas along its proposed route. Possibly, a slight increase in temperature could occur at the alignment per se due to the paving of the ground surface and removal of vegetation with the subsequent emission of vehicles using the TR4. During construction, immediate planting of small plants to the open areas could be conducted to absorb sunlight and to cover the exposed areas. A properly designed reforestation on both sides of the road will be implemented during the operation to reduce sensory disturbance and to provide a relatively cooler micro-climate in the area.

On the contrary, the projected changes in the climate, primarily the projected increase in the amount of rainfall may result in flooding along the road which may consequently affect the safety of motorists. As such, the road is designed with an efficient drainage system with sufficient capacity for the projected amount of rainfall. Also, regular patrol and close monitoring will be conducted in the event of unusual down pour. The proponent will also closely coordinate with the office of the National Disaster Risk Reduction and Management Council (NRRDMC) for early warnings and alerts that needs to be conveyed immediately to road users. The potential impacts on meteorology and proposed mitigation measures are presented at the end of this section (**Table 2-73**).

2.3.2 Ambient Air Quality

2.3.2.1 Scope

This section covers the ff.: a) updated baseline and impact assessment for the proposed re-alignment of Packages A and E; and, b) the baseline and impact assessment for Packages B, C, and D. The air quality impact assessment for Packages B, C, and D were based on the report submitted to DENR-EMB in 2014 in compliance with Condition No. 8 of ECC-CO-1402-0002, which required the submission of an air dispersion modeling report covering construction and operation of the proposed original project alignment. Said report aimed to address the specific requirements of the Review Committee, which included among others, modeling of TSP and PM10, inclusion of emissions rates of construction activities (e.g., truck loading, truck unloading and bulldozing), identification and tabulation of Area Sensitive Receptors (ASRs), and tabulated modeling results at the ASR.

2.3.2.2 Methodology

2.3.2.2.1 Applicable Air Quality Regulations

2.3.2.2.1.1 <u>Regulations Related to Air Dispersion Modeling</u>

In August 2008, DENR-EMB issued Memorandum Circular No. 3, Series of 2008 (MC 2008-003) as a guide on determining compliance with applicable ambient guideline or standard values (NAAQG or NAAQS) through air dispersion modeling for proposed new sources or sources with modification. This guideline has been issued pursuant to the DAO 2000-81 (Implementing Rules and Regulations of the Philippine Clean Air Act of 1999). The following are the relevant requirements in DAO 2000-81 related to air dispersion modeling.

a) **Part II, Rule X, Section 3 (Increment Consumption)** - no new source may be constructed or existing source modified if emissions from the proposed new source or modification will, based on computer dispersion modeling, result in:

   - Exceedance of the National Ambient Air Quality Guideline Values (NAAQGV); or
   - An increase in existing ambient air levels above the levels shown below:

-PM_{10}, Annual arithmetic mean	17 micrograms per cubic meter
-PM_{10}, 24-hour maximum	30 micrograms per cubic meter
-Sulfur Dioxide (SO_2), annual arithmetic mean	20 micrograms per cubic meter
-SO_2, 24-hour maximum	91 micrograms per cubic meter

-Nitrogen Dioxide (NO_2) 25 micrograms per cubic meter

In case of multiple point sources at a single facility, the net emissions from all affected sources shall be included in a single increment analysis.

b) **Part VI, Rule XIX, Sections 3 (Authority to Construct) and Section 5 (Application for Permit to Operate)**. *Pursuant to DAO 2004-26*, Authority to Construct (AC) is no longer required for new source of installation (e.g., power plants), and that proponents are required to secure Permit to Operate (PO) for permitting purposes.

c) **Part VI, Rule XXVI, Section1 (National Ambient Air Quality Standards).** This section specifies compliance with the National Ambient Air Quality Standards (NAAQS) for any industrial establishment or operation, and that the locations of the sampling stations will be determined using dispersion modeling.

It is the opinion of the preparer of this modular report that sources covered under the above rules [Item (a) to (c)] are those for proposed new sources or existing sources to be modified. These sources refer to installation, new source, or existing sources that are under modification that generally fall within the definition of stationary source. Stationary source refers to *"any building or fixed structure, facility or installation that emits or may emit any air pollution.* Further, MC 2008-003 does not explicitly specify demonstration of compliance of proposed highway projects, specifically from vehicular tail pipe emissions, with the NAAQS, or NAAQG or both. Dispersed particulates emissions from vehicular traffic could be covered under **Part VII, Rule XXV, Section 13 (Prohibited Acts),** which *"prohibits emission of particulate matter from any source including vehicular movement, transportation of materials, construction, etc., without taking reasonable precautions to prevent such emission"*.

2.3.2.2.1.2 Ambient Air Quality Standards and Guideline Values for TSP, PM10, SO_2, NO_2, and CO

The ambient air quality standards and guideline values in **Table 2-49 and Table 2-50**, respectively, are used in this report as benchmarks on the expected increase of ambient air concentrations arising from release of fugitive emissions during construction and vehicular traffic emissions during operation. This is to recommend mitigation measures, if necessary, in order to minimize or lessen the impact of the proposed project to the air environment.

Table 2-49: NAAQS for TSP, PM_{10}, SO_2, and NO_2

Air Pollutant	Concentration		Averaging Time (min)
	µg/Nm³	ppm	
TSP	300	-	60
PM_{10}	200	-	60
SO_2	470	0.18	30
	340	0.13	60
NO_2	375	0.20	30
	260	0.14	60

Legend: µg/Nm³ – microgram per normal cubic meter

Table 2-50: NAAQG values for TSP, PM_{10}, SO_2, NO_2, and CO

Air Pollutant	Concentration		Averaging Time
	µg/Nm³	ppm	
TSP	230	-	24-hour
PM_{10}	150	-	24-hour
SO_2	180	0.07	24 hour
NO_2	150	0.08	24 hour
CO	35 mg/Nm³	30	1-hour
	10 mg/Nm³	9	8-hour

Legend: µg/Nm³ – microgram per normal cubic meter

2.3.2.2.2 Ambient Air Sampling and Background Air Quality Data

In addition to the ambient air monitoring conducted by Berkman Systems Inc. (BSI) in July 2013 for the proposed original TR4 route, ambient air monitoring for PM_{10}, SO_2, and NO_2 was conducted by Hi Advance Philippines, Inc. (Hi Advance) along the proposed alignments of TR4-A and TR4-E from June 2 to 3, 2016. A total of six (6) locations were established for the two (2) proposed new routes or three (3) stations each for TR4-A and TR4-E (**Figure 2-52**).

Further, air quality data from DENR CALABARZON, which were presented in EIS TR4 (2013), are also discussed briefly in **Section 2.3.2.3**. The coordinates and sampling map of the said data from DENR CALABARZON, however, were not provided in EIS TR4 (2013).

Annex M presents the ambient air sampling and testing report of Hi Advance – a third-party environmental service provider commissioned by Ascott Pacific Consultants to conduct the baseline air sampling along the proposed TR4-A and TR4-E alignment.

Table 2-51 shows the methods of air sampling and analysis of the observed air pollutants in 2013 and 2016.

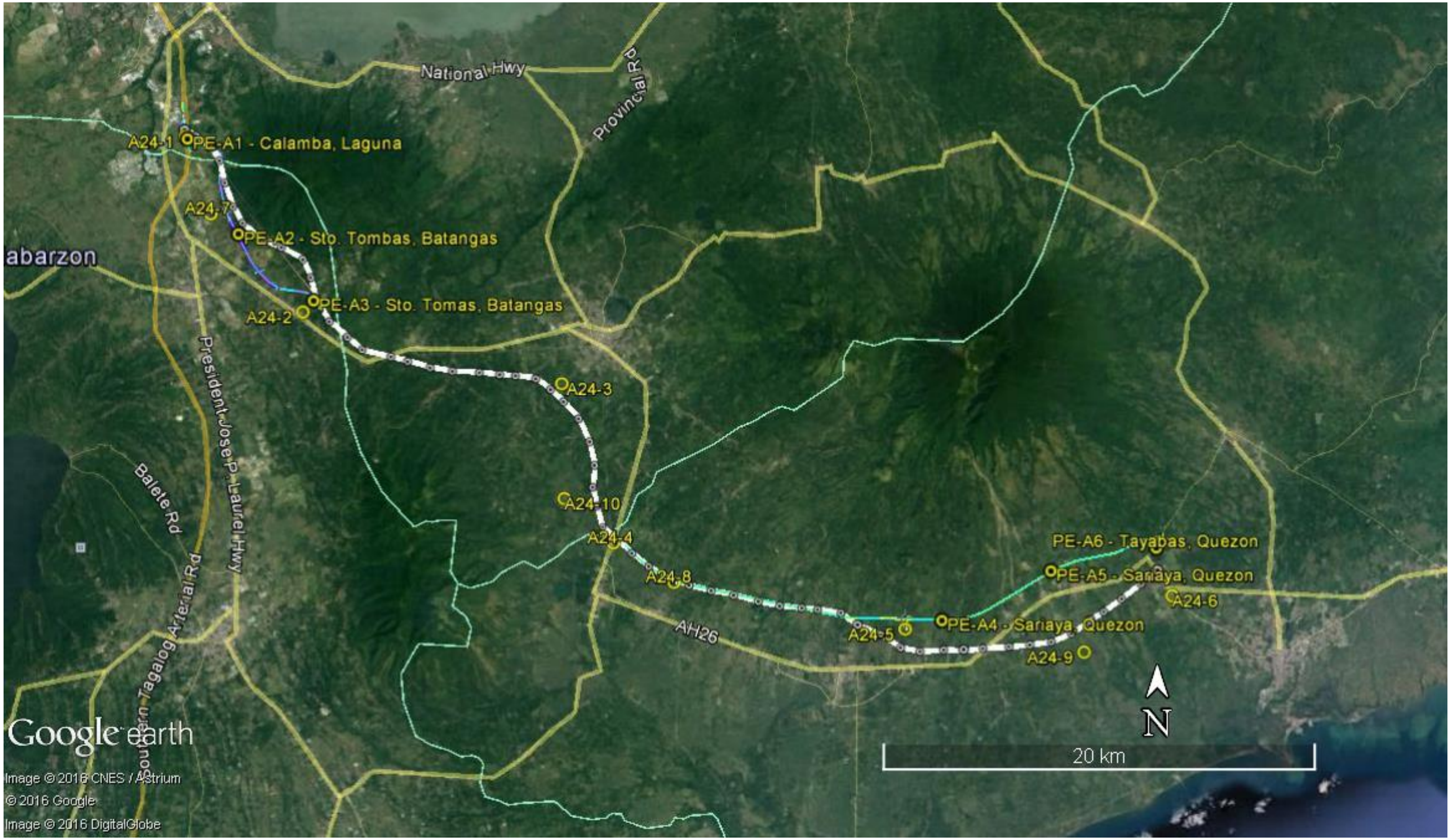


Figure 2-52: Map showing locations of Air Sampling Stations in July 2013 and June 2016 sampling

Table 2-51: Methods of Air Sampling and Analysis by Hi Advance

Parameter	Analytical Method
Nitrogen Dioxide(NO_2)	Impinger–GriessSaltzman Method
Sulfur Dioxide (SO_2)	Impinger–Pararosaniline Method
Total Suspended Particulates(TSP)	High Volume–Gravimetric Method
Particulate Matter<10microns(PM 10)	High Volume–Gravimetric Method
Benzene(C_6H_6)	Gas Chromatography
Hydrocarbon	Gas Chromatography
Ozone(O_3)	Ozone Meter– Direct Reading
Carbon Monoxide(CO)	Atomic Absorption Spectrophotometry(AAS)

2.3.2.2.3 Simulation for the Impact Assessment

The anticipated impacts of the proposed project to the air environment during construction and operation phases were assessed using air dispersion models, namely, Ausplume Air Dispersion Model, and CALINE4 Air Dispersion Model. In 2014, SLTC commissioned Ascott to conduct detailed assessment of the expected impacts of the project arising from the operation of construction equipment using an air dispersion model (Ausplume), though the results could be used for the proposed new routes (TR4-A and TR4-E) as simulations intended for the construction period assumed typical construction activities over a specific area in each modeling domain (TR4-A and TR4-E).

CALINE4 was used to evaluate the expected impact of the project during operation phase. CALINE4 was developed by the California Department of Transportation (Caltrans) as a tool to assess the air quality impacts of roadway projects. This model was based on the Gaussian diffusion equation and employs the mixing zone concept within the roadway. CALINE4 is capable of modeling CO, NO_2, suspended particulates, and other inert gases. CALINE4 is the upgraded version of CALINE3, in which the latter has limitations as it is only capable of modeling CO along roadways.

2.3.2.3 Background Air Quality

Figure 2-51 shows the air sampling stations in July 2013 and June 2016. **Table 2-53** to **Table 2-54** show the measured PM_{10}, TSP, SO_2, NO_2, Hydrocarbons, Ozone, and CO in July 2013. **Table 2-55** shows the secondary data from DENR CALABARZON, which were presented in the EIS TR4 (2013).

The measured air quality monitoring data in July 2013 and June 2016 showed that ambient air quality at the time of air sampling were within the ambient standards (or NAAQS) and guideline values (or NAAQG), as shown in **Table 2-49** and **Table 2-50**, respectively. Note that the NAAQS are presented above for comparison purposes only, as NAAQS are intended to check compliance of projects during operation (e.g., power plants for SO_2 and NO_2 and particulate emissions of construction projects).

Table 2-52 shows the comparison of the measured air pollutants in comparison with the air quality indices stipulated in Annex A of DAO 2000-81. The air quality indices for TSP showed good to fair conditions implying “no specific cautionary statements for the general public” (DAO 2000-81). For the other air pollutants (PM_{10}, SO_2, NO_2, Ozone, and CO), the observed ambient air quality levels could be categorized as “good conditions” suggesting that ambient air quality at the air sampling locations were within levels with no “significant health effect”.

Sources of particulates at the time of sampling were generally from fugitive dusts along roads and from vehicular emissions, although industrial areas are also found in the vicinities of the proposed project site.

Table 2-52: Comparison of observed air pollutants with the air quality indices

Pollutant	Measured Pollutant (µg/Nm^3)	DENR Air Quality Indices	Remarks
TSP	24.5 to 127.3	Good (0 to 80 µg/m^3) to Fair (81 to 230 µg/m^3)	Good to Fair Condition
PM10	0.6 to 24.2	Good (0 to 50 µg/m^3)	Good condition
SO2	0.1 to 12.48	Good (0 to 0.034 ppm)	Good condition
NO2	1.0 to 34	None (no 1-hour term NAAQG)	Not specified
Ozone	<0.01 to 0.011 ppm	Good (0.000 to 0.064 ppm)	Good condition
CO	< 1 to 4 ppm	Good (0.0 to 4.4 ppm)	Good condition

Table 2-53: Observed Concentrations of PM_{10}, TSP, SO_2, and NO_2 (in µg/Ncm) along the proposed Route (July 2016)

Sta. No.	Location	Location Coordinates	Date/ Time of Sampling	PM_{10}	SO_2	NO_2
PE-A6	Vista Verde Residential Estate, Brgy. Calumpang Tayabas, Quezon	N 13° 58' 49.29" E 121° 33' 39.46"	02June2016/ 1050H-1150H	10	12.48	10
PE-A5	Palmas Verdes, Brgy. Concepcion I Sariaya, Quezon	N 13° 58' 14.99" E 121° 30' 57.12"	02June2016/ 1320H-1420H	5	11.40	5
PE-A4	Halamanan Street, Brgy. Concepcion I Sariaya, Quezon	N 13° 57' 1.25" E 121° 28' 9.19"	02June2016/ 1545H-1645H	16	12.39	16
PA-A3	Brgy. San Felix Sto. Tomas, Batangas	N 14° 4' 58.36" E 121 °12' 0.94"	03June2016/ 0910H-1010H	34	10.95	34
PA-A2	Brgy. San Bartolome Sto. Tomas, Batangas	N 14° 6' 38.02" E 121° 10' 4.87"	03June2016/ 1100H-1200H	4	9.43	4
PA-A1	Purok I, Brgy. Makiling Calamba, Laguna	N 14° 8' 59.83" E 121° 8' 45.84"	03June2016/ 1312H-1412H	14	1.06	14
DENR NAAQS				300	340	260

Table 2-54: Observed Concentrations of PM_{10}, TSP, SO_2, and NO_2 (in µg/Ncm) Along the Proposed Route

Sta. No.	Location	Location Coordinates	Date/ Time of Sampling	PM_{10}	TSP	SO_2	NO_2
A24-1	Brgy. Saimsim, Calamba, Laguna	N 14° 09'01.6" E 121° 08'41.6"	July 16-17, 2013/ 0745H-0745H	2.3	59.9	0.1	3.5
A24-2	Brgy. San Felix, Sto. Tomas, Batangas	N 14° 04'39.8" E 121° 11' 43.0"	July 17-18, 2013/ 0900H-0900H	2.4	47.5	0.2	2.5
A24-3	Brgy. San Miguel, San Pablo, Laguna	N 14° 02'53.0" E 121° 18'22.2"	July 17-18, 2013/ 1130H-1130H	9.6	127.3	0.6	3.6

Sta. No.	Location	Location Coordinates	Date/ Time of Sampling	PM_{10}	TSP	SO_2	NO_2
A24-4	Brgy. Lalig, Tiaong, Quezon	N 13° 58'55.2" E 121° 19'41.7"	July 18-19, 2013/ 1130H-1130H	0.6	30.7	1.0	3.9
A24-5	Brgy. Mangilag, Candelaria, Quezon	N 13° 56'46.6" E 121° 27'11.1"	July 19-20, 2013/ 0400H-0400H	1.4	25.2	2.6	1.0
A24-6	Brgy. Isabang, Tayabas, Quezon	N 13° 57' 36.2" E 121° 34' 02.3"	July 20-21, 2013/ 0820H-0820H	15.0	70.6	2.1	1.8
A24-7	Brgy. San Antonio, Sto. Tomas, Batangas	N 14° 07' 06.3" E 121° 09' 20.8"	July 16-17, 2013/ 1000H-1000H	21.9	104.0	1.4	1.8
A24-8	Brgy. Anastacia, Tiaong, Quezon	N 13° 57'56.6" E 121° 21'15.2"	July 19-20, 2013/ 1500H-1500H	24.2	93.8	0.7	2.9
A24-9	Brgy. Tumbaga I, Sariaya, Quezon	N 13° 56'12.1" E 121° 31'46.8"	July 20-21, 2013/ 0730H-0730H	8.5	24.5	1.1	1.2
A24-10	Brgy. Santisimo Rosario, San Pablo, Laguna	N 14° 00'01.6" E 121° 18' 26.0"	July 18-19, 2013/ 1215H-1215H	16.7	109.0	1.8	1.9
DENR Ambient Air Quality Guideline Values for Criteria Pollutants Based on 3 hour Averaging Time				150	230	180	150

Table 2-55: Observed Measured Ambient Air Concentrations C_6H_6

Sta.No.	Location	Location Coordinates	Date/Time of Sampling	Benzene
A24-1	Brgy. Saimsim, Calamba,Laguna	N14°09'01.6" E121°08'41.6"	July16-17,2013/ 0745H-0745H	<0.1
A24-2	Brgy.SanFelix.Sto.Tomas,Batangas	N14°04'39.8" E 121°11'43.0"	July17-18,2013/ 0900H-0900H	<0.1
A24-3	Brgy. SanMiguel, San Pablo,Laguna	N14°02'53" E121°18'422.2"	July17-18,2013/ 1130H-1130H	<0.1
A24-4	Brgy.Lalig,Tiaong,Quezon	N13°58'55.2" E121°18'41.7"	July18-19,2013/ 1130H-1130H	<0.1
A24-5	Brgy.Mangilag, Candelaria,Quezon	N13°56'46.6" E121°27'11.1"	July19-20,2013/ 0400H-0400H	<0.1
A24-6	Brgy.Isabang, Tayabas,Quezon	N13°57'36.6" E 121°34'02.3"	July20-21,2013/ 0820H-0820H	<0.1
A24-7	Brgy.SanAntonoi, Sto.Tomas, Batangas	N14°07'06.3" E121°09'20.08"	July16-17,2013/ 1000H-1000H	<0.1
A24-8	Brgy.Anastacia,Tiaong, Quezon	N13°57'56.6" E121°21'15.2"	July19-20,2013/ 1500H-1500H	<0.1
A24-9	Brgy.TumbagaI,Sariaya, Quezon	N13°56'12.1" E121°31'46.8"	July20-21,2013/ 0730H-0730H	<0.1
A24-10	Brgy.Santisimo,Rosario,SanPabloLaguna	N14°00'01.6" E 121°18'26.0"	July18-19, 2013/ 1215-1215H	<0.1

Table 2-56: Observed concentrations of Hydrocarbon along the proposed route (ppm)

Sta. No.	Location	LocationCoordinates	Date / Time of Sampling	Benzene
A24-1	Brgy. SaimsimCalamba, Laguna	N 14°09’01.6” E121°08’41.6”	July 16-17, 2013 / 0745H-0745H	< 0.1
A24-2	Brgy. San Felix. Sto.Tomas , Batangas	N14°04’39.8” E121°11’43.0”	July 17-18, 2013 / 0900H-0900H	< 0.1
A24-3	Brgy. San Miguel SanPablo, Laguna	N14°02’53” E121°18’422.2”	July 17-18, 2013 / 1130H-1130H	< 0.1
A24-4	Brgy. Lalig,Tiaong, Quezon	N13°58’55.2” E121°18’41.7”	July 18-19, 2013 / 1130H-1130H	< 0.1
A24-5	Brgy. MangilagCandelaria, Quezon	N13°56’46.6” E121°27’11.1”	July 19-20, 2013 / 0400H-0400H	< 0.1
A24-6	Brgy. IsabangTayabas, Quezon	N13°57’36.6” E121°34’02.3”	July 20-21, 2013 / 0820H-0820H	< 0.1
A24-7	Brgy. San Antonio Sto. Tomas Batangas	N14°07’06.3” E 121°09’20.08”	July 16-17, 2013 / 1000H-1000H	< 0.1
A24-8	Brgy. Anastacia,Tiaong Quezon	N 13°57’56.6” E 121°21’15.2”	July 19-20, 2013 / 1500H-1500H	< 0.1
A24-9	Brgy. Tumbaga I,Sariaya, Quezon	N13°56’12.1” E 121°31’46.8”	July 20-21, 2013 / 0730H-0730H	< 0.1
A24-10	Brgy. Santisimo,Rosario, San PabloLaguna	N14°00’01.6” E 121°18’26.0”	July 18-19, 2013 / 1215-1215H	< 0.1
DENR Ambient Air Quality Guideline for Criteria Pollutants Based on 3 hour averaging time				None

Table 2-57: Observed Concentrations of Ozone and CO (ppm) along the proposed project alignment.

Sta. No.	Location	Location Coordinates	Date / Time Of Sampling	Ozone	CO
A24-1	Brgy. Saimsim Calamba, Laguna	N14°09’01.6” E 121°08’41.6”	July 16-17, 2013 / 0745H-0745H	0.005	3
A24-2	Brgy. San Felix. Sto. Tomas , Batangas	N14°04’39.8” 121°11’43.0”	July 17-18, 2013 / 0900H-0900H	0.002	1
A24-3	Brgy. San Miguel San Pablo, Laguna	N14°02’53” E	July 17-18, 2013 / 1130H-1130H	0.004	1
A24-4	Brgy. Lalig, Tiaong, Quezon	N13°58’55.2” E 121°18’41.7”	July 18-19, 2013 / 1130H-1130H	0.004	2
A24-5	Brgy. Mangilag Candelaria, Quezon	N13°56’46.6” E121°27’11.1”	July 19-20, 2013 / 0400H-0400H	0.001	< 1
A24-6	Brgy. Isabang Tayabas, Quezon	N13°57’36.6” E121°34’02.3”	July 20-21, 2013 / 0820H-0820H	0.011	4
A24-7	Brgy. San Antonio Sto. Tomas Batangas	N14°07’06.3” E121°09’20.08	July 16-17, 2013 / 1000H-1000H	0.011	2
A24-8	Brgy. Anastacia, Tiaong Quezon	N13°57’56.6” E121°21’15.2”	July 19-20, 2013 / 1500H-1500H	0.008	3
A24-9	Brgy. Tumbaga I, Sariaya, Quezon	N13°56’12.1” E121°31’46.8”	July 20-21, 2013 / 0730H-0730H	< 0.01	< 1
A24- 10	Brgy. Santisimo, Rosario, San Pablo Laguna	N14°00’01.6” E121°18’26.0”	July 18-19, 2013/ 1215- 1215H	0.002	< 1
DENR Ambient Air Quality Guideline for Criteria PollutantsBased on 3 hour averaging time				0.03	9.0

Table 2-58: Ambient Air quality within the vicinity of the project site (alignment) based on secondary data from DENR CALABARZON.

DENRstandards	300	340	260
Sto.Tomas-Makban			
SiamSiam	37	110	66
MuntingRiver	50	150	75
Makban-SanPablo			
Tigaw	65	59	43
Buboy	79	63	50
Bucal	87	75	62
Matandan	96	75	61
SanPablo-Tiaong			
Tarac	118	95	88
Balatuin	110	89	74
Macampong	115	98	78
Banadero	139	101	83
Malaonod	111	99	76
Balanga	121	105	92
Tiaong-Candelaria			
Labatan	120	164	110
Tagwa	170	196	132
Maasim	189	220	144
Quipo	200	234	155
Candelaria-Tayabas			
Lagnas	189	199	122
Guis-guis	200	220	145

Source:DENRCALABARZONSelf-MonitoringRecord,4thQuarter2012

2.3.2.4 Impact Assessment and Mitigation Measures

2.3.2.4.1 Construction Phase

The construction of the proposed project is expected to generate significant fugitive emissions especially during dry weather condition, if not properly mitigated. This was demonstrated in the report covering construction and operation period (herein referred to as "compliance report"), which was submitted to DENR-EMB in 2015 in compliance with Condition No. 8 of the ECC for the Project. ECC Condition No. 8 requires the proponent to submit air quality study covering construction and operation of the project.

Although the results of the said compliance report cover the proposed original TR4 routes, it can also be applied in the current proposed routes (TR4-A and TR4-E) as said study assumed typical construction activities in each of the modeling domain or proposed route.

The following highlights the modeling inputs, results and discussions presented in the compliance report, which can be used for the current proposed routes.

2.3.2.4.1.1 Air Dispersion Model

Ausplume Air Dispersion Model was used to model dispersion of particulates and PM_{10} from fugitive emissions. Ausplume was developed by Victoria Environmental Protection Authority in Australia and its calculation procedure is basically the same as the Industrial Source Complex (ISC) model of the U.S.EPA.

The limitations of AUSPLUME model are as follows:

i. AUSPLUME is a Gaussian-plume model best used for flat and simple terrain. Although it can predict concentrations at complex terrain (terrain higher than the top of the stack), predicted concentrations during stable condition at complex terrain are likely overestimated because the model does not account for winds flowing around sides of hills or terrain during stable flows,

ii. Overpredicts when wind speeds are less than 0.5 m/s, though for wind data less than 0.5 m/s, AUSPLUME assumed wind speed equal to 0.5 m/s.

iii. Assumes constant wind flows at one direction within the simulation period (i.e., 1-hour averaging time); and

iv. Assumes that atmosphere is uniform across the entire modelling domain within the entire averaging period (e.g., 60 minutes)

2.3.2.4.1.2 *<u>Source Input Data</u>*

The significant dust-generating activities likely occurred during site preparation and road construction. **Table 2-59** shows the typical activities during construction and the corresponding emission factors, which were derived from AP-42 (U.S. EPA's Compilation of Air Pollutant Emission Factors).

The modelling assumed the following:

- Moisture content = 8%
- Average vehicle speed = 11.5 km/hr
- Silt content = 20%
- Particle size diameter = 0.8
- Mean wind speed = 4 m/s

Further, construction works were assumed along a section of the proposed road with the following scenarios/assumptions:

- One (1) scraper with capacity of 20 tons unloading top soil per hour;
- Two (2) scrapers traveling along the section of the proposed project (about 350 m) every hour;
- One (1) scraper removing top soil operating on an hourly basis ;
- Twenty-ton truck loading excavated materials per hour;
- Twenty-ton truck dumping fill materials per hour; and
- One (1) compactor operating at the section of the roads per hour

Table 2-59: Typical Construction Activity and Emission Factors (Source: U.S. EPA, 1996)

Activity	Emission Factor	Unit
a) Bulldozing (overburden)	=2.6 (s)^1.2 / M^1.3	Kg/hr
b) Scrapers unloading top soil	= 0.02	Kg/Mg
c) Scrapers in travel	= 0.0034 (S) ^ 2.5	Kg/VKT
d) Scrapers removing top soil	= 5.7 kg/VKT	Kg/VKT
e) Loading of excavated material	= K * 0.0016 * (u/2.2)^1.3 / (M/2)^1.4	Kg/Mg
f) Truck dumping of fill material, road base, or other materials	= K * 0.0016 * (u/2.2)^1.3 / (M/2)^1.4	Kg/Mg
g) Compacting	=2.6 (s)^1.2 / M^1.3	Kg/hr

Note: s = silt (%); M = Moisture (%); S = speed (kph); K = particle size distribution; u = wind speed (m/sec)

2.3.2.4.1.3 *Meteorological Input*

Meteorological input data were based on sequential data provided by EPA (2004), which were revised to include wind directions from 10° to 360°. The objective of including all possible wind directions was to ensure that all selected ASRs located in the vicinities of the proposed routes were included in the simulations.

2.3.2.4.1.4 *Modeling Results and Discussion*

The unmitigated predicted ambient concentrations of TSP (or PM) at the ASRs ranged from as low as 431 to as high as 6082 µg/Nm^3 in all modeling domains. Unmitigated predicted concentrations of PM_{10}, which represents about 30% of TSP (or PM), were also very high with maximum predicted concentrations at 1825 µg/$Nm^{3.}$ These unmitigated concentrations were few times higher than the ambient standard for TSP (or PM) set at 300 µg/Nm^3 including those for PM_{10}.

High predicted concentrations were apparently due to emissions of fugitive dusts without mitigating measures (i.e., wet suppression) arising from construction activities, such as bulldozing, removal of top soil, loading and unloading of excavated materials and other activities as shown in **Table 2-59.** Note that unmitigated concentrations of TSP and PM_{10}, as shown in **Table 2-59***,* were based on conservative (or very high) estimates of emission factors as presented in U.S. EPA's AP-42, and that dispersion modeling utilized the "worst-case" meteorological input data file ("Metsamp.met") of the EPA Victoria, Australia. These resulted to very high concentrations of TSP and PM_{10}.

2.3.2.4.1.5 *Proposed Mitigation and Monitoring Program*

To reduce the expected high concentrations of TSP (or PM) and PM_{10} especially during dry weather conditions coupled with high winds where high fugitive dusts generations are likely, common measures included water spraying of dry and exposed surfaces at the construction site and, if possible, suspend construction works during dry periods with very strong winds. These measures when implemented could significantly lower the concentrations of TSP (or PM) and PM_{10} downwind of the construction site where the ASRs are located. The results showing predicted TSP (or PM) and PM_{10} with mitigating measures as described above, showed significant reduction to a maximum of about 243 and 73 µg/Nm^3 for TSP (or PM) and PM_{10}, respectively. These concentrations were based on the assumed 96% reduction of fugitive dusts emissions with the implementation of the mitigation measures.

The modeling exercise in this section demonstrated the need to implement mitigating measures during construction activity along the proposed project route, especially on areas close to households (ASR) and during dry and windy conditions that favour generation of fugitive dusts. Part VII, Rule XXV, Section 13 (Prohibited Acts) in the implementing rules of the Philippine Clean Air Act (PCAA) prohibits the emissions of particulate matter from any type of sources, such as vehicular movement, transport of materials and construction activities, without measures to prevent or limit fugitive dust emissions. The ambient air quality standard for TSP (or PM) set at 300 µg/Nm^3 (including PM_{10} at 200 µg/Nm^3) may apply for this project during construction works.

In summary, the following are the proposed mitigation measures to reduce fugitive dust emissions during construction period.

a) Conduct water spraying at dry and exposed areas near residences. This should be regularly done during dry weather condition wherein fugitive dusts are potentially dispersed by winds;
b) Provide wheel washing facilities at the construction site especially during rainy or wet season in order to remove muds at the tires of the heavy equipment and other vehicles, which are potential sources of fugitive emissions when detached from tires of vehicles traveling outside the project site (e.g., paved or unpaved roads);
c) Impose speed limits within the construction site and along access roads;

d) If possible, re-route vehicles at considerable distances from the ASRs. This measure (re-routing) is effective means of decreasing release of fugitive emissions to nearby ASRs, especially during very dry conditions where wetting of dry surfaces would be effective for short duration;
e) Suspend construction works during very dry weather condition and windy conditions when dusts are apparently dispersed to nearby ASRS; and,
f) Conduct regular visual inspection at the project site to determine areas with high fugitive emissions, and to implement mitigation measures when necessary. Ambient monitoring of TSP, PM_{10}, SO_2, and NO_2 should also be conducted to check compliance with the ambient air quality standards.

The potential impacts on air quality during construction and the proposed mitigation measures are shown in **Table 2-73**.

2.3.2.4.2 Operation Phase

This section presents the updated air modeling covering operation of TR4-A and TR4-E including the modeling results for TR4-B to TR4-D, which were presented in the compliance report. Dispersion modeling in the compliance report focused on TSP (or PM), PM_{10}, SO_2, NO_2, and CO because these were the parameters or pollutants required in ECC Condition No. 8 of the original TR4 alignment. For the re-alignment of TR4-A and TR4-E, dispersion modeling included Carbon Monoxide (CO) as one of the significant emissions from vehicular traffic.

2.3.2.4.2.1 CALINE4 Air Dispersion Model

CALINE4 was developed by the California Department of Transportation (Caltrans) to assess the air quality impacts of roadway projects. This model was based on the Gaussian diffusion equation and employs the mixing zone concept within the roadway. CALINE4 is capable of modeling CO, NO_2, suspended particulates, and other inert gases. It is also used to model SO_2 for this project. CALINE4 is the upgraded version of CALINE3, in which the latter has limitations as it is only capable of modeling CO along roadways.

The following are some of the limitations of CALINE4 (Source: CALINE4 User's Manual)

1) CALINE4 assumes a zone of uniform emissions and turbulence over the modelled highway or lanes plus three (2) meters on either side. This is to account for initial horizontal dispersion due to vehicle wake;
2) Thermal turbulence created by hot vehicle exhaust are assumed to be the dominant dispersive mechanisms for all atmospheric conditions, except on the most unstable atmospheric conditions;
3) Surface roughness is assumed to be reasonably uniform throughout the modelling domain or study; and
4) Meteorological variables of atmospheric stability, wind speed and wind direction are also taken as constant over the study area

2.3.2.4.2.2 Modeling Domain and Area Sensitive Receptors

Figure 2-53 shows the modeling domains used in the compliance report and the current modeling study. Dispersion modeling for TR4-A and TR4-E utilized six (6) receptors at both sides along each kilometer stretch of the proposed re-alignment, as shown in **Figure 2-54** and **Figure 2-55**, respectively. The purpose of assigning parallel and line receptors at each kilometer stretch along TR4-A and TR4-E is to generate contours of predicted GLCs that are likely parallel to the alignment given the type of emission source (e.g., line source). CALINE4, however, it is limited to generating 35 receptors per simulation, thus it would be impractical to process finely-spaced receptors (e.g., 100 m grid size) in the vicinities of the proposed project route.

2.3.2.4.2.3 Model Input Data

The input data to CALINE4 are categorized into three (3) major groups as follows:

a) Coordinates of highway links from KM-56 to KM-114, as shown in **Table 2-60**.
b) Vehicles per hour and the emission rates of PM, PM_{10}, SO_2 and NO_2 (**Table 2-61**); and,
c) Meteorological input data (**Table 2-62**).

Table 2-60 shows the coordinates at every one (1) km from KM 47 (herein referred as "highway links"). There are seven (7) modeling domains considered in this study, five of which were already included in the compliance report and the remaining two (2) are presented in the current modeling.

The vehicles per hour and its corresponding emission rates (**Table 2-61**) were based on the updated traffic study of SLTC in 2012 and the emission factors for PM and NO_X for Clean Air Asia (2012) and SO_2 and PM_{10} from Venfield (2013).

Meteorological input data utilized the general prevailing winds at the project site, which are the northeast and southwest winds. As shown in **Table 2-62**, atmospheric stability classes were varied from PG Class 1 to 6, including wind speeds and ambient air temperatures in order to include likely meteorological surface conditions at the project site.

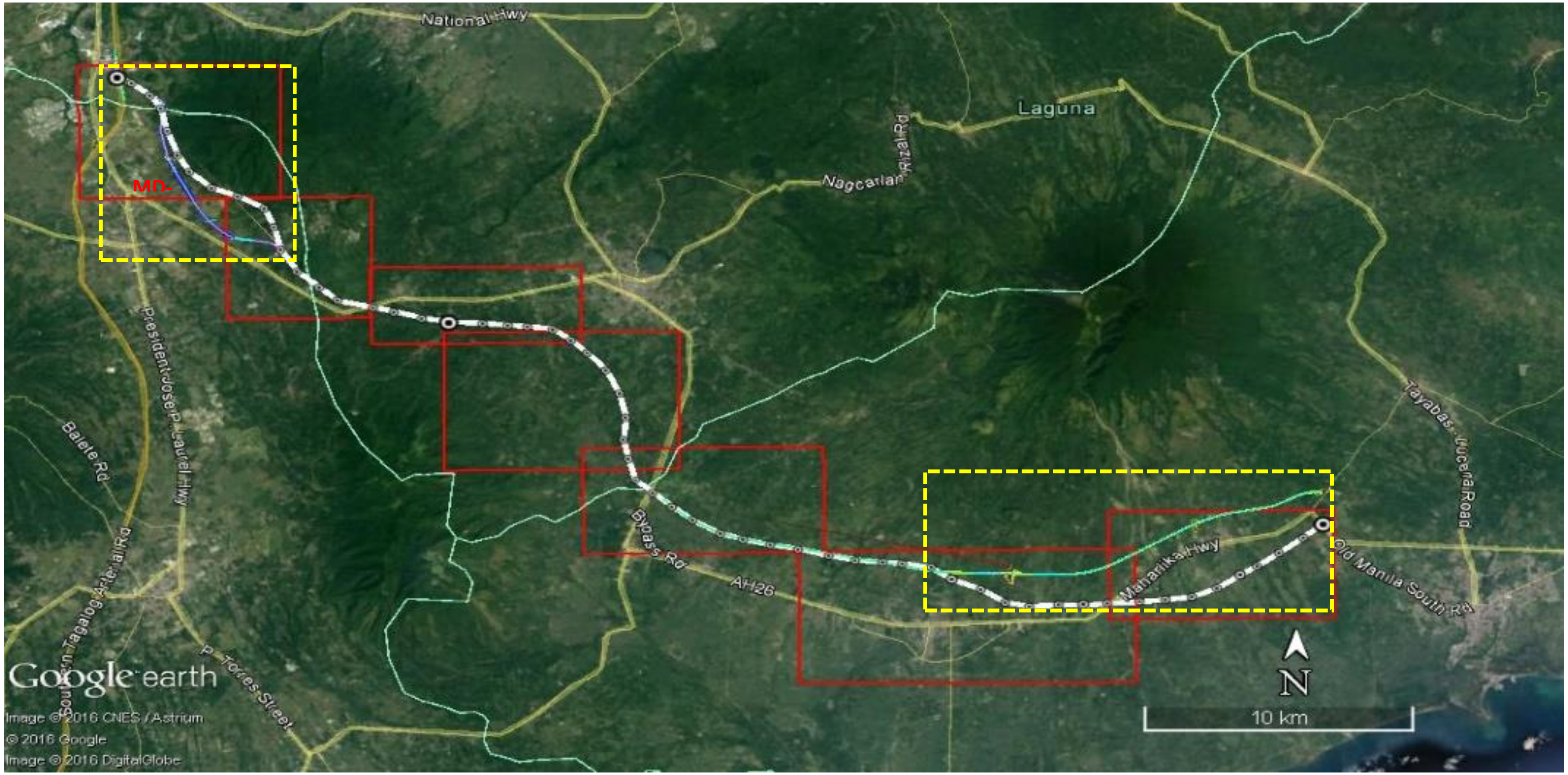


Figure 2-53: Modeling domains used in the previous and current modeling studies

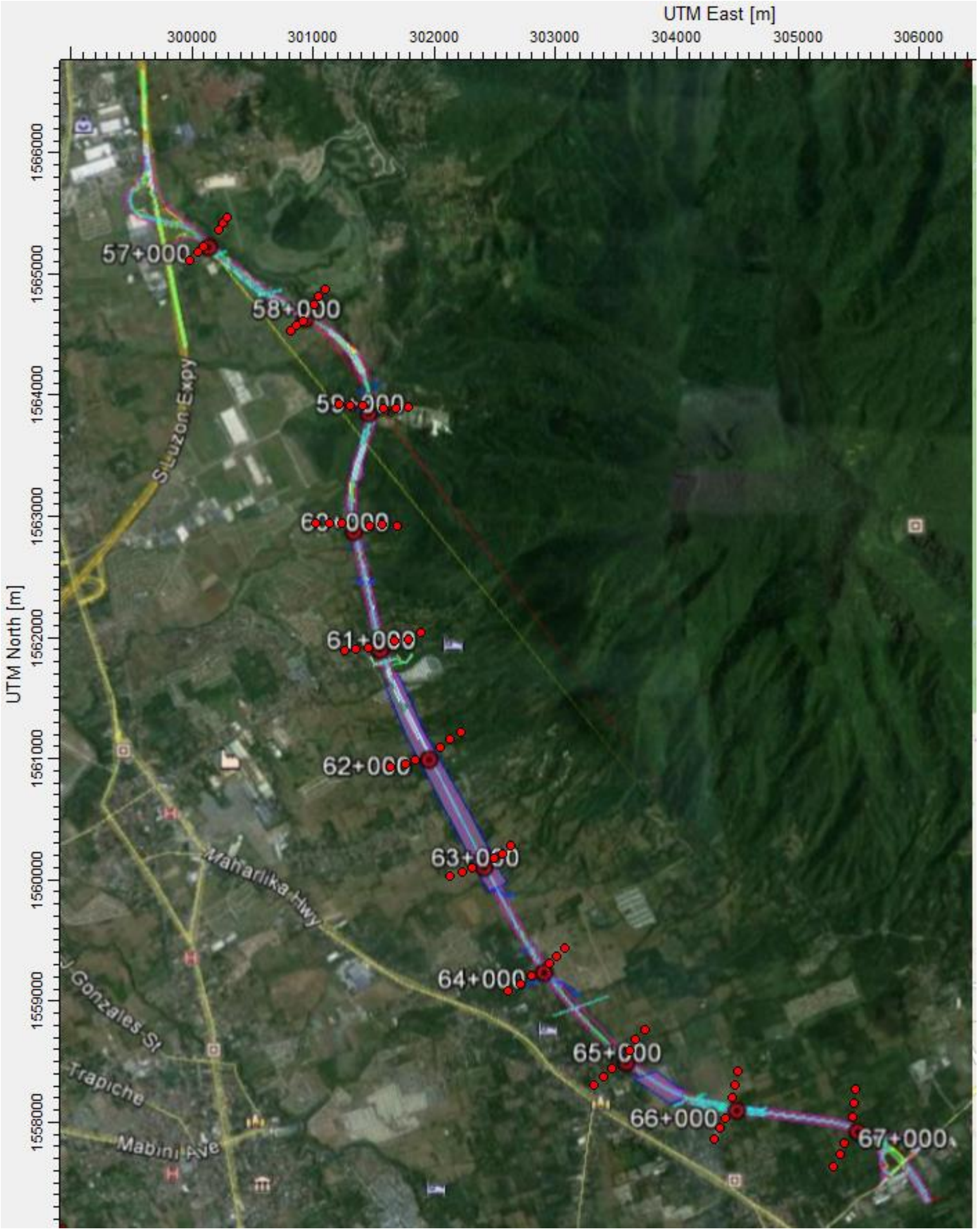


Figure 2-54: Locations of receptors used in CALINE4 modeling for Package A

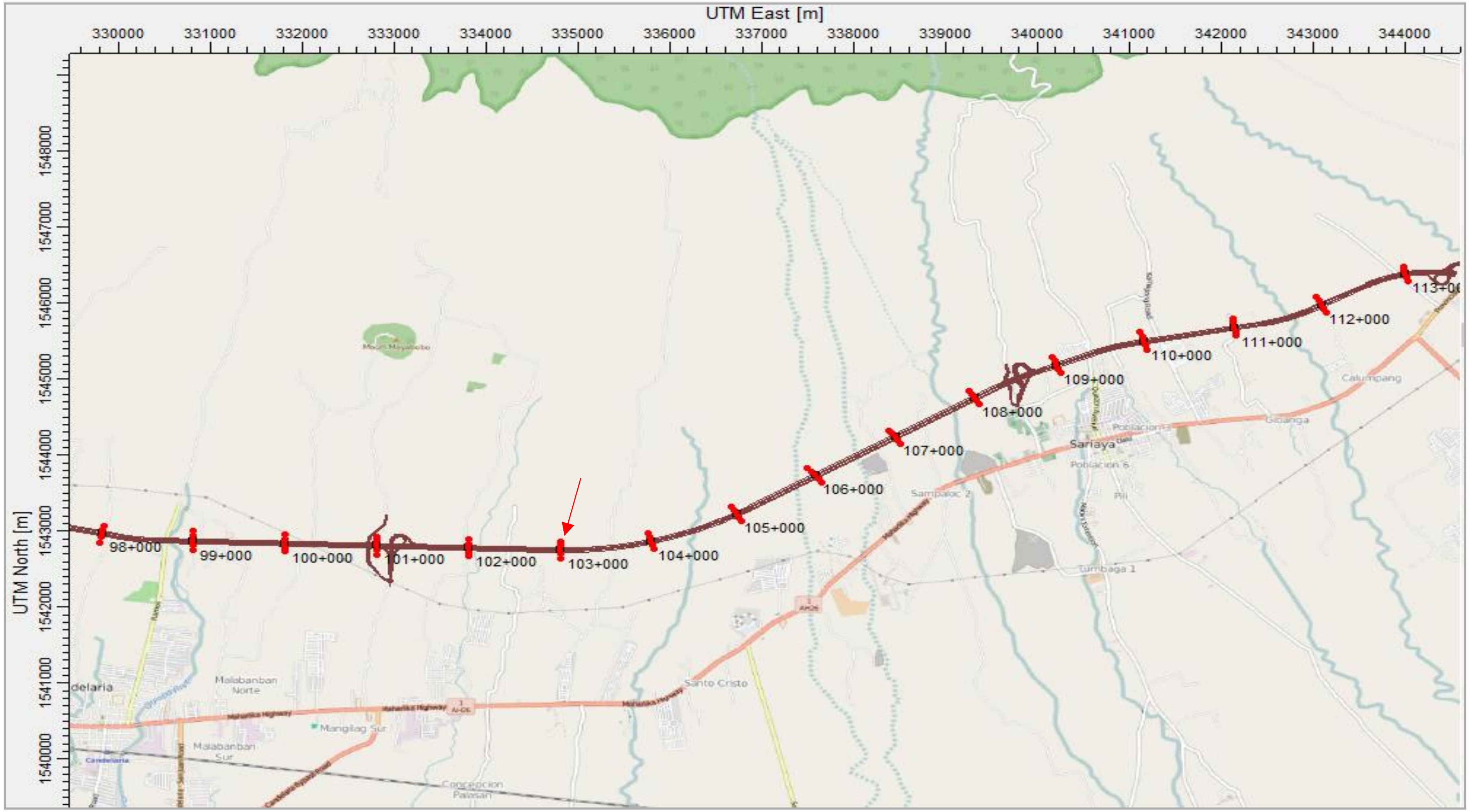


Figure 2-55: Locations of receptors used in CALINE4 modeling for Package E

Table 2-60: Modeling domain and coordinates of highway km numbers

Modeling Domain	*KM No./Link*	X-Coordinate (m)	Y-Coordinate (m)
MD-1 (Package A)	*Link start*	299765	1565513
KM56- KM 67	*57+000*	300180	1565296
	58+000	300968	1564684
	59+000	301485	1563893
	60+000	301351	1562918
	61+000	301560	1561936
	62+000	301952	1561023
	63+000	302396	1560125
	64+000	302878	1559249
	65+000	303542	1558503
	66+000	304438	1558101
Makban Interchange	67+000	305419	1557921
MD-2	64+000	304187	1560076
KM 64- KM 71	65+000	305177	1559514
	66+000	305535	1558678
	67+000	305787	1557667
	68+000	306385	1556657
	69+000	307215	1555932
	70+000	307894	1555349
MD-3	71+000	309222	1555019
KM 71- KM79	72+000	309993	1554795
	73+000	311027	1554503
	74+000	312061	1554332
	75+000	313305	1554264
	76+000	314242	1554166
	77+000	314972	1554106
	78+000	315912	1553966
MD-4	79+000	316589	1553468
KM79-KM85	80+000	317187	1552903
	81+000	317875	1552117
	82+000	318382	1551058
	83+000	318599	1549974
	84+000	318505	1548970
MD-5	85+000	318690	1548105
KM85-KM93	86+000	318964	1547144
	87+000	319585	1546560
	88+000	320299	1545930
	89+000	321069	1545323
	90+000	322101	1544712
	91+000	322933	1544444
	92+000	323952	1544190

Modeling Domain	KM No./Link	X-Coordinate (m)	Y-Coordinate (m)
MD-6	93+000	324992	1543976
KM93-KM105	94+000	326132	1543683
	95+000	327115	1543460
	96+000	328140	1543366
	97+000	328870	1543292
Start of Package E	98+000	329949	1543132
	99+000	330716	1542589
	100+000	331788	1542112
	101+000	332693	1541516
	102+000	333591	1541329
	103+000	334684	1541406
	104+000	335616	1541419
	105+000	336506	1541462
MD-7 (Package E)	Start of Link	329415	1543056
KM98-KM113	98+000	329825	1542968
	99+000	330817	1542868
	100+000	331816	1542838
	101+000	332816	1542808
	102+000	333815	1542777
	103+000	334815	1542748
	104+000	335805	1542866
	105+000	336736	1543225
	106+000	337598	1543731
	107+000	338459	1544240
	108+000	339319	1544749
	109+000	340216	1545186
	110+000	341165	1545492
	111+000	342148	1545674
	112+000	343094	1545977
	113+000	344004	1546382

Table 2-61: Input Emission Rates and Vehicles per Hour

Section	Vehicles per hour	Emission Rate (g/mile)				
		PM	PM_{10}	SO_2	NO_2	CO
Sto Tomas IC to MakBan IC	3,267	1.474	0.145	0.006	1.506	50.932
Makban to San Pablo	925	1.474	0.145	0.006	1.506	50.932
San Pablo to Tiaong	717	1.474	0.145	0.006	1.506	50.932
Tiaong to Candelaria	791	1.474	0.145	0.006	1.506	50.932
Candelaria to Lucena	903	1.474	0.145	0.006	1.506	50.932

Notes:

a) *SO_2 molecular weight = 64 g/mole*
b) *NO_2 molecular weight = 46 g/mole*
c) *NO_2 – 15% of NO_X*

Table 2-62: Meteorological Input Data

No.	Bearing	Wind Speed (m/s)	Stability (P-G Classes)	Temperature (ºC)
1	45	1	1	31
2	45	1	2	31
3	45	2	3	27
4	45	4	4	28
5	45	4	5	24
6	45	3	6	24
7	225	1	1	31
8	225	1	2	31
9	225	2	3	27
10	225	4	4	28
11	225	4	5	24
12	225	3	6	24

2.3.2.4.2.4 Modeling Results and Discussions

CO is a colorless, odourless and poisonous gas, which is a product of incomplete burning of hydrocarbon-based fuels. As shown in **Table 2-61**, the total estimated emissions of CO arising from operation of vehicles along the proposed project route is 50.932 g/mile.

Table 2-63 shows the predicted highest 1-hour and 8-hour average concentrations of CO in Package A and E modeling domains. The highest predicted CO concentrations were 2.9 and 1.74 ppm for Packages A and E, respectively. Predicted CO concentrations in MD-1 (or Package A) were higher than those in MD-7 (or Package A) due to higher traffic volume in Package A.

The predicted highest concentrations of CO were within the ambient guideline values set for CO at 30 and 9 ppm for 1-hour and 8-hour averaging time periods, respectively. Note that dispersion modeling of CO was not included in the original TR4 alignment, as the requirement was only for TSP, PM10, SO2, and NO2.

Table 2-63: Summary Results of Predicted Concentrations of Carbon Monoxide (CO) for TR4-A and TR4-E

Modeling Domain	Statistics	CO (1-hour Average) (ppm)	CO (8-hour Average) (ppm)
MD-1 (TR4-A)	Minimum	0.00	0.00
	Maximum	2.90	1.74
	Average	0.39	0.24
MD-1 (TR4-E)	Minimum	0.00	0.00
	Maximum	0.40	0.24
	Average	0.18	0.11
NAAQG values for CO (ppm)		30	9

Table 2-64 and **Table 2-65** show the predicted plus background concentrations of TSP, PM_{10}, SO_2, and NO_2 in modeling domains MD1 to MD7 (or TR4-A to TR4-E). **Figure 2-56** to **Figure 2-61** shows the predicted concentrations of TSP, NO_2, and CO arising from vehicular emissions in TR4-A and

TR4-E modeling domains. **Annex O** presents the predicted concentrations from MD2 to MD6, as extracted from the compliance report.

The following shows the lowest and highest predicted concentrations of TSP, PM_{10}, and NO_2 in all modeling domains:

- TSP (1-hour) – 28.5 to 209.8 µg/Nm^3;
- TSP (24-hour) – 11.4 to 83.9 µg/Nm^3;
- PM_{10} (1-hour) – 8.6 to 62.9 µg/Nm^3;
- PM_{10} (24-hour) – 3.4 to 25.2 µg/Nm^3;
- NO_2 (1-hour) – 0 to 0.1 ppm;
- NO_2 (8-hour) – 0 to 0.04 ppm, and
- SO_2 (1-hour and 24-hour) – 0 (or nil)

The result showed varying concentrations at the ASRs in the modeling domains depending on the locations of the ASR relative to the proposed project route. Relatively high predicted ambient concentrations were noted near the road right-of-way of the proposed route (please refer to **Figure 2-56 to Figure 2-57** and **Annex O**). Note that the plots of predicted concentration in the compliance report, which are shown in **Annex P,** are concentrated at the locations of the ASR, as generation of contours using Surfer™ utilized only data at each ASR.

Although the predicted TSP concentrations were within the ambient standards and guideline values, the relatively high background concentrations have contributed to cumulative increase of predicted TSP concentrations.

Predicted NO_2 concentrations plus background were also within the ambient standards and guideline values set for NO_2 of 0.14 ppm and 0.08 ppm for 1-hour and 24-hour averaging times, respectively. NO_2 emitted from the tail pipes of vehicles were assumed 30% of the total NO_X emissions.

Predicted concentrations of SO_2 were relatively low (almost negligible) due to low sulfur content in gasoline and diesel fuels.

2.3.2.4.2.5 <u>Proposed Mitigation and Monitoring Program</u>

The predicted concentrations of PM, PM_{10}, NO_2, SO_2, and CO arising from operation of the project were within the ambient standards and guideline values. Thus, it can be said that there is no significant adverse impacts of the project in terms of increase of air emissions during operation phase.

It is, however, recommended to consider planting of strip of trees along both sides of the road-right-of way where ASRs or residences are located. The strip of trees will serve as screens to block dispersed air emissions from vehicular traffic.

It is also recommended to conduct monthly monitoring of TSP, PM_{10}, NO_2 and CO at ASRs or residences located close to the project route during the first year of operation. Thereafter, reduce the frequency of sampling, as necessary.

The potential impacts on air quality during operation and the proposed mitigation measures are shown in **Table 2-73**.

Table 2-64: Summary Results of Predicted one-hour average TSP (or PM), PM_{10}, SO_2 and NO_2 at the ASR in Seven (7) Modeling Domains from KM-56 to KM-114

Modeling Domain	Statistics	TSP (or PM) (μg/Nm^3)	PM_{10} (μg/Nm^3)	SO_2 (ppm)	NO_2 (ppm)
MD-1 (TR4-A)	Minimum	141.5	42.5	0	0.03
	Maximum	202.1	60.6	0	0.10
	Average	162.2	48.7	0	0.05
MD-2	Minimum	48.8	14.6	0	0.00
	Maximum	183.3	55.0	0	0.07
	Average	67.9	20.4	0	0.01
MD-3	Minimum	131.6	39.5	0	0.00
	Maximum	209.8	62.9	0	0.04
	Average	137.9	41.4	0	0.00
MD-4	Minimum	117.0	35.1	0	0.00
	Maximum	173.9	52.2	0	0.05
	Average	127.5	38.3	0	0.01
MD-5	Minimum	66.2	19.9	0	0.00
	Maximum	89.7	26.9	0	0.01
	Average	72.2	21.7	0	0.00
MD-6	Minimum	28.5	8.6	0	0.00
	Maximum	105.6	31.7	0	0.10
	Average	47.6	14.3	0	0.00
MD-7 (TR4-E)	Minimum	137.3	41.2	0	0.03
	Maximum	155.9	46.7	0	0.05
	Average	144.9	43.5	0	0.04
DENR NAAQS*		300	200	0.13 (1-hour)	0.14 (1-hour)

Note – The Results for the Stations in Italics are adapted from the 2014 Compliance Report

Table 2-65:Summary Results of Predicted 24-hour average TSP (or PM), PM_{10}, SO_2 and NO_2 at the ASR in Seven (7) Modeling Domains from KM-56 to KM-114

Modeling Domain	Statistics	TSP (or PM) (µg/Nm^3)	PM_{10} (µg/Nm^3)	SO_2 (ppm)	NO_2 (ppm)
MD-1 (TR4-A)	Minimum	56.6	17.0	0.0	0.01
	Maximum	80.9	24.2	0.0	0.04
	Average	64.9	19.5	0.0	0.02
MD-2	Minimum	19.5	5.9	0.0	0.00
	Maximum	73.3	22.0	0.0	0.03
	Average	27.2	8.1	0.0	0.00
MD-3	Minimum	52.6	15.8	0.0	0.00
	Maximum	83.9	25.2	0.0	0.02
	Average	55.2	16.5	0.0	0.00
MD-4	Minimum	46.8	14.0	0.0	0.00
	Maximum	69.6	20.9	0.0	0.02
	Average	51.0	15.3	0.0	0.00
MD-5	Minimum	26.5	7.9	0.0	0.00
	Maximum	35.9	10.8	0.0	0.00
	Average	28.9	8.7	0.0	0.00
MD-6	Minimum	11.4	3.4	0.0	0.00
	Maximum	42.2	12.7	0.0	0.04
	Average	19.0	5.7	0.0	0.00
MD-7 (TR4-E)	Minimum	54.9	16.5	0.0	0.01
	Maximum	62.4	18.7	0.0	0.02
	Average	57.9	17.4	0.0	0.02
DENR NAAQG (24-hour average)*		230	150	0.07	0.08

Note – The Results for the Stations in Italics are adapted from the 2014 Compliance Report

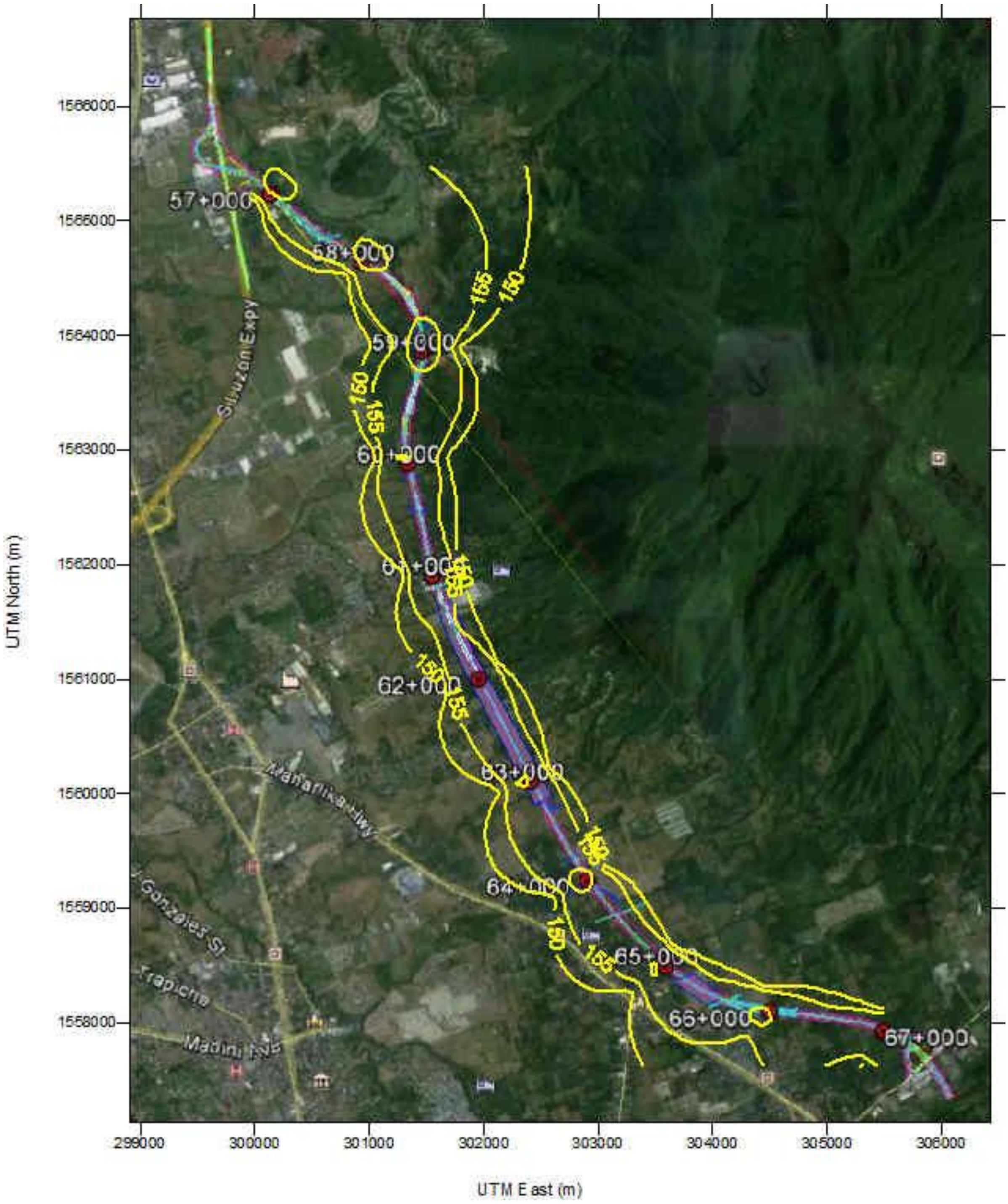


Figure 2-56: Predicted PM in Package A (in µg/Nm^3)

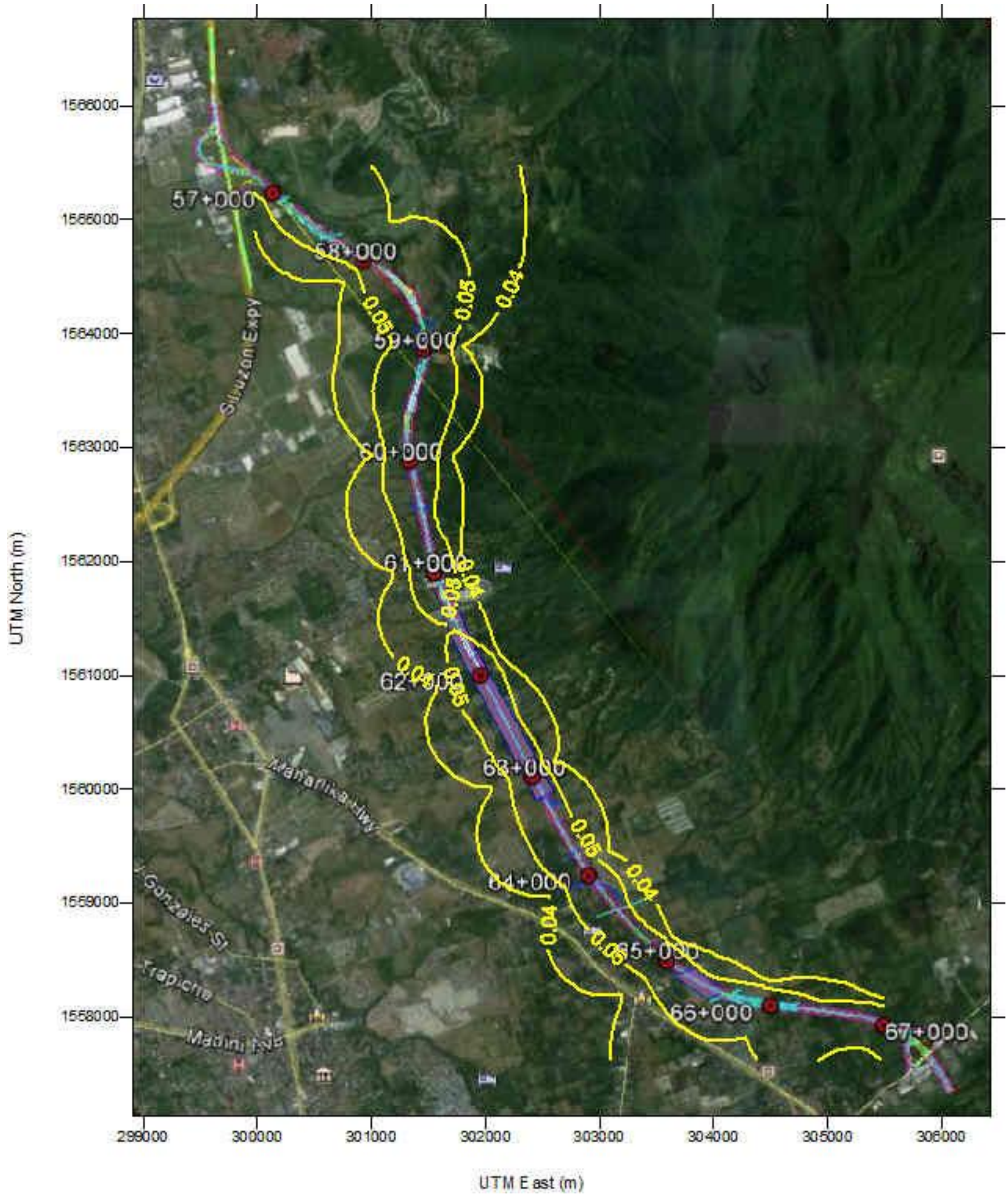


Figure 2-57: Predicted NO_2 in Package A (in ppm)

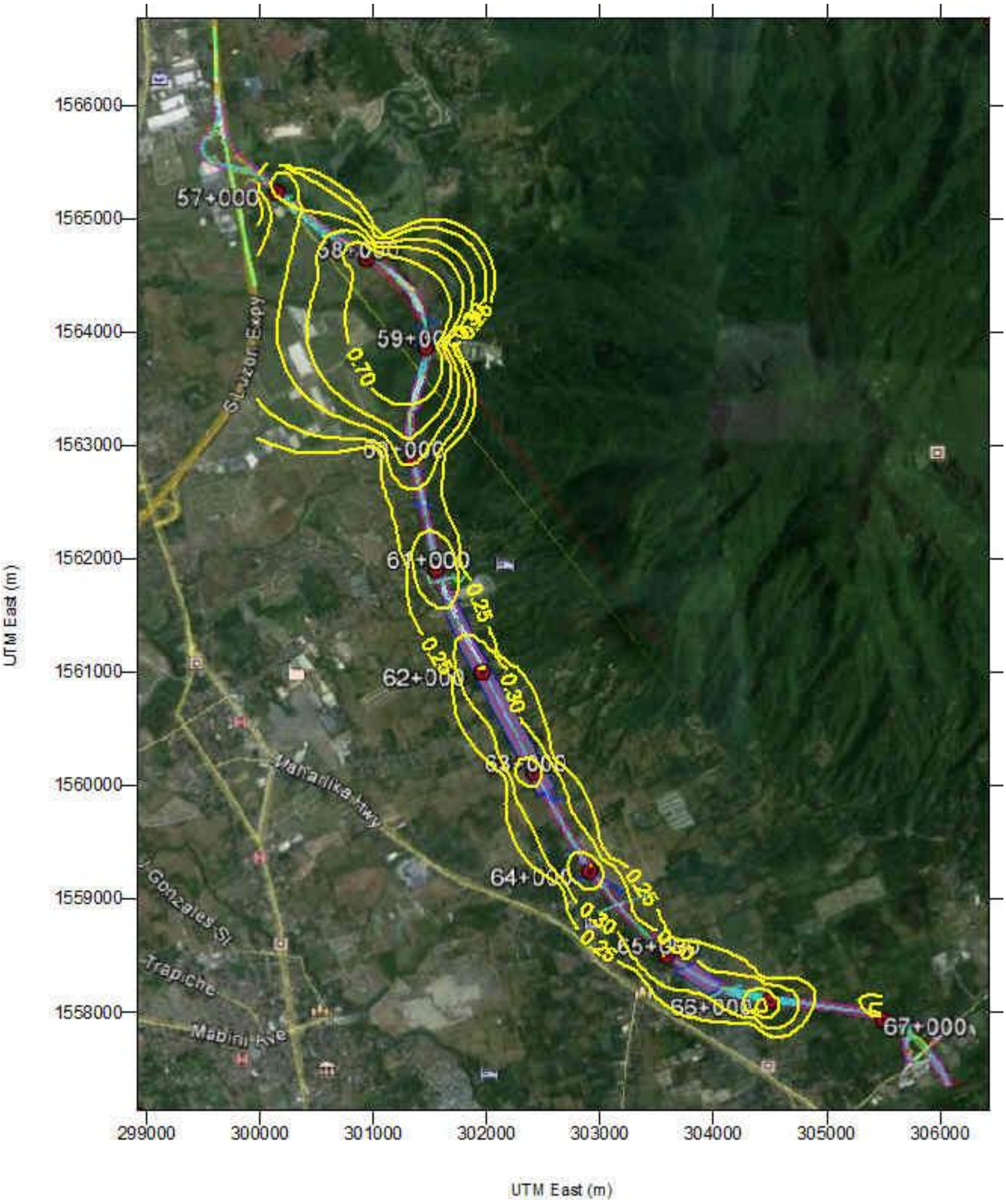


Figure 2-58: Predicted CO in Package A (in ppm)

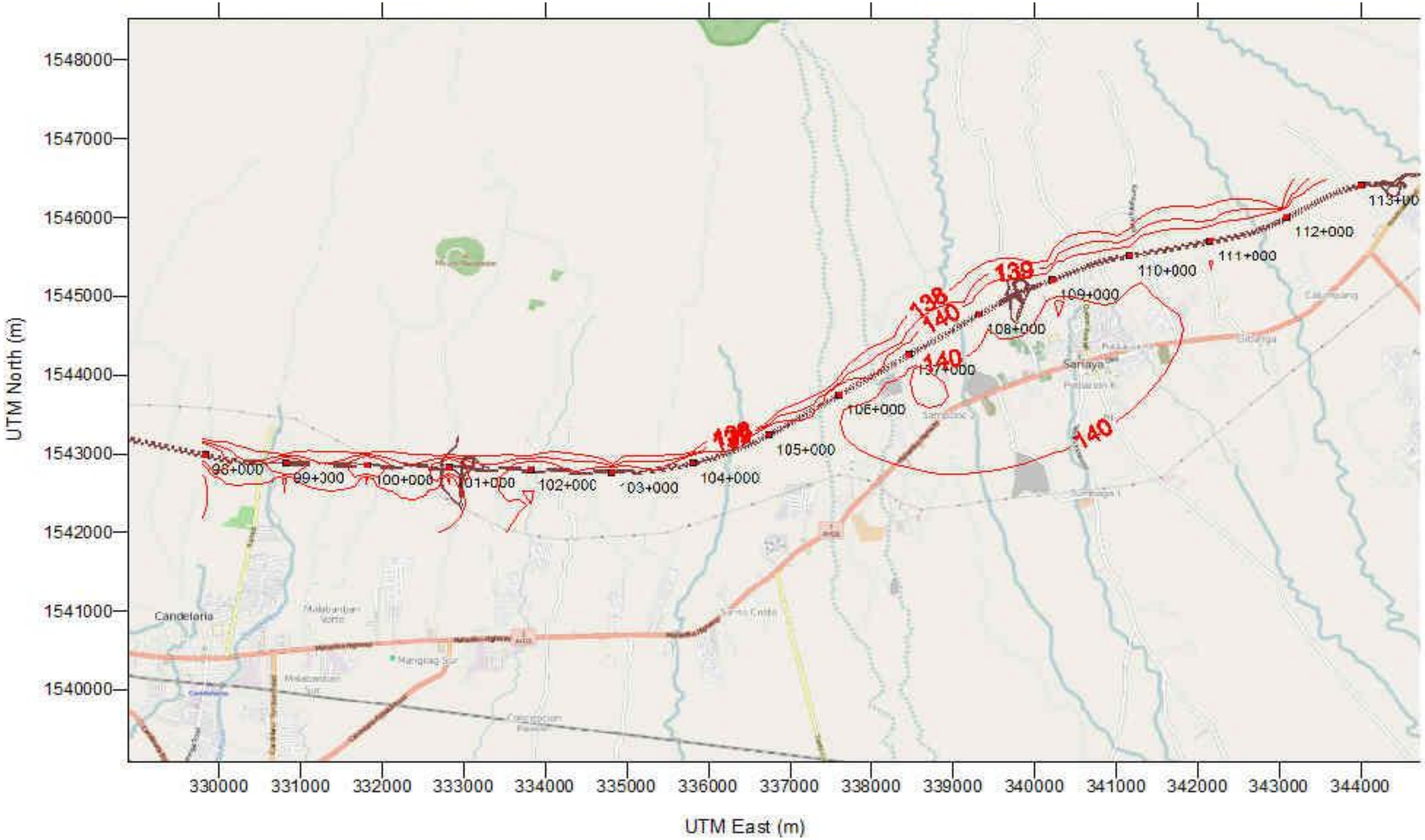


Figure 2-59: Predicted PM in Package E (in µg/Nm³)

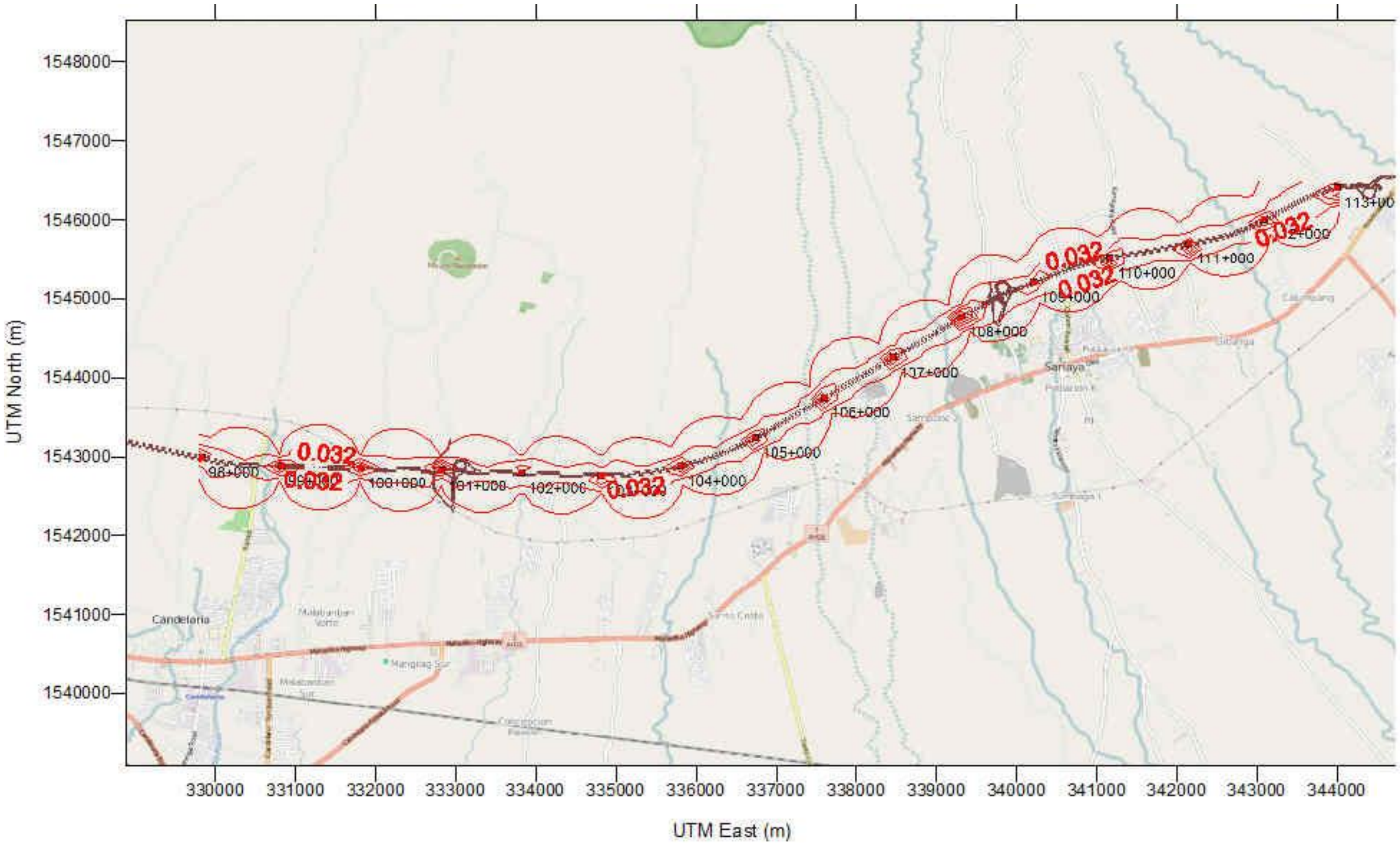


Figure 2-60: Predicted NO_2 in Package E (in ppm)

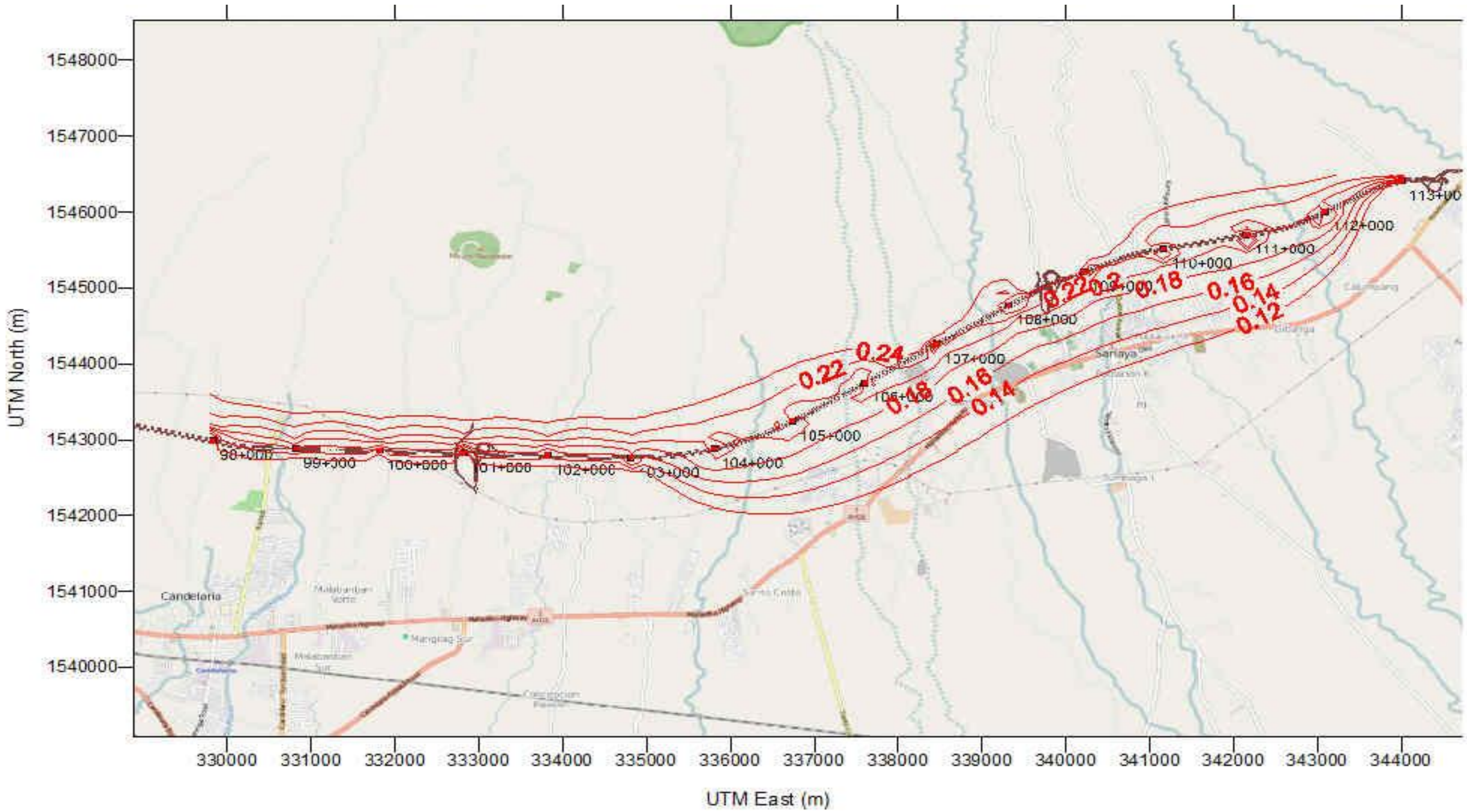


Figure 2-61: Predicted CO in Package E (in ppm)

2.3.3 Ambient Noise

2.3.3.1 Scope

This section presents the updated baseline and noise impact assessment for the proposed project based on the report submitted to DENR-EMB in 2014 (herein referred to as “compliance report”) in compliance with Condition No. 9 of ECC-CO-1402-0002 of the original TR4 alignment, which required SLTC to submit a revised noise modeling report covering construction and operation of the project. The said report aimed to address the specific requirements of the Review Committee, which included among others, tabulation of noise modeling input data, list of construction equipment to be used, and the results of the noise modeling at the Noise Sensitive Receptor (NSR) during construction and operation phases.

2.3.3.2 Methodology

2.3.3.2.1 Applicable Noise Standards

The applicable environmental noise standards are those stipulated in NPCC (1980), as shown in **Table 2-66**. In accordance with Section 78 (b) of NPCC (1980), a correction factor equivalent to +10 dBA shall apply to areas directly facing the proposed project route. It follows that for residential areas directly facing the road right-of-way of the proposed project, the applicable noise standards are 65 dBA (55 dBA + 10 dBA) for daytime, 60 dBA (50 dBA + 10 dBA) for morning and evening periods, and 55 dBA (45 dBA + 10 dBA) for nighttime periods. Note that the NPCC noise standards have not been revised since its issuance in 1980.

Table 2-66: Philippine Ambient Air Quality Standards

Category[1]	Maximum Allowable Noise (dBA) by time periods[2]		
	Daytime	Morning/Evening	Nighttime
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

[1]Class AA - a section of contiguous area which requires quietness, such as areas within 100 meters from school site, nursery schools, hospitals and special house for the aged

Class A - a section of contiguous area which is primarily used for residential area

Class B - a section of contiguous area which is primarily a commercial area

Class C - a section of contiguous area reserved as light industrial area

Class D -a section which is primarily reserved as heavy industrial area

[2] Morning - 5:00 A.M. to 9:00 AM

Daytime -9:00 A.M. to 6:00 P.M.

Evening -6:00 P.M. to 10:00 P.M.

Nighttime -10:00 P.M. to 5:00 A.M.

[3]Correction factor = + 5 dBA for areas facing two-lane roads

= + 10 dBA for areas facing a four-lane road or wider

2.3.3.2.2 Background Noise Monitoring

Berkman Systems, Inc (BSI) conducted noise level monitoring at ten (10) locations along the proposed original project route from July 16 to 21, 2013. A Lutron Noise Level meter was used to measure noise levels at A-weighting mode. A total of fifty (50) readings was recorded per monitoring station per time period (e.g., morning, daytime, evening, and nighttime)

In July 2016, Ascott Pacific Consultants, Inc. commissioned Hi-Advance, Inc., a third-party environmental monitoring service provider, to conduct ambient air and noise monitoring at six (6) locations along the TR4-A and TR4-E (3 stations along TR4-A and 3 stations along TR4-E). Hi-Advance utilized an Extech Sound Level Meter (Model 407736) during the said baseline monitoring.

2.3.3.2.3 Simulation for the Noise Impact Assessment

The expected increase of noise during construction and operation phases was assessed using the Roadway Construction Noise Model (RCNM) and Custic 3.2 Noise Model. RCNM was developed by the US. Federal Highway Administration (FHWA) in the United States as a screening tool to predict attenuated noise levels from operation of construction equipment. On the hand, Custic 3.2 Noise Model, which was developed by Canarina Environmental Software, has options to model noise emission from vehicular traffic by specifying the average vehicle velocity and the traffic volume. **Section 2.3.2.4** below presents the technical details of RCNM and Custic 3.2.

2.3.3.3 Baseline Studies/Background Noise Levels

Figure 2-63 to **Figure 2-66** show the observed noise levels at ten (10) locations along the original proposed project route during early morning, daytime, early evening, and nighttime periods in July 2013.

Equivalent noise levels (L_{eq}) at all stations in all periods of the day range from about 46.9 dBA to 69.8 dBA (**Table 2-68**). Without most of the noise sources at the time of monitoring (i.e., observed readings higher than 90% are excluded), it appears that L_{90} ranged from 46 dBA to 60.8 dBA. These represent the background levels at areas close to the highway. Wilson (1989) referred L_{90} as the background noise levels.

In June 2016, Hi-Advance conducted ambient noise monitoring at three (3) locations along each of the proposed alignment of TR4-A and TR4-E. Equivalent noise levels (L_{eq}) at all stations ranged from 52.1 to 63.1 dBA and the background noise levels (L_{90}) range from 51.2 to 59.4 dBA (**Table 2-69**). The differences of measured noise levels among the monitoring locations were highly attributed to the number of vehicles passing the area and the proximity of the noise stations from the road.

For the June 2016 sampling as shown in **Table 2-68**, it appears that the baseline noise levels (median of 7 highest readings) at areas adjacent to roads (except PE-A4 and PE-A6) were generally higher than the prescribed daytime noise standards for residential areas (55 dBA + 5 dBA correction factor for areas facing two-lane roads).

Sources of noise at the time of monitoring were generally from vehicular traffic and community noise.

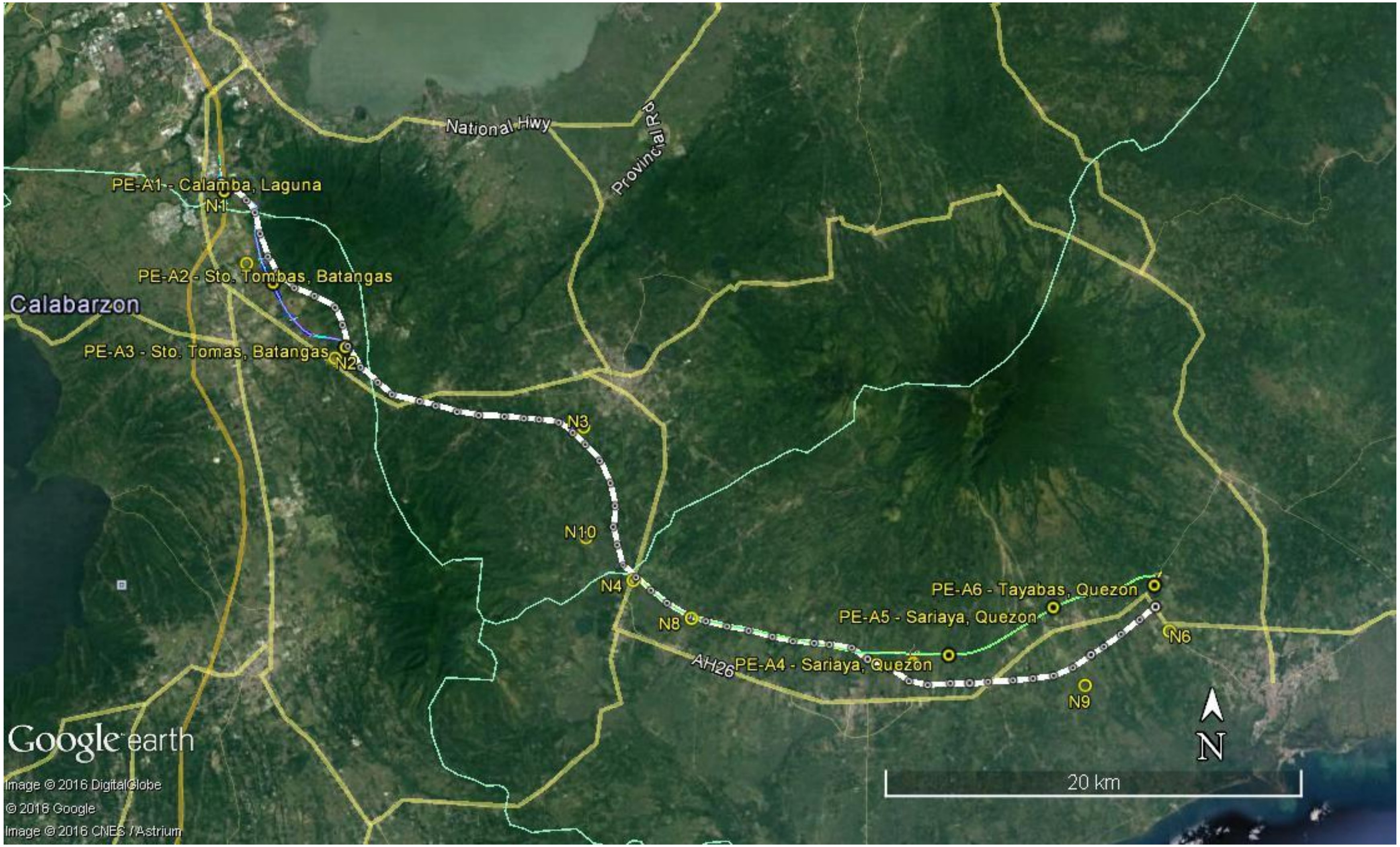


Figure 2-62: Map showing locations of air and noise sampling stations

Table 2-67: Measured noise levels along the proposed TR4 from July 16 to 21, 2013

Sta ID.	Location	Coordinates	Date of Sampling	Early Morning			Daytime			Early Evening			Nighttime		
				Min (dB A)	Max (dB A)	Leq (dBA_)	Min (dB A)	Max (dB A)	Leq (dB A)	Min (dB A)	Max (dB A)	Leq (dB A)	Min (dB A)	Max (dB A)	Leq (dBA)
N1	Brgy. Saimsim, Calamba, Laguna	N 14º 09'01.6" E 121º 08'41.6"	July 16-17, 2013	55.4	62.6	60.2	57.0	62.4	58.6	54.6	62.7	59.9	54.1	62.7	58.8
N2	Brgy. San Felix, Sto. Tomas, Batangas	N 14º 04'39.8" E 121º 11' 43.0"	July 17-18, 2013	51.6	54.6	53.4	52.1	61.4	54.2	51.2	60.7	55.0	48.6	57.5	53.8
N3	Brgy. San Miguel, San Pablo, Laguna	N 14º 02'53.0" E 121º 18'22.2"	July 17-18, 2013	56.7	62.5	59.9	54.1	63.1	59.3	54.0	59.9	57.7	54.0	61.5	58.5
N4	Brgy. Lalig, Tiaong, Quezon	N 13º 58'55.2" E 121º 19'41.7"	July 18-19. 2013	47.5	60.0	53.1	51.0	56.8	53.4	52.7	57.0	55.2	48.3	56.9	54.0
N5	Brgy. Mangilag, Candelaria, Quezon	N 13º 56'46.6" E 121º 27'11.1"	July 19-20, 2013	44.6	60.6	49.1	46.4	54.7	49.9	44.0	55.4	49.1	44.0	49.9	46.9
N6	Brgy. Isabang, Tayabas, Quezon	N 13º 57' 36.2" E 121º 34' 02.3"	July 20-21, 2013	54.5	75.2	65.5	57.5	76.0	67.6	54.3	74.9	69.8	54.8	74.9	68.1
N7	Brgy. San Antonio, Sto. Tomas, Batangas	N 14º 07' 06.3" E 121º 09' 20.8"	July 16-17, 2013	58.7	64.8	61.8	57.7	62.4	58.4	58.7	62.4	60.8	58.7	62.7	59.8
N8	Brgy. Anastacia, Tiaong, Quezon	N 13º 57'56.6" E 121º 21'15.2"	July 19-20, 2013	59.1	61.1	59.6	60.1	62.1	61.2	60.1	62.3	61.2	59.1	62.5	59.9
N9	Brgy. Tumbaga I, Sariaya, Quezon	N 13º 56'12.1" E 121º 31'46.8"	July 20-21, 2013	59.0	60.4	59.7	57.7	60.6	57.6	47.8	55.1	50.0	48.0	60.6	57.6
N10	Brgy. Santisimo Rosario,San Pablo, Laguna	N 14º 00'01.6" E 121º 18' 26.0"	July 18-19, 2013	50.1	59.9	54.9	33.7	60.7	56.5	49.5	60.1	56.4	49.8	57.8	51.3

Table 2-68: Measured noise levels on June 2-3, 2016 along the proposed routes of Packages A and E

Sta. No.	Location	Location Coordinates	Date/ Time of Sampling	Min (dBA)	Max (dBA)	Median (dBA)	Leq (dBa)
PE-A6	Vista Verde Residential Estate, Brgy. Calumpang Tayabas, Quezon	N 13° 58' 49.29" E 121° 33' 39.46"	02June2016/ 1150H-1200H	50.7	54.1	53.4	52.1
PE-A5	Palmas Verdes, Brgy. Concepcion I Sariaya, Quezon	N 13° 58' 14.99" E 121° 30' 57.12"	02June2016/ 1425H-1435H	52.0	65.7	63.9	58.3
PE-A4	Halamanan Street, Brgy. Concepcion I Sariaya, Quezon	N 13° 57' 1.25" E 121° 28' 9.19"	02June2016/ 1650H-1700H	51.4	60.9	59.3	54.9
PA-A3	Brgy. San Felix Sto. Tomas, Batangas	N 14° 4' 58.36" E 121 °12' 0.94"	03June2016/ 1010H-1020H	55.7	68.9	66.3	63.1
PA-A2	Brgy. San Bartolome Sto. Tomas, Batangas	N 14° 6' 38.02" E 121° 10' 4.87"	03June2016/ 1305H-1315H	50.1	67.1	65.2	60.6
PA-A1	Purok I, Brgy. Makiling Calamba, Laguna	N 14° 8' 59.83" E 121° 8' 45.84"	03June2016/ 1405H-1415H	58.6	66.2	64.0	62.0

**Median of seven (7) highest noise readings*

Table 2-69: Equivalent noise levels (Leq) in each modeling domain (July 2013)

Modeling Domain	Monitoring Stations	Mean Daytime Leq (dBA)	Mean Nighttime Leq (dBA)
MD-1 / TR4-A	PA-A1 to PA-A3	61.9	-
	N1 and N7*	58.5	59.3
MD-2	N2	54.2	59.3
MD-3	N3	59.3	58.5
MD-4	N3 and N10	57.9	54.9
MD-5	N4 and N8	57.3	57.0
MD-6	N5	49.9	46.9
MD-7/ TR4-E	N6 and N9	62.6	62.9
	PE-A3 to PE-A6	55.1	--

Notes:

1) *N1 to N10 - monitored in July 2013*
2) *PA-A1 to PA-A3 and PE-A4 to PE-A6 – monitored in June 2016*

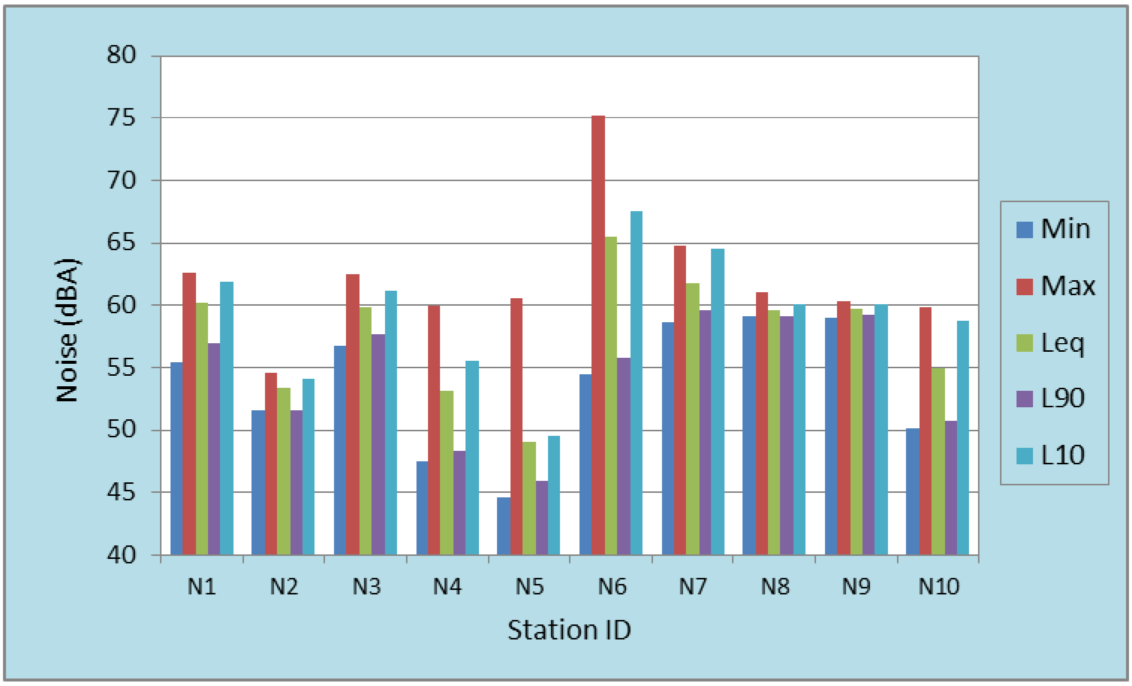


Figure 2-63: Statistics of noise levels measured during early morning at ten (10) sampling stations along the proposed original route from July 16-21, 2013

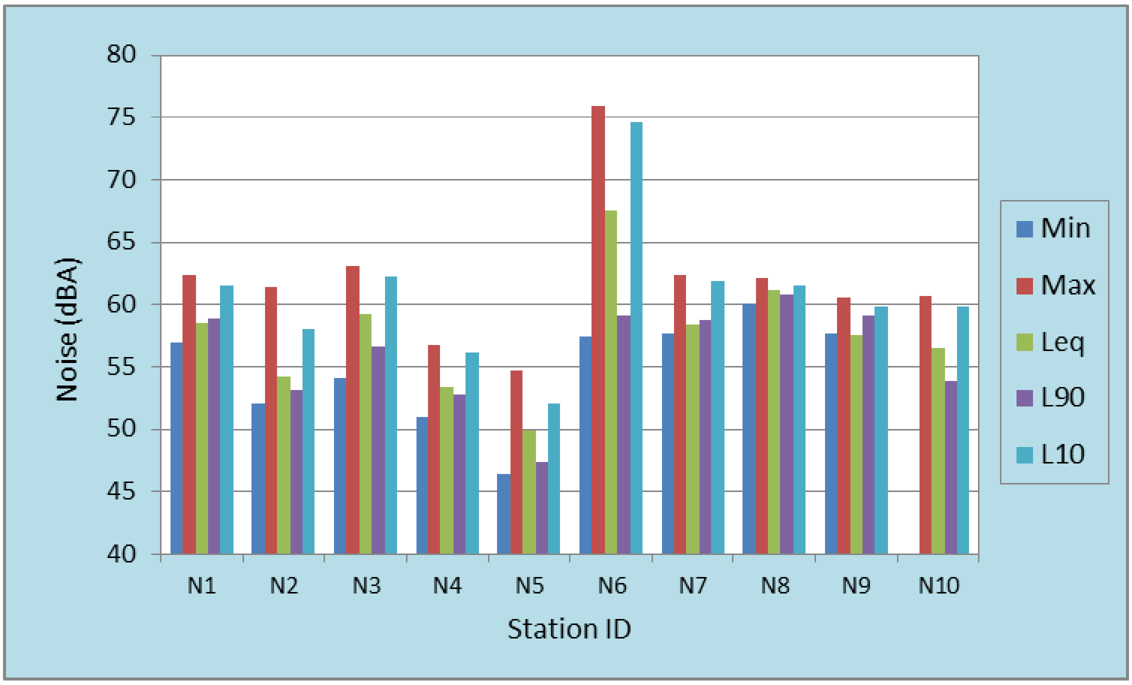


Figure 2-64: Statistics of noise levels measured during daytime at ten (10) sampling stations along the proposed original route from July 16-21, 2013

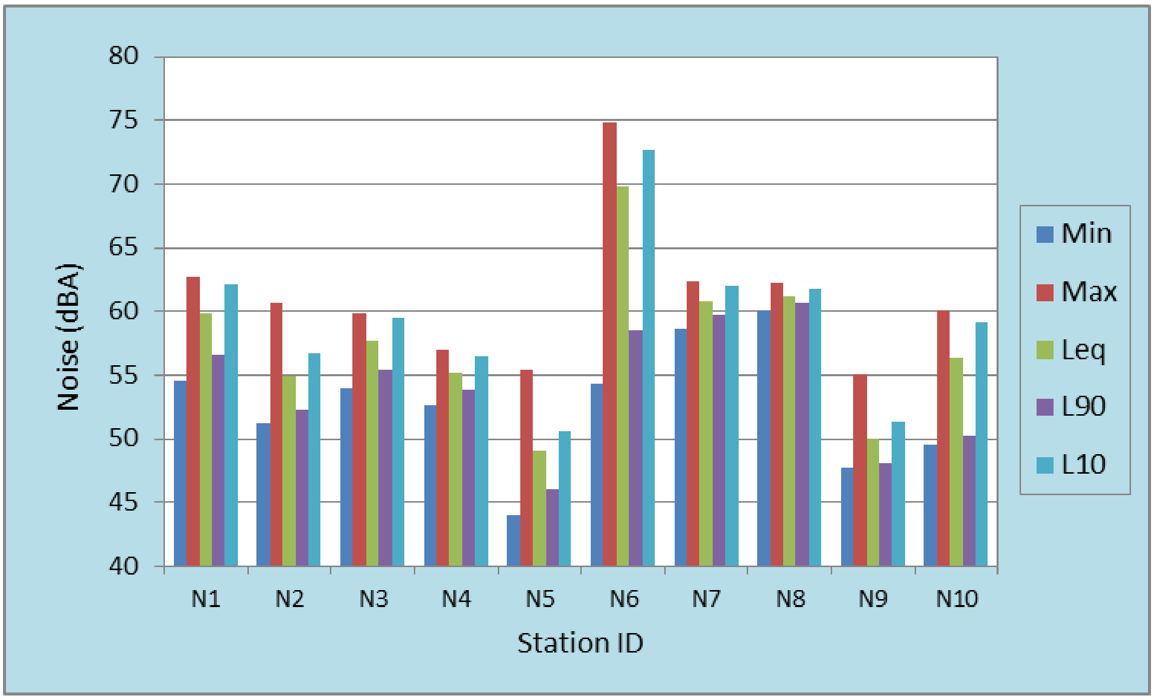


Figure 2-65: Statistics of noise levels measured during early evening at ten (10) sampling stations along the proposed original route from July 16-21, 2013

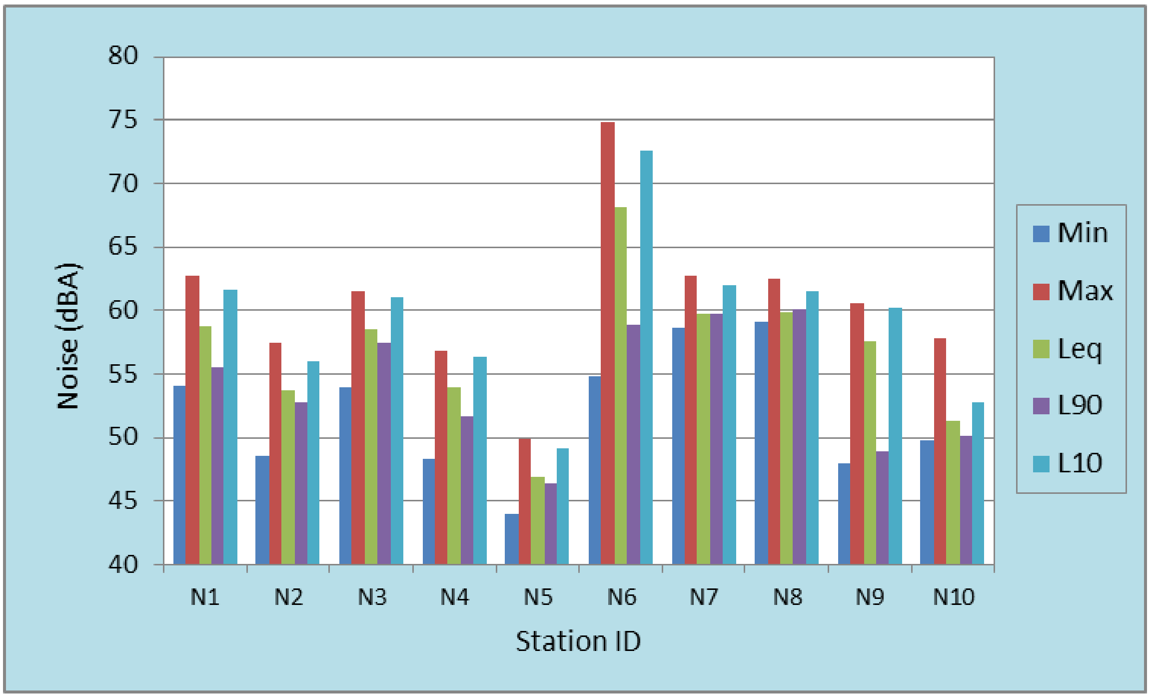


Figure 2-66: Statistics of noise levels measured during nighttime at ten (10) sampling stations along the proposed original route from July 16-21, 2013

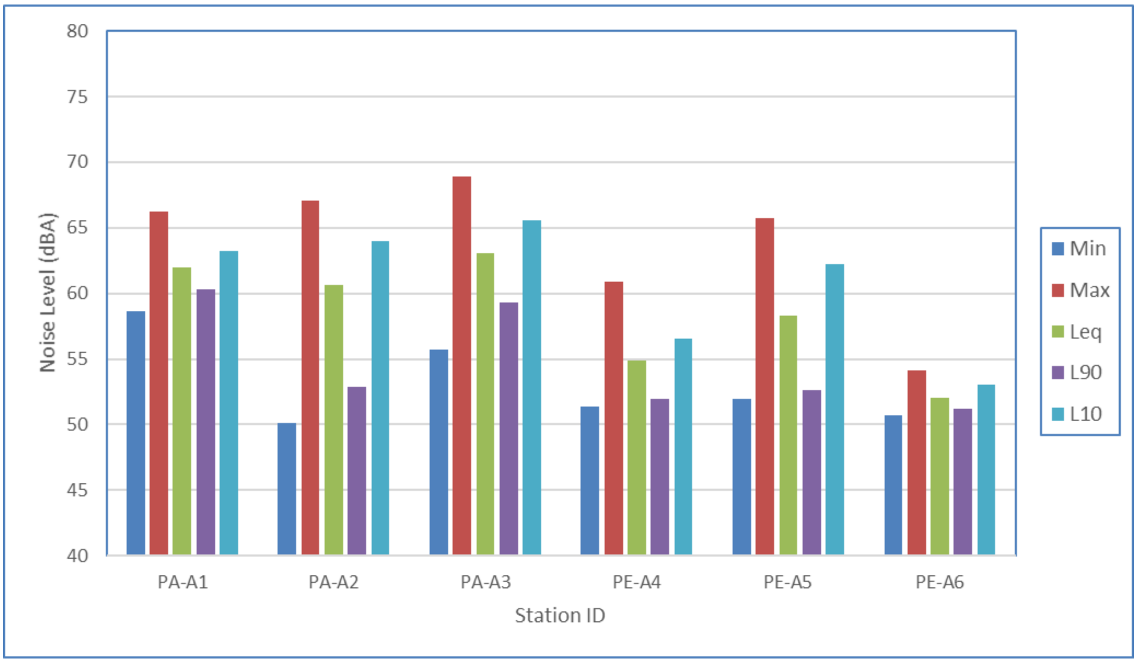


Figure 2-67: Statistics of noise levels measured during daytime from June 2-3, 2016

2.3.3.4 Impact Assessment and Mitigation Measures

2.3.3.4.1 Construction Phase

2.3.3.4.1.1 *Noise Model*

Custic 3.2 Noise Pollution Model (Custic 3.2), which was developed by Canarina Environmental Software in Spain, was initially used to model the attenuated noise levels from construction equipment. Noise from construction equipment are intermittent and not stationary, thus the need to consider usage factors (U.F.), which are the fraction of time that the equipment are utilized. To account for the U.F. of the construction equipment, RNCM's method to calculate attenuated noise with usage factors were used in this study by adding the predicted noise levels from Custic 3.2 and the usage corrector factor (10 times the logarithm of the U.F.)

The sound power level (L_w) of each of the construction equipment was computed using the equation,

$$Lw = Lp + \left|10\log(\frac{Q}{4\pi r^2})\right|$$

where:

Q	=	spherical freefield propagation factor,
L_p	=	sound level of the equipment (dB), and
r	=	distance of the source (equipment)

The attenuated noise levels, $Lp_{(calc)}$, were initially calculated within the modeling domain using Custic 3.2. Subsequently, the equivalent noise levels (L_{eq}) and noise levels exceeded 10% of the time (L_{10}) were then determined using the formula,

$$L_{eq} = Lp_{calc} + 10\log(\frac{U.F.}{100})$$

where U.F. is the time averaging equipment usage factor (in per cent). An adjustment factor of 3 dBA gives the L_{10} level, or

$$L_{10} = L_{eq} + 3 \text{ (in dBA)}$$

2.3.3.4.1.2 Modeling Domain and Noise Sensitive Receptors

As construction activities are highly intermittent and the type of equipment to be used varies during actual construction at specific location along the project route, noise modeling in this study presents the attenuated noise at selected areas along the proposed project route where the NSRs are located.

Figure 2-68 to **Figure 2-70** show the locations the NSRs at selected areas along the proposed project site. The coordinates of the NSRs were determined by plotting the proposed project route in the Google Earth imagery and digitizing the households (or groups of households) using Surfer™. Note that households found adjacent each other were represented as one NSR in the modeling domain.

2.3.3.4.1.3 Model Input Data

Table 2-70 shows the assumed list of construction equipment to be used during construction, the maximum noise levels (L_p) at 50 ft from each equipment, the usage factors, and the calculated sound power level (L_w). The maximum noise levels (Lp) represent the A-weighted maximum sound power measured at 50 ft from each equipment, which were extracted from the User's Manual of the Roadway Construction Noise Model (RCNM).

Table 2-70: List of construction equipment and corresponding usage factor and sound power levels

Item No.	Equipment*	Lp, Noise Level at 50 ft (dBA)	Usage Factor (U.F)	Lw, Sound Power (dBA re 1 PW)
1	Bulldozer	82	40	116.7
2	Scraper unloading top soil	84	40	118.7
3	Scrapers in travel	84	40	118.7
4	Scrapers removing top soil	84	40	118.7
5	Front end loader	79	40	113.7
6	Dump truck	76	40	110.7
7	Dump truck	76	40	110.7
8	Front end loader	79	40	113.7

2.3.3.4.1.4 Modeling Results and Proposed Mitigation Measures

Figure 2-68 to **Figure 2-70** show the results of the predicted noise levels at selected sections of the proposed project route. Predicted noise levels showed high noise levels at receptors (NSRs) close to the construction site where the equipment is operated. Predicted noise levels at some NSRs near the proposed route were about 65 dBA, which are greater than the ambient noise standards set for residential areas especially during nighttime.

Construction activities, however, are temporary and its noise emissions are intermittent and largely depend on the location of the mobile construction equipment relative to the NSRs. However, mitigations measures should be implemented during construction period to avoid nuisance at the NSRs close to the proposed project route where construction works are being undertaken.

The following are the proposed mitigation measures:

a) Limit the construction activities at areas close to NSRs during evening and nighttime periods. When conducting construction activity at extended periods (late evening), the project proponent should coordinate with the LGUs who have territorial jurisdiction over the area where the construction works will be done. Residents close to the area should also be informed of the said activity;

b) Ensure that heavy equipment have noise muffler as this would significantly reduce noise from the source;

c) Provide noise shielding (or temporary barriers) near the equipment and between the NSRs to minimize attenuated noise at the NSRs;

d) Impose speed limits at the construction site and along access road; and,

e) Require contractors to implement noise mitigation measures so as to ensure compliance with applicable noise regulations and to avoid nuisance at the NSRs close to the proposed project route.

The potential impacts on noise level and the proposed mitigation measures are shown in **Table 2-73.**

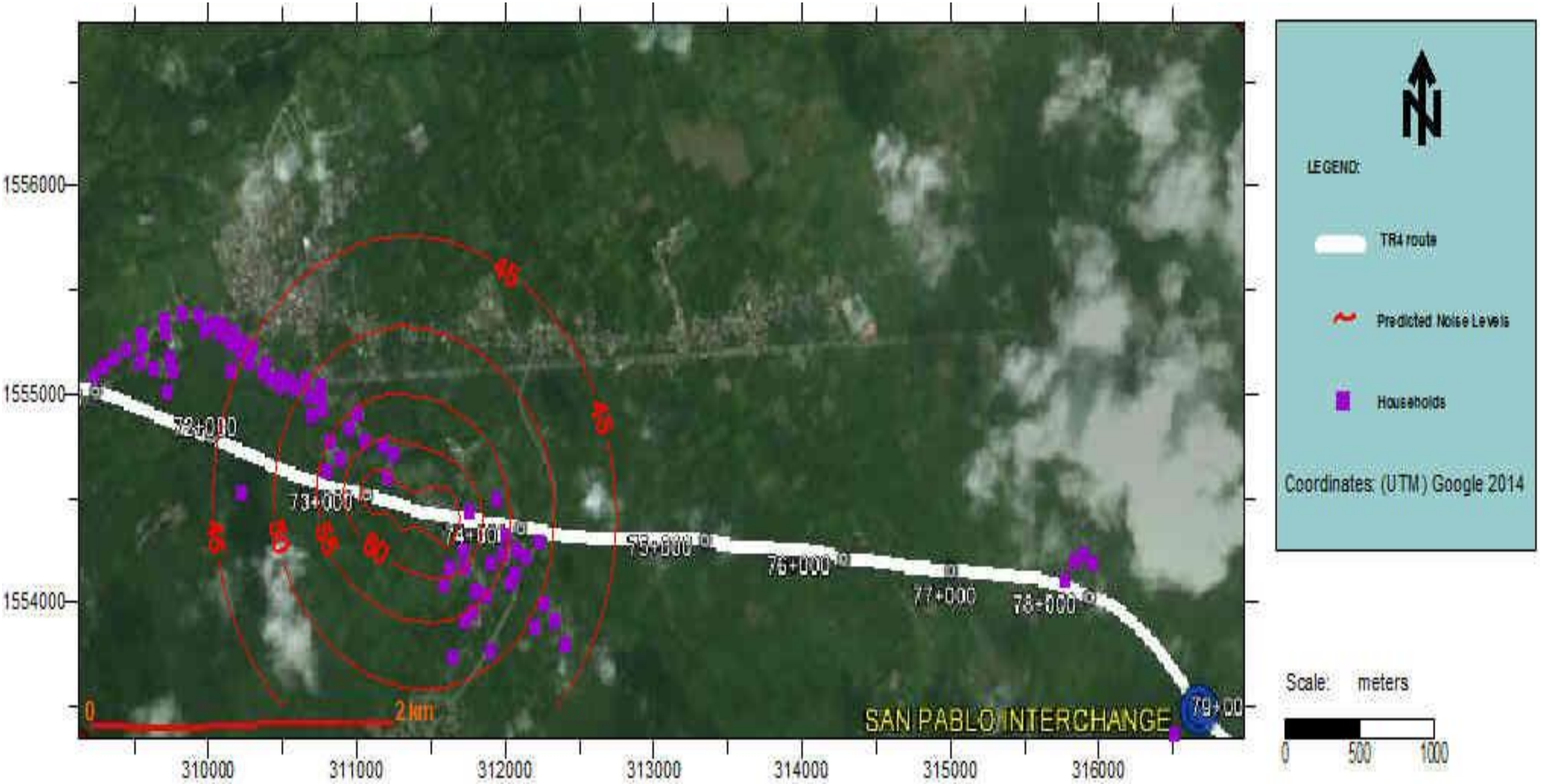


Figure 2-68: Predicted noise levels (in dBA) arising from construction activities between KM 73 and KM 74

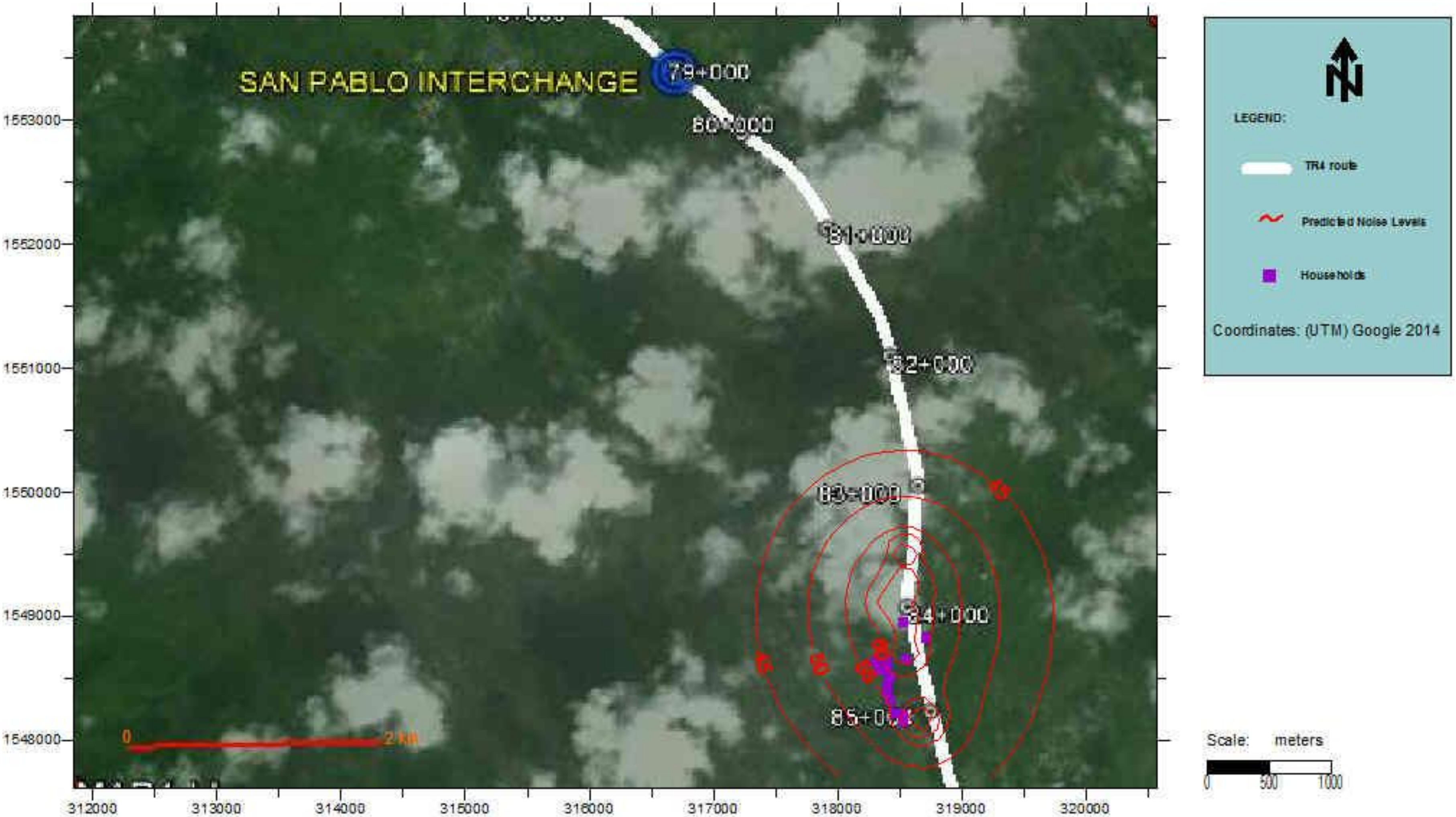


Figure 2-69: Predicted noise levels (in dBA) arising from construction activities near KM 84

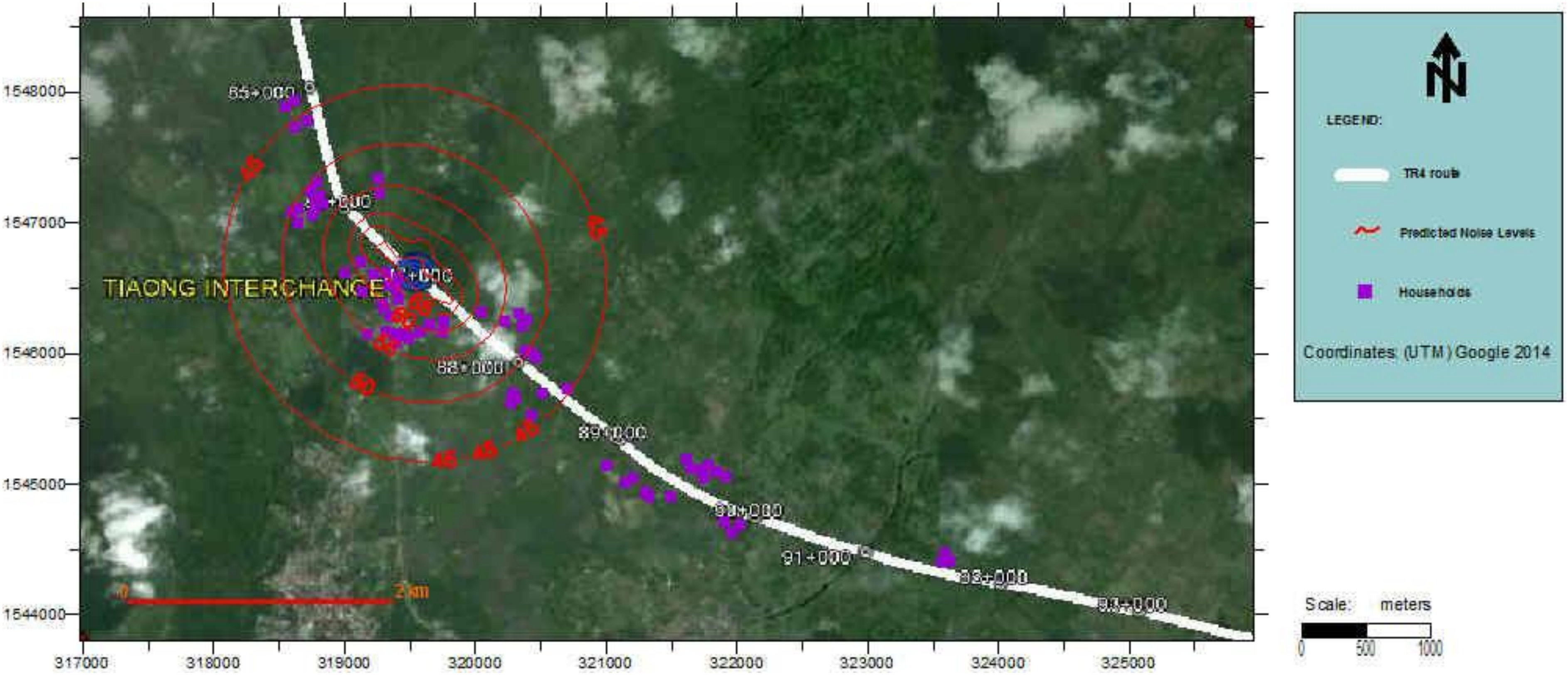


Figure 2-70: Predicted noise levels (in dBA) arising from construction activities near KM 87

2.3.3.4.2 Operation Phase

This section presents the noise modeling covering operation of the Project using Custic. 3.2 Noise Pollution Model.

2.3.3.4.2.1 Noise Model

Custic 3.2 calculates the attenuated noise from an external source using the formula,

$$L_{eq} = L_w - 20\log(r) - 11$$

where:

L_{eq}= predicted noise level (dBA) at the distance, r, from the source,
L_w = source sound power (dB re 10^{-12} W or dB re 1 PW), and
r = the distance from the source (m).

The sound power (L_w) of the vehicles plying along the proposed route were determined using the "Line Source" Option in Custic 3.2 by providing the vehicle velocity and the number of vehicles per hour. The details of the model and its application are provided in the Custic 3.2 User's Manual (Canarina, 2001).

2.3.3.4.2.2 Model Input Data

Table 2-71 shows the projected daytime and nighttime traffic volumes between interchanges along the proposed route as presented in the compliance report for ECC Condition No. 9. The projected traffic volumes (in vehicles per hour) from SLTC (2012) study were used as input in Custic 3.2 modeling. For areas where high noise levels are generated, the "Barrier" option in Custic 3.2 was used in order to determine attenuation or reduction of noise with noise barriers. Noise barriers could be perimeter concrete walls, earth mounds, or terrain, which acts as barriers between the vehicular traffic and the NSRs.

Table 2-71: Input Data for Custic 3.2 in each modeling simulation (Source: Compliance Report for ECC Condition No.9)

Simu-lation No.	Kilometer	Period (Daytime or Nighttime)	Vehicles Per Hour	Noise Power (dBA re 1 PW)	Interchange
1	KM 56 to KM 64	Daytime	3031	78	KM56-Sto Tomas IC.
2	KM 56 to KM 64	Nighttime	2728	78	
3	KM 64 to KM 66+/ KM 67 to KM 71	Daytime	3031/ 973	78/ 74	KM67-Makban IC
4	KM 64 to KM 66+/ KM 67 to KM 71	Nighttime	2728/ 876	78/ 73	
5	KM 71 to KM 78+	Daytime	973	74	
6	KM 71 to KM 78+	Nighttime	876	73	
7	KM 79 to KM 85	Daytime	754	72	KM79-San Pablo IC
8	KM 79 to KM 85	Nighttime	679	72	
9	KM 85 to KM 86+/ KM 87 to KM 93	Daytime	754/ 833	72/ 73	KM87-Tiaong IC
10	KM 85 to KM 86+/ KM 87 to KM 93	Nighttime	679/ 750	72/ 72	
11	KM 93 to KM 100+/ KM 101 to KM 105	Daytime	833/ 950	73/ 73	KM101-Candelaria IC

Simu-lation No.	Kilometer	Period (Daytime or Nighttime)	Vehicles Per Hour	Noise Power (dBA re 1 PW)	Interchange
12	KM 93 to KM 100+/ KM 101 to KM 105	Nighttime	750/ 855	72/ 73	
13	KM 105 to KM 114	Daytime	950	73	KM114-Lucena
14	KM 105 to KM 114	Nighttime	855	73	

Notes:
a) Simulation used average speed of 80 kph
b) Daytime and nighttime scenarios were considered in the simulations
c) Custic 3.2 directly calculates the noise power based on VPH and speed

2.3.3.4.2.3 <u>Modeling Results and Proposed Mitigation Measures</u>

Figure 2-71 to **Figure 2-76** show the predicted contours of noise levels at daytime and nighttime periods at selected sections along the proposed project route. The average vehicular speed is assumed at 80 kph in all modeling simulations.

Results show that predicted noise levels at some NSRs located adjacent the proposed route were higher than the daytime and nighttime noise standards (including +10 dBA correction factor) for residential areas, respectively (**Annex P**). There were also significant increases of the average equivalent background noise levels.

To reduce noise levels within acceptable limits at the NSRs, simulations included preliminary use of noise barrier. **Figure 2-77** shows a sample modeling run without a noise barrier at KM-88 and adjacent households near the road right-of-way. As can be seen in **Figure 2-77**, the predicted noise levels within 150 m from the edge of the road right-of-way ranged from about 58 to 66 dBA, which exceeded the nighttime standard of 55 dBA (including a correction factor of +10 dBA).

With an assumed 3-m high noise wall barrier along the edge of the road-right-of way, the predicted noise levels showed significant reduction at households adjacent the area, as shown in **Figure 2-78**. The results show likely compliance with the 55-dBA limit for residential areas at nighttime periods with the use of noise barriers to effectively reduce noise emissions from vehicles.

Noise barriers could be in the form of walls, earth embankment, or terrain, which could block the line-of-sight between the noise source (vehicular traffic) and the receptor (households) to effectively reduce noise levels, as depicted in **Figure 2-79**. Typical attenuation levels of noise barriers are from 5 to 15 dBA, though 10-dBA reduction is attainable, as shown in **Table 2-78**.

The detailed design, location, and extent of noise barriers considering the final route, however, is beyond the scope of this study. Thus, it is recommended to consider in the detailed engineering design the locations of sensitive receptors, such as schools, churches, and residential areas. As possible, the route should be located at wide distances from sensitive receptors, although if unavoidable, noise barriers should be considered to ensure compliance with ambient noise standards and to avoid nuisance at the NSRs.

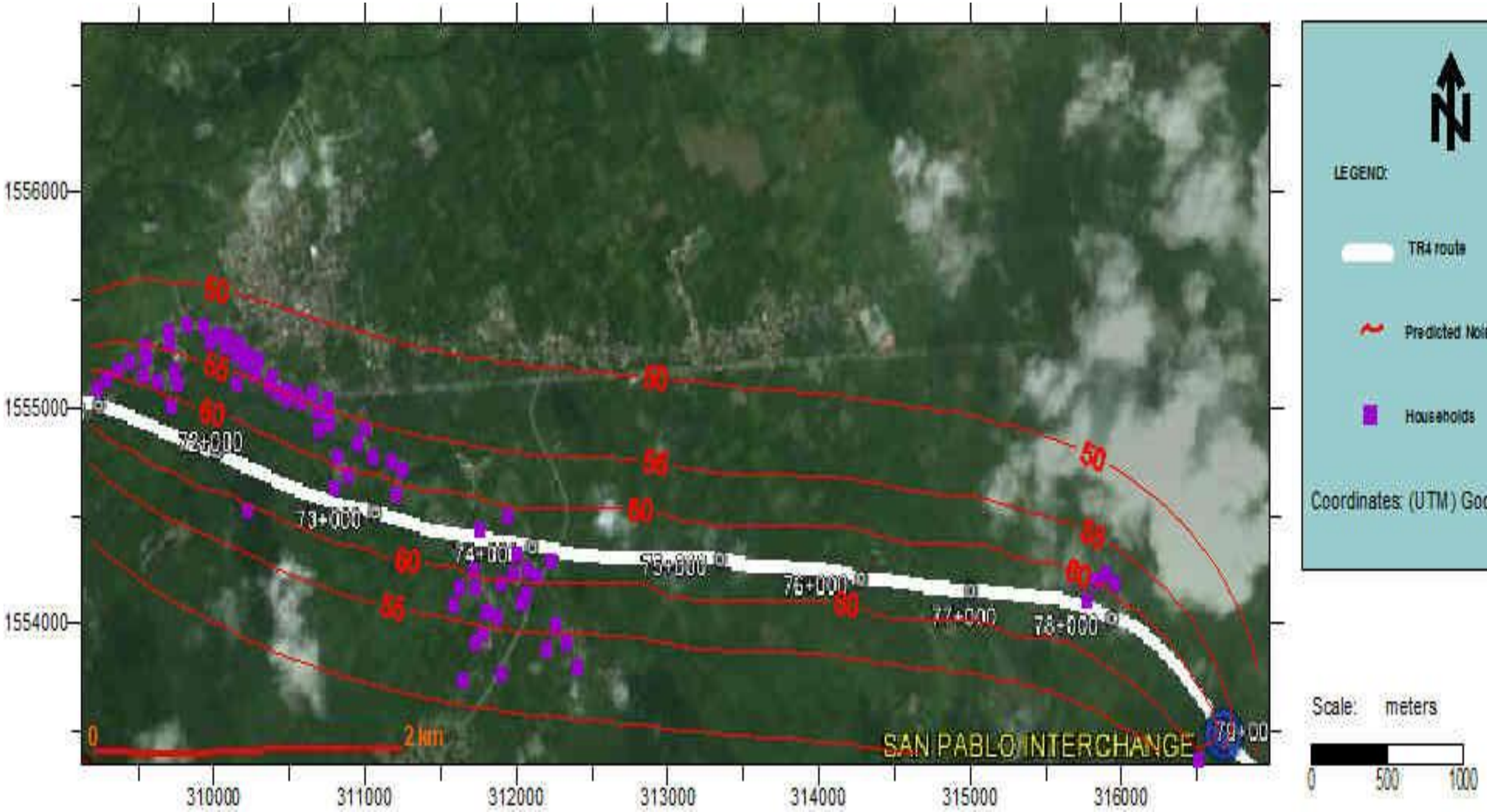


Figure 2-71: Predicted noise levels (in dBA) at daytime from KM 72 to 78 (speed at 80 kph)

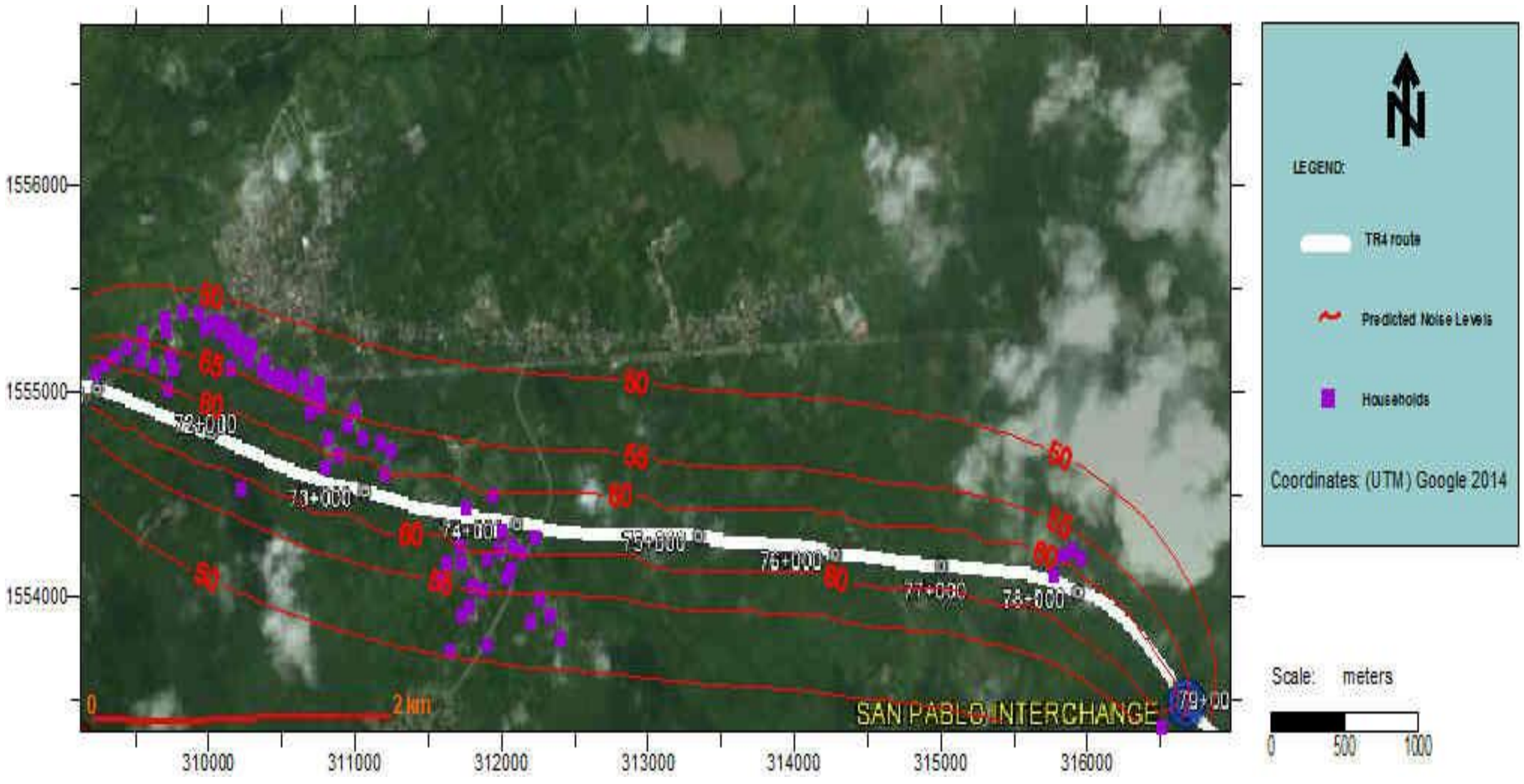


Figure 2-72: Predicted noise levels (in dBA) at nighttime from KM 72 to 78 (speed at 80 kph)

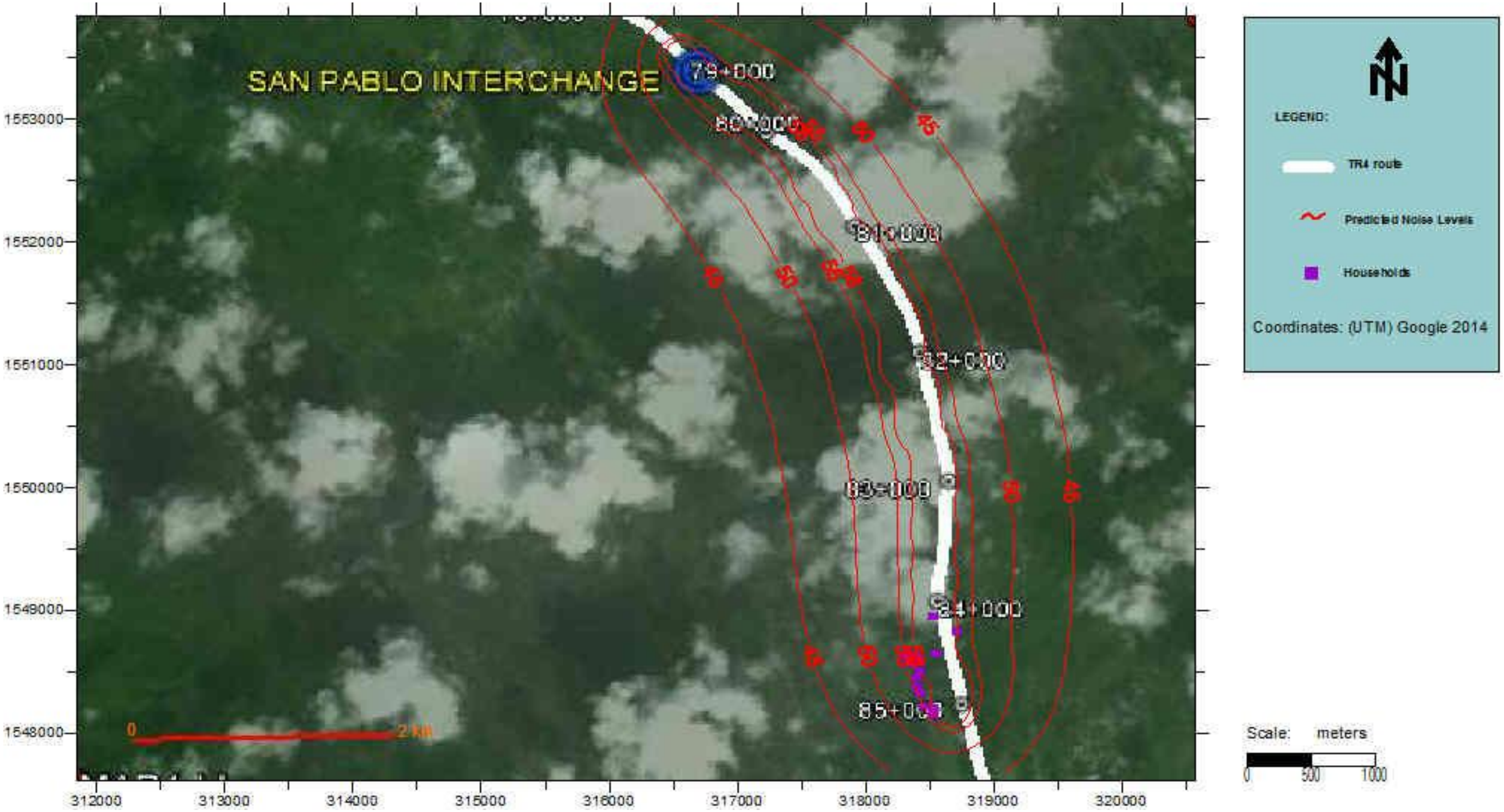


Figure 2-73: Predicted noise levels (in dBA) at daytime from KM 79 to KM 85 (speed at 80 kph)

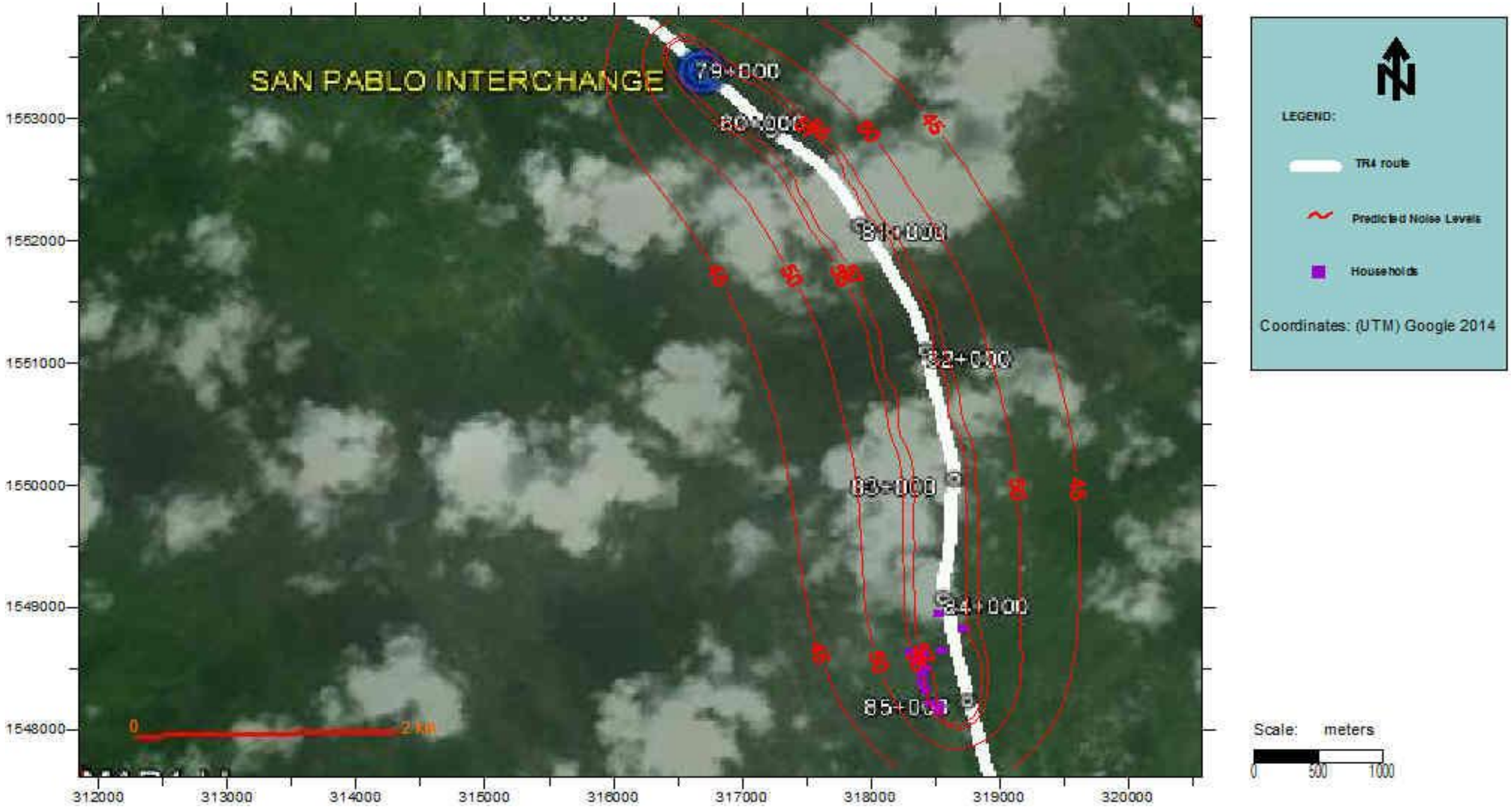


Figure 2-74: Predicted noise levels (in dBA) at nighttime from KM 79 to 85 (speed at 80 kph)

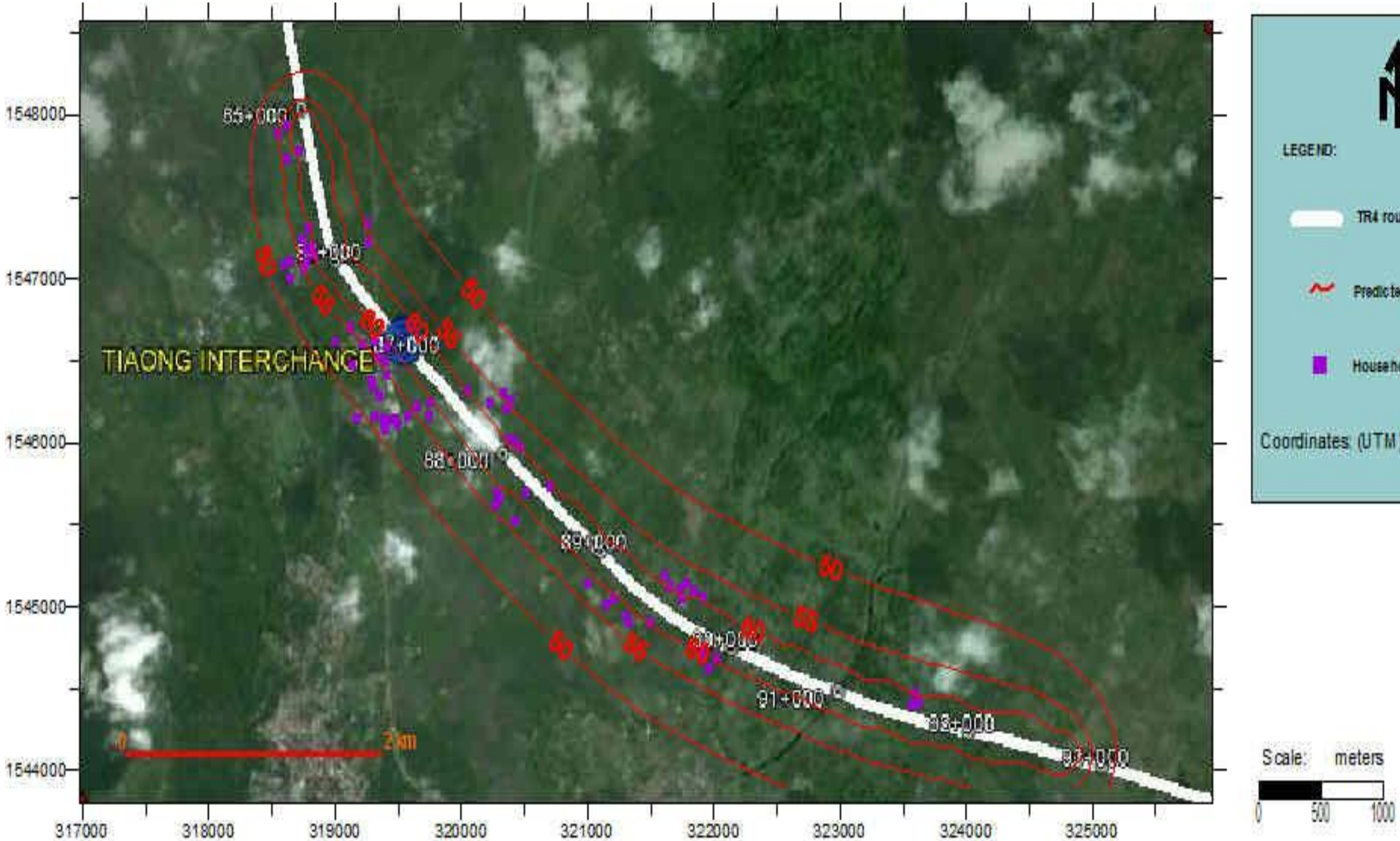


Figure 2-75: Predicted noise levels (in dBA) at daytime from KM 85 to KM 93 (speed at 80 kph)

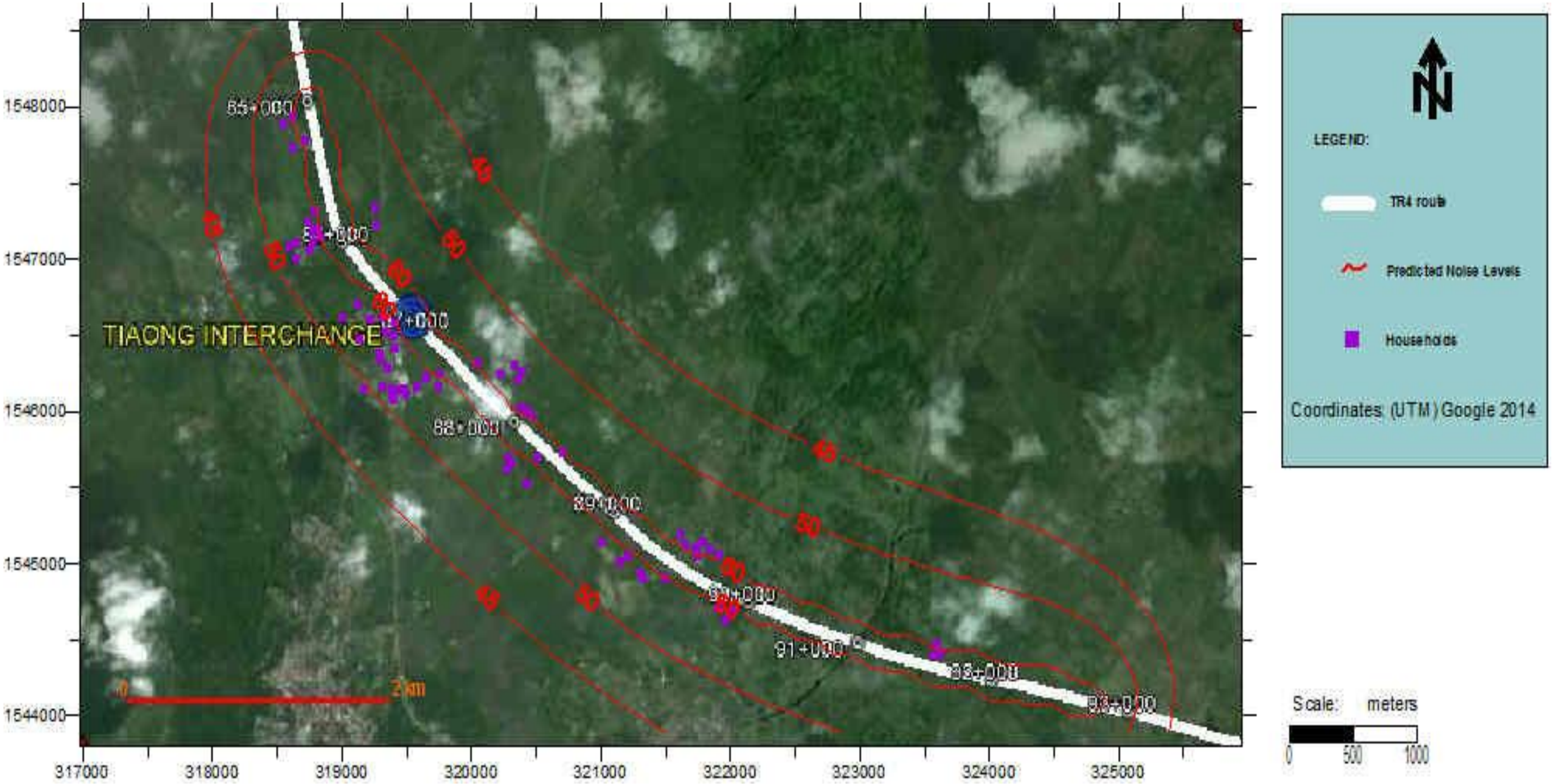


Figure 2-76: Predicted noise levels (in dBA) at nighttime from KM 85 to KM 93 (speed at 80 kph)

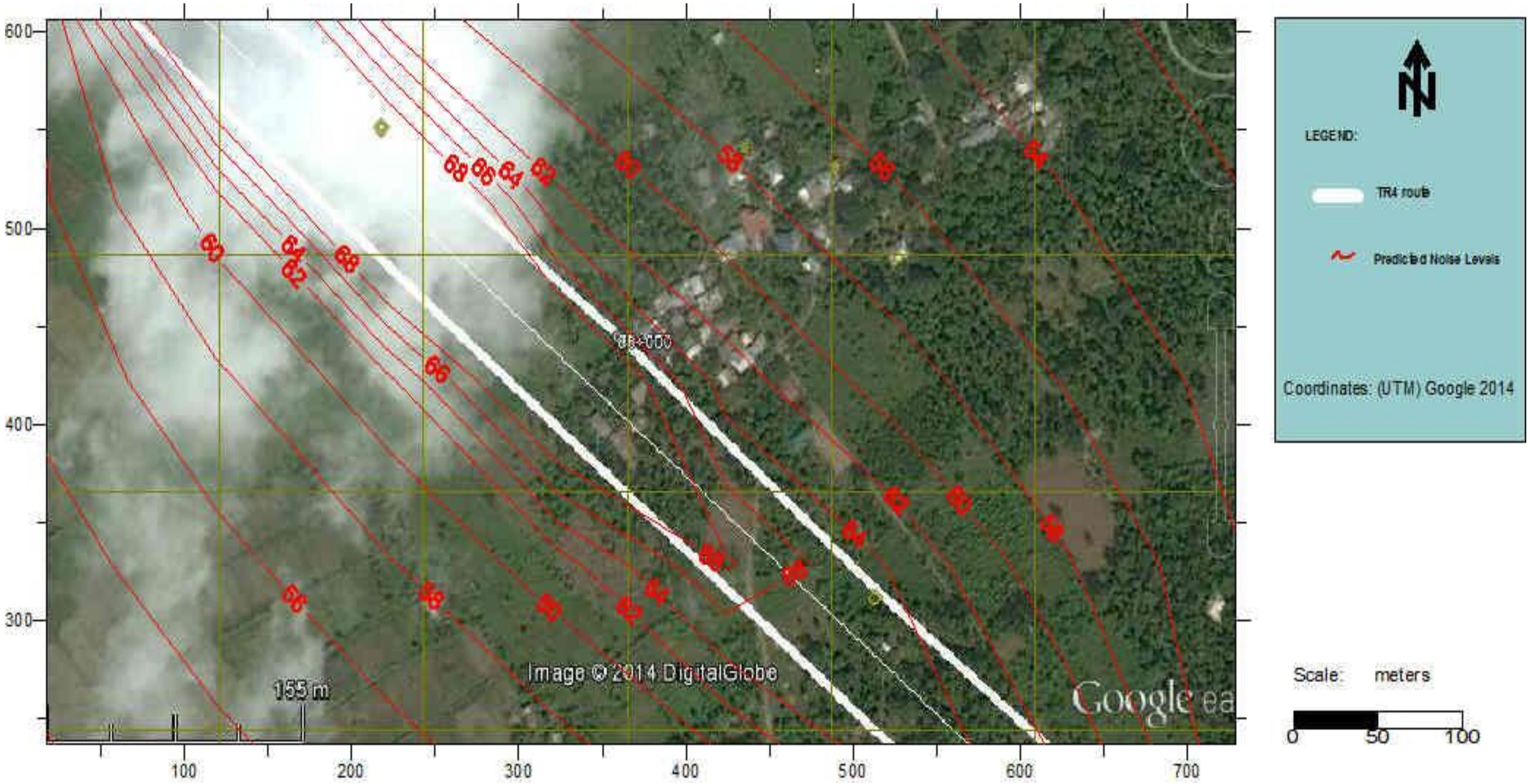


Figure 2-77: Sample plot of predicted noise levels without a noise barrier

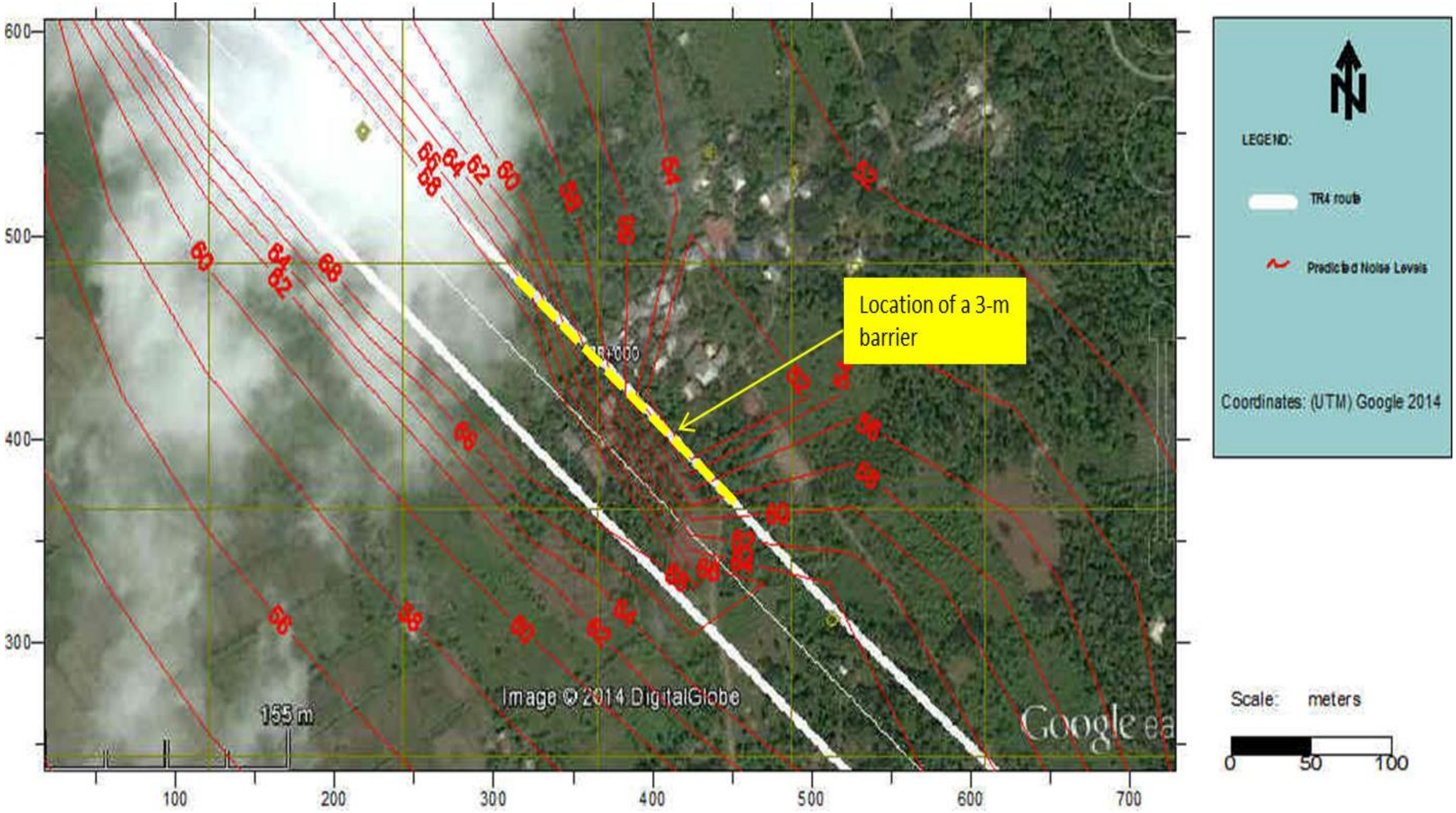


Figure 2-78: Sample plot of predicted noise levels with a 3-m noise barrier (shown in yellow line)

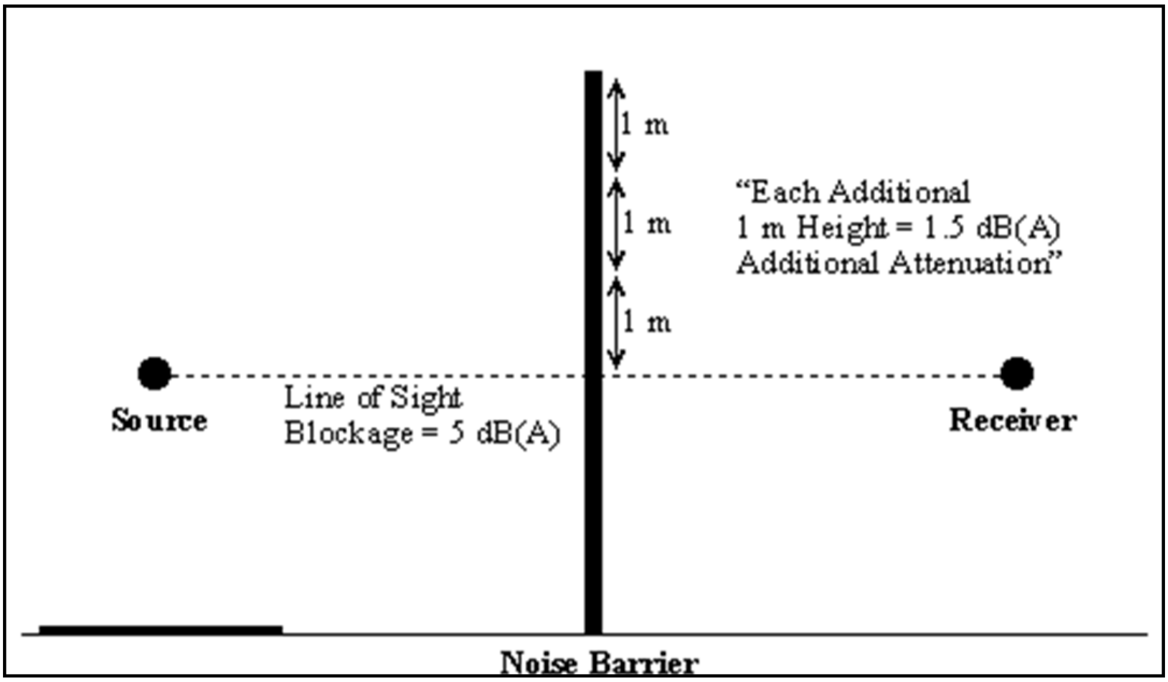


Figure 2-79: Relationship of line-of-sight and noise barrier reduction
(Source: www.fhwa.dot/gov)

Table 2-72: Relationship between barrier insertion loss and design

Barrier Insertion Loss	Design Feasibility	Reduction in Sound Energy	Relative Reduction in Loudness
5 dB(A)	Simple	68%	Readily perceptible
10 dB(A)	Attainable	90%	Half as loud
15 dB(A)	Very difficult	97%	One-third as loud
20 dB(A)	Nearly impossible	99%	One-fourth as loud

Source: FHWA Website – www.fhwa.dot.gov/environment

Table 2-73: Summary of Potential Impacts on Meteorology and Air Quality with Proposed Mitigation Measures

Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement
Change in the local micro-climate • Increase in local temperature due to vegetation removal • Increase in local temperature due to presence of road and its operation		x	x x		• Immediate planting of open areas to minimize the exposed areas and the possible increase in temperature along the RROW • Implement properly designed reforestation on both sides of the road
Degradation of air quality • Increase in fugitive dust during construction • Gaseous emission from fuel-burning equipment		x x x x x x x	x x		• Conduct of water spraying at dry and exposed areas to control dust emission • Provide wheel washing facilities at the construction site to remove muds at the tires of heavy equipment • Impose speed limit • Re-routing of construction vehicles at considerable distances from Area Sensitive Receptors (ASRs), if possible • Possible suspension of construction works during very dry weather and/or windy conditions when dusts are apparently to be dispersed at nearby ASRs • Regular visual inspection at the project site and conduct of mitigation measures to control high fugitive emissions, if necessary • Implement properly designed reforestation on both sides of the road • Monthly monitoring of TSP, PM_{10}, NO_2 and CO at ASRs during the 1st year of operation; and, reduce frequency of monitoring thereafter as necessary
Increase in ambient noise level • Noise generation from construction activities and operation of heavy equipment • Noise generation from vehicular movement along the TR4 alignment		x x x x	x x		• Enclosure of the project area during construction • Minimize, if not totally avoid, construction works during nighttime • Operation of heavy equipment only during the daytime • Provision of noise barriers such as walls or earth embankment particularly adjacent to schools, churches, and residential areas • Planting of trees along the edge of RROW or adjacent to the road fence for blocking the line-of-sight between the noise source and the receptors.

Pre–Construction; C= Construction, O = Operation; A = Abandonment or Closure

2.4 The People

2.4.1 Scope

The People module describes the (i) project location and specific geographical site of the communities (ii) inventory of assets of the families, (iii) barangay socio-economic profile and (iv) project impact, issues and concerns of the community. Perception survey and group discussions (GD) further deepened discussions of impact, concerns and issues by all affected sectors. Mitigation measures are also discussed and presented in this section.

2.4.2 Methodology

A socio-economic survey was conducted at five (5) percent of the household population of the affected areas, employing random sampling technique. Instrument was developed to capture socio-economic baseline indicator as well as perceptions of the project impact areas. Group discussion per sector was conducted to gain insights on community's issues and concern. The survey enumerators were sourced from the affected barangays and trained on site. A survey supervisor was available on field for about a month to run the data gathering.

As discussed in the project description section, there were changes in the areas impacted by the project due to re-alignment and project design. From the previous affected barangays presented in the 2013 EIS data, the new alignment now covers 45 barangays. The project data presented in this report was in part based on 2015 socio economic data collection for EIA submitted to EMB. Presented below is the data gathering history of the people module since 2013 to present year.

Table 2-74: People Module Timeline of Data Gathering

Year	Segment Number	Municipalities/Cities	Remarks
2013	All segment (A to D)	Calamba Sto. Tomas Alaminos San Pablo City Tiaong Candelaria Sariaya Tayabas City	Data lapsed, re-work done
2015	Segment A, D and E	Calamba Sto. Tomas Candelaria Sariaya Tayabas City	Data current
2018	Segment B and C	Alaminos San Pablo City Tiaong	Data current

2.4.3 Project Location

2.4.3.1 The Affected Provinces

The proposed SLEX TR 4 Project will traverse three (3) provinces namely, Batangas, Laguna and Quezon. These provinces are part of Region 4-A or the CALABARZON which is one of the country's major economic centers and industrial regions.

Based on the CALABARZON Regional Development Plan (NEDA) 2011-2016, the area forms part of the Metropolitan Manila Growth Network which is the country's biggest aggrupation of urban areas that perform key roles as main industrial core, financial and commercial center, and transshipment point of goods and services for domestic and international distribution. Region 4-A likewise holds the key to the possible expansion of the NCR toward the eastern seaboard or the Pacific side of Luzon.

CALABARZON, relying on both its agricultural and industrial sectors, is the second largest contributor to the national GDP, accounting for 17% of the gross domestic products.

CALABARZON Regional Development Plan (NEDA) 2017-2022, reiterated the area as a good alternative for investors because of its huge population size, hub of manufacturing industries, abundance of agricultural produce and raw materials, proximity to NCR, and strategic location that serves as gateway from the south.

The role of the three provinces in the regional and national context stems from their being part of the CALABARZON. Endowed with beautiful land and seascapes, the three provinces maximizes their income through tourism activities in addition to the developing agricultural, fishing and agro-industrial and manufacturing products that cater to the domestic and international markets. Strategically critical therefore, is to ensure that these provinces are able to perform their roles within the Region's development framework through the implementation of planned major transport projects to complete the missing links such as the extension of the SLEX to Lucena. Table below shows the basic socio-economic indicators for the affected provinces.

Table 2-75: Summary of Basic Socio-Economic Indicators for Affected Provinces

	Batangas	Laguna	Quezon
Population (PSA, 2015)	2,377,395	2,667,847	1,740,638
Growth Rates	2000-2010: 2.24% 2010-2015: 2.41%	2000-2010: 3.11% 2010-2015: 2.47%	2000-2010: 1.61% 2010-2015: 1.23%
Annual Food Threshold (PSA, 2015) Phil: P11,868 NCR: P17,462	P15,037	P14,756	P14,213
Annual Poverty Threshold (PSA, 2015) Phil: P16,841 NCR: P25,007	P21,534	P21,132	P20,354
Human Development Index (HDI)[10] (Rank among 77 provinces nationwide)	2006: 15th 2012: 12th	2006: 5th 2012: 9th	2006: 58th 2012: 51st
Settlements		Province is host to resettlement sites for displaced informal settlers from Metro Manila	
Economic Base	Manufacturing, Tourism, Agriculture, Services, Cottage Industries	Agriculture; fishing; eco- tourism; agri-based industries and cottage and small scale industries	Agriculture; Fishing; Eco-tourism and Food processing
Tourism	Heritage sites Seascapes	Landscapes and lakescapes	Landscapes and seascapes; Host to many annual festivals (Agawan, Pahiyas, Mayohan, etc)
Infrastructure		Presence of major vehicle manufacturer, a number of electronic	

[10] No Current HDI available to date, latest is year 2012

	Batangas	Laguna	Quezon
		and semi-conductor companies; resort capital of the world as it houses 700 hot springs resorts in the areas of Calamba and Los Banos.	
CALABARZON Development Framework (2017-2022)	Regional focus to contribute toward laying down the foundations for inclusive growth, a high-trust society, and a globally competitive knowledge economy		

Source: CALABARZON Regional Development Plan (NEDA) 2017:2022

2.4.3.2 The Affected Municipalities

The municipalities/cities that will be affected by the project are the cities of Calamba and San Pablo in Laguna, and Tayabas in Quezon; five municipalities, namely, Sto. Tomas in Batangas, Alaminos in Laguna, and Tiaong, Candelaria and Sariaya in Quezon**.** The municipalities are predominantly agricultural; Calamba City is industrial, a host to various manufacturing industries. San Pablo City and Tiaong have coconut-based economic activities, although San Pablo City is rapidly industrializing and becoming an education hub for southern part of Laguna Province.

Sto. Tomas and Calamba City registered the highest growth rate at 5.5 % and 3.85%, respectively, due to in-migration due of commercialization and industrialization of the area. Laguna province has the highest poverty incidence registering 31% of the total number of households, (PSA 2015) followed by Quezon and Batangas Provinces.

Table 2-76 below presents the summary of socio-economic indicators for cities and municipalities to be affected by the project.

- Forty-five (45) barangays will be affected and within the direct impact area, representing 12.21% of the 344 barangays covered by the 8 cities/municipalities.

- Eight (8) covered municipalities and cities have a combined population of 1,416,177 (as of 2015), with Calamba City posting the biggest population of 454,486 and Alaminos, the smallest at 47,859.

- As to income class, with the exception of Alaminos classified as a 3rd class municipality , the rest are 1st class municipalities (Sto. Tomas, Tiaong, Candelaria, Sariaya) and 1st class cities.

- In terms of land area, the 8 LGUs cover about 116,141 hectares; Sto. Tomas, Batangas having the smallest land area of 1,630 hectares or 1.40% of the total land area while Tayabas City, has the largest land area of 23,095 hectares or 19.88% of the total land area of the 8 LGUs. In terms of population density, a minimum of 3.95 persons/hectare to 76.0 persons/hectare is observed, with Tayabas City being the least dense; while Sto. Tomas, Batangas is the densest.

- Majority of the local economy is based on agriculture, except for Calamba City and Sto. Tomas. Tiaong has mixed agricultural activities and coconut growing. Candelaria and Sariaya both have tourism, Candelaria has beach front. San Pablo City, having an agricultural and coconut-based industry, also thrives aquaculture where tilapia culture is popular in areas near the seven lakes of the city. Calamba City has a strategic location being nearer to Metro Manila is experiencing boom in industrial locators and other manufacturing industries.

Table 2-76: Summary of Basic Socio-Economic Indicators for Affected Cities and Municipalities

REGION/ PROVINCE	BATANGAS	LAGUNA			QUEZON			
	Sto. Tomas	Alaminos	Calamba City	San Pablo City	Tiaong	Candelaria	Sariaya	Tayabas City
Demographic Variables								
Population 2010	124,740	43,526	389,377	248,890	91,599	110,570	138,894	91,428
2015	179,844	47,859	454,486	266,068	99,712	117,434	148,980	99,779
Growth rate	8.83%	1.99%	3.34%	3.75%	1.77%	1.22%	1.45%	1.83%
Income Class	1st	3rd	1st	1st Component City	1st	1st	1st	Component city
Congressional District	3rd	4th	2nd	3rd	2nd	2nd	2nd	1st
Land area (has) (2007)	1,630	5,746	14,950	19,756	16,838	12,910	21,216	23,095
Population Density (persons/ha.)	110	8	30	13	6	9	7	4
No. of affected barangays	11	6	2	8	5	6	6	1
Economic Base	Agricultural	Agricultural	Industrial	Agricultural, coconut products, and tilapia culture	Agricultural-coconut	Agricultural, tourism	Agricultural (long coastal area)	Agricultural
Percent poverty Incidence among population, 2012 PSA small area estimates	3.4	5.4	2.1	5.6	13.9	12.8	23.2	9.6
Percent poverty incidence among population, 2015 (PSA 1st Sem Official Poverty Statistics) Batangas Province 14.6 Laguna Province 1.8 Quezon Province 28.2								

Source: Philippine Statistics Authority (PSA), 2015 Data

2.4.3.3 Displacement of Existing Settlers

There are settlers that will be directly affected by the project. The impact will include any or combination of the following: (i) displacement of settlers; (ii) displacement/disturbance of properties; (iii) change/conflict in land ownership; and, (iv) change and conflict of right-of-way (ROW). The succeeding discussion presents the existing conditions in the area and the potential impacts/changes to the existing conditions due to the project implementation.

The direct impact area is within the 60-m RROW alignment which traverses 45 barangays of eight (8) municipalities/cities, and covers a length of 56.862 km. that includes other areas such as interchanges and other facilities. The data from the resettlement census revealed a total of 495 households composed of 2,234 individuals that will be directly affected by the road project.

The following covers potential impacts and losses:

Table 2-77: Summary of Assessment on Direct Impact Areas

Location	Primary Structures		Secondary Structures
	House	Store	
Calamba City	1	0	16
Sto. Tomas	14	0	5
Alaminos	85	2	65
San Pablo City	66	0	47
Tiaong	131	6	118
Candelaria	51	2	45
Sariaya	122	2	113
Tayabas	23	13	15
TOTAL	**493**	**13**	**426**

The Project will cause physical displacement of families and economic losses; (i) 506 units of housing structure, 493 of which are residential structures which are generally permanent and 13 structures are stores; (ii) 426 identified secondary structures such as sheds, poultry, farm houses, pavement among others; (iii) 69,341 various tree species with 27.3% of trees are *Cocos nucifera* or coconut tree. The summary of primary and secondary structures to be affected per location is shown in table below.

In addition, the TR4 alignment will directly hit at the middle of the newly constructed socialized housing developed by Rockwell/Stonewell Development with more or less 400 houses will be affected wherein mostly are financed by Pagibig. In this regard, SLTC is studying on the possible realignment of TR4 in the particular location to avoid the structures/houses and have to be not less than 200m away from the Makban Injection Well with the provision of engineering solutions/measures.

Fruit bearing trees include citrus, Calamansi, Lanzones, Rambutan, Mangoes, among others. The loss of coconut trees will be significant; coconut farmers will likely lose their main source of income or employment as a result of the cutting of coconuts during construction. Economically, this will result to decrease of production in the coconut plantations thereby possible impact on supply for processing of cooking oil, copra, and production of biofuel.

There will be temporary disturbance to be experienced by motorists during the construction phase. Some roads will be used in the hauling of construction materials. However, these roads will be repaired and maintained during and after the construction phase.

Informal settlers, potentially to be relocated, are found mostly in intersections/crossings of PNR railways estimated to be 102 informal settlers. Most of the structures are semi-permanent, made of temporary and light materials. These are used both as residential and/or commercial units (sari-sari stores, fruit stalls, vegetable stalls, etc.). Landowner residents to be affected will be compensated for loss of structures and crops. Otherwise, they will be relocated to a designated relocation site with basic amenities and other basic social services.

Indirect Impact Areas (IIAs) are sites directly outside the 60-meter road right of way (RROW) alignment, stretching out to 200 meters on both sides of the proposed highway. The land are primarily residential and agricultural areas. The indirect impact areas may not be adversely affected unlike those assets and structures within the RROW or direct impact areas.

Temporary disturbance may be experienced by residents whose access may be temporary hampered during construction activities which may also affect air quality and noise in the area. Impact to economic and livelihood of residents is through traffic re-routing for transportation vehicles that may affect time and distance to work place or access to basic services among vulnerable groups such as the elderly, youth and PWDs.

During operation phase, increased vehicle emission and air quality may be experienced near the IIAs 200 m boundary and may affect residential communities adjacent to the express way. Mitigation measures shall be implemented to manage the impacts generated during construction and operation phase such as establishment of fence, buffer zones and planting of trees/shrubs within these zones.

The estimated land area of the alignment from Calamba City to Tayabas City Interchange is about 387.96 has. This total land area is a potential for land acquisition by the proponent. **Error! Reference source not found.**Table below presents the distribution of indicative land acquisition area for the Right-of-way (ROW).

Table 2-78: Indicative Land Acquisition

Municipality/ City	Agricultural		Residential		Commercial		Industrial		Total
	No. of Lots	Area m²	No. of Lots	Area m²	No. of Lots	Area m²	No. of Lots	Area m²	Area m²
Calamba	4	18,861	482	119,522.28	2	26,540.37	8	75,715.64	240,639.29
Sto. Tomas	144	645,438.56	19	55,719.16	0	0	0	0	701,157.72
Alaminos	115	394,478.56	16	21,581.00	0	0	0	0	416,059.56
San Pablo City	115	611,952.00	25	16,599.00	0	0	1	1,255.00	629,806.00
Tiaong*	23	161,873.00	0	0	3	75,074.00	0	0	236,947.00
Candelaria	23	246,357.00	0	0	0		0	0	246,357.00
Subtotal*	424	2,078,960.12	542	213,421.44	5	101,614.37	9	76,970.64	424

*Remarks: * - the parcellary survey in Section E or from Candelaria to Tayabas City is ongoing, Thus, the above list does not include the affected areas along the alignment of Section E from Candelaria to Tayabas City.*

The potential impacts and proposed mitigation measures for the displacement of settlers are summarized in **Table 2-106**.

2.4.4 Demographic Profile of Impact Area

2.4.4.1 Number of Households and Household Size

The socio-economic/perception survey conducted in 45 barangays covered 1,051 households, representative population of 6,254. The average household size was computed at 4.2. Candelaria has the highest number of household member at 4.7 average household members per dwelling. Table below describes the sample population, sample household and average household sizes.

Table 2-79: Sample population, sample household and average household size

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
No. of barangays affected	45	2	11	6	8	4	5	8	1
Sample Households	1501	46	319	222	346	167	189	184	28
Sample population	6254	212	1290	805	1512	713	884	718	120
Average household size	4.2	4.6	4.0	3.6	4.4	3.2	4.7	3.9	4.3

2.4.4.2 Current Land Use, Land Tenure and Proof of Ownership

Rent-free occupants or caretakers abound the project area at 47%, agricultural land owners are at 43% while residential landowners are at 41%.

Farm owners reported were highest in Alaminos, also where bigger farm landholdings are found, averaging over 6,000 m^2 compared to the other areas where the average agricultural land area ranges from less than 1,000 to 3,500 m^2. There are cases, of a significant number of residential land/caretakers/rent-free occupancy (RFO) in Calamba City, San Pablo City and Candelaria.

Most of the household respondents reported that their current land use is residential at 79%, while about 12% of households reported that land use an agricultural farm.

Proof of ownership of residential lands has bigger proportion from sample households in Sto. Tomas, San Pablo City, Tiaong and Candelaria, who claimed TCT/OCT as proof of ownership . Tax Declaration documents is prevalent in Sto Tomas and Alaminos. There are three municipalities where some sample households are CLOA beneficiaries (Tiaong, Candelaria and Sariaya)

Table 2-80: Current Land Tenure, Land Use, Ave. Land Areas Owned and Proof of Land Ownership

	Total	Sto. Tomas	Calamba City	San Pablo City	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas City
% Land Tenure									
Res land owner	41.1	48.4	9.7	36	40.0	23	43.6	46.4	81.5
Agri/farm owner	43	61.4	9.7	8.0	92.0	13.0	44.4	47.6	68.8
Res caretaker/ RFO	47	51.6	90.3	72.4	6.4	21.2	56.4	53.6	31.2
Agri farm caretaker/ RFO	23	30.7	16.1	8.3	6.6	10.4	48.5	47.2	35.0
% Current land use									
Residential only	79	88.5	93.4	82.3	70.7	66.9	86.8	65.2	78.6

Agricultural farm	12	9.6	6.5	15.1	13.6	21.5	5.8	19.5	3.6
Proof of Ownership of Residential Land (no. of households)									
TCT/OCT	39.7	74	23	40	31.0	42.0	59.0	9.0	-
Tax Dec	29.0	111	1	36	41.0	6.0	15.0	1.0	21.0
CLOA	5.5	-	-	-	-	10.0	24.0	10.0	-

2.4.4.3 Gender and Age Profile

Most of the household survey respondents are female, representing 60% of 1051 total samples. Age distribution data showed that ages between 15 - 64 comprises 65.5% of the household population; below age of 15 is 30.1% and 65 years old and above make up only 4.4% of the household respondents.

The combined young and old dependency level is 50.4, indicating about 50 dependents per 100 population. A high dependency ratio is linked to poverty. Sto. Tomas have the highest computed dependency ratio at 66.9%. The other municipalities where age dependency ratio is over 50 are the following: San Pablo City, Candelaria, Sariaya and Tayabas City.

Table 2-81: Age distribution and Age Dependency Ratio

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Total	6218	212	1290	775	1501	718	884	718	120
Below 15	1816	46	430	159	468	192	262	220	39
15-64	4056	161	773	534	951	507	585	468	77
65 and over	346	5	87	82	82	19	37	30	4
Age Dependency Ratio	50.4	31.7	66.9	45.1	57.8	41.6	51.1	53.4	55.8

2.4.4.4 Literacy Rate / Profile and Educational Attainment of Household Head

Household respondents educational level tends to range on high school education at 50% while those with some form of elementary education are at 26%. College level/degree at 21% and vocational education at 3.2%. The proportion of college graduates or those with college education by municipality was recorded highest in Alaminos at 31.1%, followed by San Pablo City at 24.7% and Sto. Tomas at 24%.

The low turn-out of respondents enrolling in vocational education is indicative of the value most Filipinos put to a 4-year degree. As the area is host to many industrial zones and outsourcing companies, vocational/technical skills are therefore needed to support the local industries.

Table 2-82: Educational attainment of household head

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
No of Bgys	45	2	11	6	8	4	5	8	1
Base: sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No formal schooling	9.4	-	2	4.1	2.3	-	1	-	-
With Elementary education	26.0	20	21	10.8	26.7	16.8	40	52	21

With High school Education	50.1	59	44	53.2	45.1	68.3	38	29	64
With College/post graduate education	17.3	13	24	31.1	24.7	12.6	14	5	14
With Vocational education	3.2	9	8	0.9	1.2	2.4	3	1	0

2.4.4.5 Settlements Maps

The settlement maps per municipality/city can be found in **Annex Q** of the report. Please note that google imagery is captured year 2016, hence this images are fairly new and accurate.

Housing Ownership profile /Availability of housing /Number of Informal Settlers

Households respondents house ownership is at 74%; household house renters are 8%; while care takers/RFOs are pegged at 15%. As to RFOs, most of them are in the barangays of San Pablo City, as well as in Sariaya and Tiaong, Quezon province.

Table 2-83: Household House Occupancy Status

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
No. of barangays	45	2	11	6	8	5	5	6	1
Base: sample Households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
House Owner	74	93	59	94	57	78	79	53	75
Renter	8	6	33	2.8	2.3	5.4	11	1	-
Caretaker/ RFO	15	-	7	3.2	40.7	16.6	10	37	7

2.4.4.6 Project implementation’s threat to public health vis-avis the baseline health conditions; basic services availability and resource competition in the project area

Basic services provide households the amenities and services that contribute to quality life and better living conditions. The proposed project will not pose risks on cessation of basic services as a result of project construction and operation activities. Though there may be some roads and creeks/rivers that will be temporarily affected, rehabilitation will be done after construction.

The findings on households’ access to basic services are as follows:

Water Supply

More than half of the household respondents or 58% have access to piped water connection (Level III). There are some households who still utilize Level II water connection through community faucet at

21.8% prevalent in Tayabas City. Some use wells at 21.6%, rainwater harvesting at 4.3% and spring or stream water at 3.3%. Lastly, 3.1% of respondents buy water from water vendors.

Table 2-84: Households by Primary Source of Water for Domestic Use

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Base: total sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Piped connection	58.0	77.0	80.0	97.0	50.0	50.0	57.0	49.0	7.0
Public / street faucet	21.8	-	13.0	1.0	6.8	-	5.0	26.0	79.0
Deep or shallow well	21.6	14.0	0.4	1.5	42.7	50.0	30.0	13.0	-
Spring/river/pond/ stream	3.3	-	0.9	-	-	-	3.0	6.0	-
Rain	4.3	4.0	0.3	-	-	-	0.5	3.0	14.0
Water vendors	3.1	5.0	5.6	0.5	0.5	-	4.0	3.0	-

Power Supply

During the power crisis in 1992 - 1993, many private sector companies built power plants in the CALABARZON as they were invited to invest and participate in power generation to accelerate capacity augmentation. 89% of generated power capacity of the region is from Batangas (50%); Laguna (22%); and, Quezon (18%) (Source: Regional Development Plan, NEDA, 2004-2010).

Based on the survey conducted, majority of sample households source their power from an electric company and a minimal number is connected to neighbors through sub-meters. Sub-metering from neighbors has been reported in most barangays except in Candelaria and Tayabas City which is 100% connected to power lines.

Table 2-85: Households' Power Supply

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Base: sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Connected to a power company	85.8	89.0	94.0	98.0	88.0	93.0	79.0	86.0	59.0
Sub-connect to neighbor	15.0	9.0	4.0	-	-	-	18.0	12.0	32.0
Not connected /instead use kerosene lamp	4.6	2.0	2.0	2.0	12.0	7.0	0.5	2.0	9.0
LPG lamp	3.0	-	-	-	-	-	3.0	-	-

Communication/Transportation

Telephone companies such as PLDT, Smart, Globe and Sun has coverage in the project areas.

Banking and Financial Institutions

The five (5) municipalities and three (3) cities are hosts to major banking institutions; BPI, METRO BANK, LAND BANK, DBP, RCBC and other commercial banks. Pawnshops and other smaller lending institutions are also operating in the area. Some cooperatives also operate in the area serving the needs of farmers and small entrepreneurs. Overall, these banking institutions serve the financial/ capital needs of the communities and business owners and establishments.

Health Services

Respondents are generally aware of health facilities in their areas. Barangay health centers are most popular at 70.5% awareness, government hospitals at 43.6%, private clinics at 28.9% , and private hospitals at 29.2%.

Barangay Health Centers (BHC) are manned by nurses or midwives with the support of Barangay Health Workers (BHWs). Doctors visit the BHC once or thrice a week. The city has however health center facilities in some districts that are manned by doctors, nurses and midwives. There is somehow a low availment of services among the respondents at the government hospitals, private clinics and private hospitals as indicated in the survey. These health facilities may be far from their residences, hence, if only for medical consultations they go to the Barangay Health Center. Additionally, women get free medicines and contraceptives; vitamins are most often available for children.

Table 2-86: Household Health Facility Awareness and Treatment Availment

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Base: total sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Barangay Health Center	70.5	65.0	68.0	82.1	48.1	98.2	54.0	60.0	89.0
Government Hospital	43.6	48.0	18.0	76.6	30.6	92.8	22.0	15.0	46.0
Private clinic	28.9	4.0	14.0	63.0	22.5	72.4	35.0	17.0	4.0
Private hospital	29.2	30.0	20.0	62.1	20.3	72.4	18.0	7.0	4.0
Did not consult – resorted to self-medication	-	-	-	-	-	-	5.0	-	21.0

Education Facilities

The awareness among respondent households on availability of a pre-school is at 33.8% and elementary school in their respective areas is at 56.9%. As to utilization of educational facilities, the pre-school and elementary school are mostly availed of by about 7-67% (pre-school) and for an elementary school by about 42-70%

College and vocational facilities may be distant from residences but are availed of by students enrolled in college and vocational courses. About 9-16 % is enrolled in college while only a few are into vocational courses.

Table 2-87: Household Educational Facilities Availability and Awareness

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas

Base: total sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Pre-school	33.8	67.o	18.0	52.6	24.5	72.4	14.0	15.0	7.0
Elementary	56.9	70.o	51.0	65.6	31.1	79.6	42.0	550.0	61.0
High School	35.4	20.0	25.0	63.9	23.9	76.6	38.0	220.0	14.0
College	18.3	9.0	14.0	23.1	12.1	59.9	11.0	110.0	7.0
Vocational	11.5	-	2.0	21.7	10.1	34.2	1.0	0.5	-

Recreational Facilities /Sports Facilities

Recreational facilities/sports facilities are present in each of the barangays. These are mostly covered court with basketball /volleyball facilities. During typhoon and calamities, these facilities serve multiple functions, as sleeping quarter for flood or disaster victims and also as areas for food rationing and other relief services. These facilities are constructed either from the funds of the barangay, Municipal LGUs or donations from congressmen or governors.

Literacy Rate, Profile of Educational Attainment

Educational profile of the households shows a relatively low educational achievement, evident in 56.9% elementary education reached; high school education reached is at 35.4% and college education has an average reached of 18.3%. This circumstance may not adversely impact issues on public health and safety with project presence in the area, as long as the information on project impacts will be explained and reiterated during all phases of project development.

Peace and Order

On the consolidated responses below, peace and order is ranked 3rd among seven (7) listed community issues. Unemployment and poverty related problems emerged as top community issues from the household of the project area at 34% response rate. Other significant issues mentioned are; potable water (19%); peace and order (17.2%); garbage and sanitation (17%); as well as alcohol and drug related issues (15%).

These may have potential implication on public safety of motorist if not addressed in the future. Implications may be in form of robbery and theft of motor vehicles, hold-ups, theft to facilities of the project such as safety equipment installations/fences ,among others. The unemployment and poverty incidence may exacerbate the safety issues.

Table 2-88: Community Issues

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	`Candelaria	Sariaya	Tayabas
Total Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Peace and order	17.2	48.0	14.0	11.0	20.0	10.0	15.0	20.0	-
Garbage and sanitation	17.0	6.0	28.0	48.0	17.0	17.0	5.0	18.0	-
Potable water supply	19.0	15.0	20.0	2.0	6.0	9.0	11.0	26.0	68.0
Youth conflicts /problem	3.0	-	4.0	2.0	3.0	10.0	7.0	2.0	-
Unemployment/ poverty	34.0	61.0	47.0	26.0	64.0	26.0	38.0	15.0	-
Drugs/alcohol	15.0	26.0	18.0	14.0	30.0	16.0	6.0	11.0	-
Crime/robbery	4.0	-	0.6	6.0	4.0	6.0	8.0	5.0	-

2.4.4.7 Environmental Health and Sanitation Profile

Potable Water Supply
Most households in the project area are connected to a piped water system. There are still municipalities and cities along the proposed alignment who utilized ground water like those in San Pablo City, 24%; Alaminos, 2% and significantly in Tiaong at 50%. Potable water supply issue was indicated as major concern by households from Tayabas, 68%; and Sariaya, 26%; evident in the matrix of community issues noted above.

Toilet Facilities
The most predominant toilet facilities are the water sealed type, exclusively used or sometimes shared by the household, 87.7%. There still a small segment of sample households utilizing non-water sealed facilities, 7.6%; that may pose danger to health of residents as well as community as a whole.

Table 2-89: Household Toilet Facilities Used

	Total	Sto. Tomas	Calamba	San Pablo	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas
Base :Total sample households	1501	46	319	222	346	167	189	184	28
Percent (100%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Water sealed	87.7	97.9	100	62.7	96.8	91.2	85.9	76.9	93.9
Non-water sealed (closed /open pit)	7.6	0.3	-	28.3	-	5.9	10.9	2.9	7.9
Shared toilet	3.7	0.9	-	8.4	2.8	2.9	4.9	11.9	-
Public toilet	0.1	-	-	-	-	-	-	.5	-
No toilet (wrap and throw, etc, bush, lake, etc)	1.3	-	-	-	-	-	.5	10.9	-

Waste Management
Waste collection by LGU with no segregation at source is reported as most prevalent way of waste management (37.8%) in the project areas, though LGU is also collecting segregated waste at 31.8% as responded by the household.

Waste burning is still a practice among households (average 32.4%) prevalent in Sariaya, Candelaria and San Pablo City. Composting is being practiced at an average of 9.4% in the project areas, prevalent in Candelaria and Sariaya.

Table 2-90: Households Waste Disposal Management

	Total	Sto. Tomas	Calamba	San Pablo	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas
Base: total sample households	1501	46	319	222	346	167	189	184	28
Percent	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Collected by LGU (no separation at HH)	37.8	18.0	61.0	53.8	55.6	38.7	6.0	5.0	64.0
Collected by LGU (segregated)	31.8	69.0	37.0	-	-	-	6.0	26.0	21.0
Composting	9.4	4.0	2.0	0.7	12.7	0	29.0	23.0	4.0
Recycling/reuse as livelihood	3.6	3.0	-	-	-	-	2.0	6.0	-
Burning	32.4	13.0	13.0	37.2	12.4	29.0	78.0	66.0	11.0
Throw in river/anywhere	0.6	0.3	-	-	-	-	-	1.0	-

2.4.5 Potential Impacts and Mitigation Measures

2.4.5.1 Census of Population / Properties that will be disturbed

Based on resettlement study, 495 households will be affected in direct impact areas (DIAs). The impacts on directly affected households will be in terms of residential land properties, a median of 200m^2 will be affected for residential land owners while about 1,000 -6,750 m^2 for agricultural land owners will either be acquired or disturbed.

Some road network along Maharlika Highway may be affected /disturbed during construction. Some creeks/rivers may also be affected as result of construction diggings or installation of facilities. Appropriate mitigation measures will be undertaken to reinstate normal conditions of the existing public facilities and waterways in the area.

Resettlement data is not yet definitive as of this time.

2.4.5.2 In-Migration due to Project Implementation

In-migration or proliferation of informal settlers is possible as a result of project implementation.

Minimum population density is noted along the proposed alignment, within and outside of the 60 m ROW stretching 200 m on both sides of the proposed highway. Population becomes dense at the approach to the urban centers, along intersections and the PNR stations. It then becomes sparse at agricultural and farm areas.

Potential in-migration may happen as a result of project implementation although not along the proposed alignment but in areas near interchanges/exits adjacent to the urban centers. This will be induced by potential business opportunities for commercial and auto/vehicle equipment and repairs services, informal settlers may be attracted to potential opportunities as labors, welders, mechanic or other businesses that requires workers.

2.4.5.3 Impacts on IPs and Culture / Lifestyle

2.4.5.3.1 Impacts on Indigenous People

There is no presence of Indigenous People (IP) community in the project area.

2.4.5.3.2 Cultural / Lifestyle Change

Lifestyle change would be inevitable for the affected household in the direct impact areas who will be relocated because of the project. The changes would probably be in terms of community cohesion, resource mobilization and competition, social and economic network disruptions, among other things.

There is a possibility that relocation might result to economic difficulties, hence adequate financial compensation coupled with sound financial management should be in place for the affected households. Access to basic services might be hampered for indirect impact areas , it might be temporary impeded or re-routed because of the road construction. Therefore, route panning should be well thought of in this case so that affected household would still be able to maintain their mobility and basic services access.

2.4.5.4 Physical and Cultural Resources

No resources will be used by the project that will change the landscape of current environment except the minimal impact the project will cause by traversing the lower portion of the buffer zone of Mt. Makiling. It is assumed however, that even without the project, encroachers may find their way to the forested areas. A positive note that the improvement of the Mt. Makiling watershed is a priority commitment by the proponent to enhance the environmental condition and resources.

It must be noted that there is no physical and/or cultural landscape along the route that will be traversed by the SLEX TR4 alignment.

2.4.5.5 Food Security

Food security is a potential adverse social impact of the project as a result of displacement of some households due to relocation and loss of economic assets/opportunities. The project will ensure adequate mitigation measures that will prevent the issue of food shortage from happening during relocation and post-relocation.

Appropriate livelihood and skills interventions should provide the households opportunities and also capture possible outside work opportunities. The project will prioritize those living below the poverty threshold and the vulnerable groups including women, elderly and PWDs receiving P8,000/month and below income.

2.4.5.6 Resource Competition

Community tends to compete for resources once there is influx of migrants or if population increases exponentially in an area. Resource competition poses a risk upon influx of migrants during construction phase of the project. One of the mitigating measures will be a clear policy to contractors to prioritize local hiring to minimize in-migration. Proper information, education and communication program should be developed and key messages should reach the communities and authorities about the measures developed by the company.

Resettlement program if not done properly might also risk resource competition in the resettlement sites. Entitlements given to the relocatees should include resources assistance or augmentation to host communities like health centers or schools etc.

2.4.5.7 Threat to Public Health and Safety

Based on the household survey common illnesses that respondents cited to be afflicting their male or female household members are almost the same. Top illnesses cited by the respondents are common colds/cough, common fever, flu, hypertension and asthma and UTI

Respiratory health problem like asthma is cited as one of the causes of morbidity of household respondents (7%) and particularly afflicting female household members. There is a probability that the project may increase cases like this due to vehicle emissions.

Public health may be a potential issue at the indirect impact areas or within 200 m distance due to vehicle emissions hence, buffer zones should be established in indirect impact areas that are populated. Planting buffer zones may include growing trees or shrubs that will absorb carbon emissions, increase oxygen level and may also serve as protection from possible accidents during road operation.

Rural health units may also conduct regular monitoring of primary health conditions of households living within the 200 m zone on both sides of the proposed expressway and implement proper primary health care interventions that can help improve health conditions of communities at indirect impact areas.

Table 2-91: Common Illnesses affecting Male Household Members

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Total Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Common colds /coughs	39.0	63.0	32.0	38.0	32.0	65.0	38.0	20.0	64.0
Common fever	30.0	8.0	23.0	31.0	24.0	.0	25.0	28.0	57.0
Flu	21.0	-	15.0	17.0	21.0	5.0	8.0	12.0	-
Hypertension	-	21.0	18.0	13.0	13.0	9.0	11.0	4.0	-
Asthma	7.0	7.0	5.0	5.0	5.0	16.0	4.0	5.0	-
UTI	8.0	4.0	7.0	7.0	2.0	8.0	3.0	5.0	-

Table 2-92: Common Illnesses Afflicting Female Household Members

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Total Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Common colds/cough	39.0	61.0	30.0	39.0	38.0	64.0	38.0	23.0	43.0
Common fever	30.0	4.0	17.0	30.0	23.0	62.0	24.0	34.0	46.0
Flu	19.0	4.0	17.0	10.0	23.0	52.0	6.0	10.0	-
Hypertension	13.0	22.0	16.0	14.0	16.0	10.0	11.0	7.0	-
UTI	6.0	4.0	7.0	8.0	4.0	9.0	4.0	6.0	-
Asthma	6.0	4.0	5.0	5.0	5.0	14.0	2.0	4.0	4.0

Leading causes of mortality cited for both male and female are hypertension, 26%; heart disease, 22%; diabetes related sickness, 17%; kidney disease, 7%; and, tuberculosis at 6%.

Table 2-93: Causes of death in the community for male household members

	Total	Calamba	Sto. Tomas	Alami nos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Total Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Hypertension	26.0	20.0	49.0	49.0	36.0	35.0	28.0	12.0	7.14
Heart disease	22.0	37.0	24.0	38.0	23.0	27.0	10.0	11.0	-
Diabetes	17.0	2.0	17.0	35.0	27.0	28.0	2.0	2.0	-
Kidney Disease	7.0	-	8.0	21.0	10.0	14.0	4.0	1.0	-
Tuberculosis	6.0	-	14.0	8.0	4.0	17.0	4.0	2.0	-

Table 2-94: Causes of death in the community for female household members

	Total	Calamba	Sto. Tomas	Alaminos	San Pablo	Tiaong	Candelaria	Sariaya	Tayabas
Total Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Hypertension	26.0	13.0	21.0	30.0	23.0	61.0	17.0	9.0	-
Heart disease	15.0	28.0	11.0	26.0	21.0	24.0	7.0	5.0	-
Diabetes	15.0	2.0	11.0	32.0	28.0	26.0	2.0	3.0	-
Kidney Disease	7.0	-	7.0	17.0	11.0	9.0	1.0	-	-
Tuberculosis	3.0	-	0.3	2.0	3.0	12.0	2.0	0.5	-

Chronic degenerative diseases (hypertension, heart disease, diabetes, kidney disease) afflict the elderly/senior citizens while tuberculosis, a primary health disease is preventable with proper nutrition, rest and hygiene hit all ages. Although only few cases are reported, relocation of affected households may pose higher incidence of tuberculosis . Food is important, hence it is vital to ensure households have occupation and economic opportunities to increase their capacity to buy food, especially if they do not produce such.

It should be crucial for households engaged in farming, if relocated, that parallel occupation be prioritized as mitigation measures particularly land based enterprise that will be appropriate for faming activities. Increasing farm productivity is a goal for the farming sector to be able to produce enough food for the family and surplus for commercial purposes. It is important that condition at the relocation site should restore previous livelihood/ income source and create even better socio-economic life for relocatees. The Resettlement Plan should be able to spell out the strategy for livelihood/income restoration.

2.4.6 Disaster Profile (Disaster Risk Reduction/Climate Change Adaptation)

In recent years, flood and inundation disasters in the provinces were caused by Typhoon Milenyo in 2006, Typhoon Frank in 2008, Tropical Storm Ondoy in 2009, Typhoon Basyang in 2010 and Typhoon Maring in 2013. An average of 20 typhoons pass through the country annually, four (4) to five (5) of them cause major disasters by floods, storm surges and strong winds. Table below enumerates natural hazards in the three (3) affected provinces.

Table 2-95: List of Provincial Disasters

Disaster/year	Batangas	Laguna	Quezon
Primary natural hazard	Drought Flood Landslide Storm Surge Volcanic eruption	Drought Flood Landslide	Drought Flood Landslide Storm Surge

As typhoon occurrence intensifies in the country, it is necessary that mitigation measures in the project affected areas are climate-proof such that relocation homes will be made sturdier and away from low lying areas to avoid flood. Any assistance to the community should also be in consonance with DRR/CCA principle.

2.4.7 Expected Local Benefits from the Project

Local benefits from the project comes in three (3) opportunities, as follows: (i) Enhanced employment and livelihood opportunities; (ii) Increased business opportunities and associated economic activities;(iii) Increased revenue of LGUs. The proposed project is expected to enhance overall local economy by increasing opportunities for economic activities and employment, either directly and indirectly both during construction and operations phases.

During project construction phase, the project will engage contractors, who in turn will hire local laborers. Along with this, entrepreneurial activities including food and dry good vending, services, etc. will increase in the area. In the operations phase, road buffer zone maintenance along the expressway is a potential source of income for households. There will be potential business opportunities associated with the new road such as gasoline stations, food shops/pasalubong centers motor shops, welding services etc. in areas near the interchanges and exits. Business permit and taxes will be paid by the proponent to the LGUs. Businesses brought about by project operations will also contribute to revenues to the affected LGUs.

2.4.7.1 Current Employment Status / Livelihood Sources

The project will impact on the income and livelihood of the project affected population given the results of the sample survey. Some 11% of sample households rely on farming as source of income come may be affected. Those employed in the private sector or government sector, the project may provide positive benefits in terms of faster access to places of work. Those in the construction industry may gain employment during the construction phase of the project, while those having businesses could translate to benefits/gains in terms of faster access to sources of raw materials and goods for retail.

Based on survey results, the dominant source of employment in the affected areas are employment to the private sector (24.6%); followed by small and medium enterprises (16.6%); and farming (11.4%). Farming is the top cited occupation in Tiaong and Sariaya (34% and 20%). Employment in the private sector was recorded highest in Alaminos (28%) and San Pablo City (24%), while lowest in Sariaya (3%).

Farming, particularly the areas whose land will be affected by the project, will be vulnerable in the future. Hence mitigating measures on livelihood and farming inputs should be in place.

Table 2-96: Primary Occupation of Household Head

	Total	Sto. Tomas	Calamba	San Pablo	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas
Base: Sample Households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Farming	11.4	10.0	0.0.	4.5	3.0	34.0	14.0	22.0	4.0
Employment from private sector	24.6	21.0	4.0	24.0	28.0	18.0	5.0	3.0	14.0
Driving	12	5.0	-	-	-		10.0	15.0	18.0
Labor/Construction	10.6	9.0	-	10.0	12.0	10.0	13.0	9.0	11.0
Own Business	16.6	10.0	15.0	29.0	32.0	24.0	7.0	2.0	14.0
Manufacturing	6.5	4.0	4.0	-	11.0	5.0	6.0	9.0	-
Employment in Government Sector	7.7	10.0	13.0	10.0	9.0	9.0	5.0	3.0	4.0

2.4.7.2 Monthly Incomes and Poverty Thresholds/Poverty Incidence

PSA 2015 Annual per Capita Poverty Threshold in the affected provinces are as follows, Batangas P21,767; Laguna P21,770; and Quezon P20,515. Official data shows that Quezon Province has the lowest poverty threshold income among the three provinces, followed by Batangas and Laguna Provinces.

There are around 58.7% of the total respondents of the 42 barangays traversed by the proposed expressway living with P8, 000 and below income. San Pablo City has the highest incidence of household living below P8,000, at 63.3%; while Tayabas City has the lowest at 39.1%.

Households income of P8,000 and below may experience difficulty in meeting basic needs. As basic household items and transportation expenses are increasing, it is most likely school drop-outs will increase; health needs may not be met; and overall access to social services will be affected. In case of permanent displacement of the affected household, the same group may experience further threats to poverty.

The household data on incomes were disaggregated per sectors as follows:
i.)farming sector indicates that farmers from San Pablo City reported highest earnings to around P10,994.9 income monthly and lowest in Calamba City, which is understandable being a highly urbanized city; ii.) Private sectors employees reported highest average salary in Alaminos at P13,011.9

and lowest at Candelaria at P4,000; iii.) Government employees in Alaminos responded to earn at an average of P10,000 while lowest in Tayabas City at an average of P2,000; iv.)Small and medium enterprises reported highest earners at Tayabas City at an average of P8,000 and lowest at Calamba City at P5,000.

Mitigation measures may be planned for the low income groups covering livelihood/income opportunities, improving access to social services including health, education and basic facilities. The creation of opportunities for increased investments, business opportunities and employment shall be pursued thereby increasing incomes in the project affected areas.

Table 2-97: Monthly Median Household Incomes, Per Capita Threshold, Monthly Poverty Threshold

	Batangas (PhP)	Laguna (PhP)	Quezon (PhP)
Annual Per Capita Poverty Threshold (PSA, 2015)	21,767	21,770	20,515
Median Monthly income from all sources	Sto. Tomas- 15,174	Calamba-12,500 Alaminos- 9,585.5 San Pablo-7,928.5	Tiaong- 8,291.4 Candelaria- 7,228 Sariaya- 5,334 Tayabas- 9,500
Household monthly Income:P8,000 and below	Sto Tomas - 20.4%	Calamba-17.4% Alaminos-62.8% SanPablo-63.3%	Tiaong-51.4% Candelaria-54.5% Sariaya-45.6% Tayabas-39.1%
Median Monthly income from Farming	Sto Tomas-5,000.0	Calamba-2,500.0 Alaminos-2022.7 San Pablo-10994.9	Tiaong -5906.5 Candelaria-5,000.0 Sariaya-4,533.0 Tayabas-6,500.0
Median Monthly income from Employment in private sector	Sto. Tomas- 12,500.0	Calamba-9,800.0 Alaminos-13,011.9 San Pablo-12,948.8	Tiaong- 8809.9 Candelaria-7,200.0 Sariaya-9,500.0 Tayabas- 10,000.0
Median Monthly income from Employment in govt. sector	Sto Tomas-5,100	Calamba-5,500.0 Alaminos-8601.1 San Pablo-5,440.7	Tiaong-7259.3 Candelaria-4,000.0 Sariaya-10,000.0 Tayabas-2,220.0
Median Monthly income from self-employment /own business	Sto. Tomas-7,500	Calamba-5,000.0 Alaminos-6908.9 San Pablo-4784.3	Tiaong- 6612.6 Candelaria-6,800.0 Sariaya-6,667.0 Tayabas-8,000.0

Information on household savings shows that about 33-74% of the households in Sto, Tomas, Calamba, San Pablo, Alaminos and Candelaria reported that they have not set aside any savings fund, averaged at 40% of the respondents in the project area. Those reported to have net savings, the computed median monthly savings per household is about P1,991.6 or 16% of gross monthly income of the respondents.

Full sample households (100%)in Sariaya and Tayabas reported to have savings estimated at about 11 to 18% of the gross monthly incomes.

Table 2-98: Household Monthly Gross Incomes and Net Savings

	Total	Sto. Tomas	Calamba	San Pablo	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas
Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Median monthly gross income from all sources	P8939	P15,174	P12,500	P7928.5	9585.9	8291.4	P7,228	P5,334	P8,800
Households with monthly net savings	59.6	60.0	67.0	32.0	25.0	56.0	37.0	100	100
Median monthly net savings	P1991.6	P1,847	P2,417	<P1,000	2629.9	1353.2	<P1,000	<P1,000	P,1,000
Households with no net savings	40.4	40.0	33.0	68.0	75.0	44.0	43.0	-	-
Net savings as % of gross monthly income	16.0	12.0	19.0	13.0	27.0	16.0	14.0	18.0	11.0

2.4.7.3 Monthly Household Expenditures

The study indicated that the top reported expense item across all affected areas is food (100 %); this, not discounting the fact that expenses on medical related bill (PHP3350, 31%) is also a priority of some respondents as opposed to 100% response rate on food.

Essential utilities such as electricity (89%); cellphone load (72%); water (68%); LPG fuel (56%); as well as basic needs like education expenses (tuition fee (46%); transportation (46%) and necessary allowance (45%) are part of top household expenditures in the affected areas.

Food remains the top most expense item. Transportation to work, electricity, education expenses (which includes tuition, student allowance and transportation) and medical bills are the big items subsequent to food. There is an indication that telecommunications (particularly cell phone loads) are becoming a regular and basic expense of most household.

Table 2-99: Household Mean Monthly Expenditures

Expense Item	Households reported expense in %	Mean Monthly Expenses in Pesos	Range of Expenses in Pesos
Food	100.0	3282	3,000- 5,500
Clothing	53.0	1633	400-2,100
Housing (amortization, rent/repair)	18.0	1128	1,000-24,500
Education expense	45.0	2304	
Transportation to work place	27.0	1144	500-2,100
Furniture/appliances (per year)	9.0	329	1,000=9,000
Utilities			
• Water	68.0	407	240-400
• Electricity	89.0	909	400-1,600

• Telecommunications (load and net usage)		1598	
• Fuel for cooking			
LPG	56.0	639	650-700
Others	2.0	229	100-850
Solid waste/garbage	4.0	197	150-750
Medical bills ((consultations)	31.0	3350	600-2,900
Entertainment/recreation	5.0	1,105	400-1,600
Remittances to relatives outside household	5.0	2,102	550-5,2350-85000
Betting	17.0	370	50-700
Cigarette/alcohol (per month)	26.0	527	350-850
Others (cable, car maintenance etc.)	5.0	368	350-850

2.4.7.4 Other Assets / Household Equipment

Data on other assets/equipment owned by the households were consolidated as indicators of lifestyle and economic well-being. There is high percentage of households who owns electric-operated appliances such as televisions (87%); refrigerators (61%) and washing machines (50%) due to access to electricity and affordability of these appliance. For transportation, about 3 out of 10 household owns motorcycle or tricycle

Cellphones or mobile phone has become necessity with some 83% claiming ownership; translated to an average of two (2) cell phones per household. Personal computers are owned by 25% of respondent households. This figure indicates opportunity for households to be connected to information technology and a bigger chance of networking for social networks and for jobs opportunities as well.

Table 2-100: Household Asset Ownership

	Total	Sto. Tomas	Calamba	San Pablo	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas
Sample households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
with cars	12.0	18.0	9.0	4.0	25.0	9.0	8.0	6.0	4.0
with motorcycles/ tricycles	33.0	24.0	7.0	26.0	24.0	40.0	35.0	48.0	14.0
with trucks	-	3.0	-	4.0	2.0	2.0	11.0	2.0	-
with televisions	84.0	97.0	93.0	86.0	89.0	83.0	67.0	80.0	89.0
with refrigerator	61.0	78.0	76.0	54.0	73.0	56.0	60.0	38.0	36.0
with telephones/ cellular phones	82.0	94.0	76.0	95.0	83.0	94.0	68.0	59.0	71.0
with washing machines	50.0	71.0	65.0	42.0	64.0	48.0	32.0	33.0	18.0
with air conditioner	11.0	12.0	7.0	6.0	19.0	17.0	10.0	4.0	4.0
with personal computer	25.0	30.0	41.0	14.0	37.0	41.0	16.0	6.0	7.0
with electric water pump/ overhead tank	8.0	3.0	-	4.0	9.0	21.0	12.0	4.0	4.0

2.4.7.5 Commercial Establishments and Activities

Commercial establishments and industrial centers are established in urban centers along the highway like those in San Pablo City and Calamba City. Most of these include food establishments, dry goods and groceries /malls, pharmacies, among others. In other areas most commercial establishments are found in the town centers like those in Tayabas City, Tiaong and Sariaya, Quezon.

2.4.7.6 Banking and Financial Institutions

The areas hosts major banking institutions; i.e. BPI, METRO BANK, LAND BANK, DBP, RCBC and other commercial Banks. Pawnshops and lending institutions also operate in the areas. Cooperatives are present in the area serving the needs of farmers and smaller entrepreneurs. Card Inc. a leading micro-finance organization in the country serves the CALABARZON area, the organization is founded in Laguna and currently headquarters in San Pablo City, Laguna.

Overall, ample banking/micro-finance institutions serve the financial/capital needs of the communities and business owners.

2.4.7.7 Participation and Involvement/Linkages

Participation and linkage are important aspects that needs enhancement in the project. Household members' participation in decision-making will contribute to stronger family relationships, this contributes to event like physical displacement or emergencies that families move together as a unit. Improve linkages also provide opportunities for referrals and support network for bigger social and economic opportunities.

2.4.7.8 Household Decision Making Process and Gender Involvement in Activities /Practices

Who decides in the household on matters related to economic, political or social concerns (gender role) is important and provides project planners and implementers with insights on how this can used to maximize in developing and proposing plans of actions to ensure project success.

Survey results indicated that concerns that would impact on the households economic well-being (such as buying household equipment, renovation/buying a house/fixtures, changing residence or changing jobs) are often decided by the husband and wife. The proportion of sample households who admitted to joint husband and wife decision are significant across project affected areas (range 25%-62%).

For gender involvement in household activities, indicates that there areas where both males and females in the households still performs traditional roles like farming and farm produce selling.
Although male members of the household now shares the tasks on what used to be females roles, and vice versa Examples are monitoring activities/needs of children, water collection, garbage disposal and the likes

Table 2-101: Gender Involvement in Household Decision Making

Decisions/Activities/Practices	Gender Involvement in %		
	Male only	Female only	Joint involvement
Decisions:			
-buying household equipment	53	24	25
-House renovation/ house purchase	21	18	61
-Change of residence	16	26	58
-Change in jobs	16	26	57
-Support to those in need	15	23	62
-Who would join or get involved in projects/community activities	18	30	52
Conduct of:			
-Farming Activities	53	24	23
-Marketing of farm produce	46	30	24
-Monitoring activities/needs of children	12	45	42
-Cleaning the house	11	68	21
-Water collection/management	34	36	30
-Garbage disposal/waste management	33	42	25

2.4.7.9 Community Networks

Membership to community organizations is a reflection of current community networks and indicates the extent of influence of these organizations to the communities. A possible intervention would be putting community organizations at fore, potentially instrumental in the mitigating measures of some project impacts to the community. This is where organizational advocacy is inherent to enhance project benefits.

Survey results indicated that around 41.8% of household respondents' head and/or member belong to organization such as Cooperatives (21 %); Savings Group (21%); Seniors citizen group (18%) and Women's group (18 %). Active membership role in these organizations like attending meetings, voting during elections and providing suggestions to projects indicated is indicated at 85.6%.

Cooperative membership are mostly prevalent in Quezon Province respondents (Candelaria, 34%; Sariaya, 35%; and Tayabas City, 47%); the savings group membership in San Pablo City (32%); Alaminos (22%) and Sto. Tomas (22%); and senior citizens group membership in Alaminos (39%) and Tayabas City (27%); and women's group membership in Calamba(57%), Sariaya (29%) and Tiaong (13%).

Households with no membership in organizations are estimated at 68.7%, the reasons cited are non-interest in joining these organizations and "no time" because of work and household chores.

Project recommendations given by the members of these organizations are: to make other members understand the project; and if opportunity presents, offer livelihood and capital assistance to the organization.

Table 2-102: Membership to Community Organization

	Total	Sto. Tomas	Calamba	San Pablo	Alaminos	Tiaong	Candelaria	Sariaya	Tayabas
Base: sample Households	1501	46	319	222	346	167	189	184	28
Percent (%)	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Membership (%)	41.8	43	50	78.9	14	13.8	35	46	54
Type of organization (% of Households who have members in com organizations)									
-Seniors	18.0	23.0	9.0	8.0	39.0	10.0	12.0	16.0	27.0
-Cooperative	25.5	14.0	-	16.0	12.0	21.0	34.0	35.0	47.0
-Women's	21.0	12.0	57.0	11.0	12.0	28.0	6.0	29.0	13.0
-Savings group	17.5	22.0	4.0	32.0	22.0	23.0	13.0	24.0	0
-Homeowners	6.0	17.0	4.0	-	3.0	-	9.0	2.0	0
-Religious	7.0	10.0	11.0	6.0	3.0	4.0	7.0	8.0	7.0
Active status	85.6	92.0	95.0	78.0	86.0	73.0	88.0	730	100
Reasons for non-membership (% of households with no membership)									
-Non-interest	68.7	59	56	21.1	145	86.2	94	19.0	69.0
-Busy with work/household chores	29.6	43	43	-	-	-	26	5.0	31.0

2.4.8 Perception of the Project: Issues and Concern, Project Benefits, and Reocmmendation to Facilitate Project Implementation

Group Discussions (GDs) were conducted in almost all barangays to be affected by the project. Initial GDs were conducted during the months of May-June 2013 as part of the initial baselining activities of TR4 during that year. Subsequently due to some project development/re-alignment in 2015, GD activities were conducted in some areas affected by the project realignment; and finally following lapse of data by year 2018, validation activities for the issues and concern raised from the previous GDs were done in the year 2016 and 2018.

Validation activities were deemed appropriate because the result of the 2013 GDs were substantial, it was also to avoid duplications from the key stakeholders. The review of the GD results were for the following: i.) to determine if the issues and concerns raised were still valid in the barangay through the years; ii.) to determine emerging issues and concern with regards to the project; and iii.) to determine if some of the issues and concern previously raised are already resolved.

Table below refers to the timeline of the actual conduct of the GDs.

Table 2-103: Group Discussion Activities Timeline

Month/Year Group Discussion Conducted	Municipality/City	Activity
May - June 2013	Calamba City, Laguna Sto. Tomas, Batangas Alaminos, Laguna San Pablo City, Laguna Tiaong, Quezon Candelaria, Quezon Sariaya, Quezon Tayabas, Quezon	Group discussion
February - June 2016	Calamba City, Laguna Sto. Tomas, Batangas Candelaria, Quezon Sariaya, Quezon Tayabas, Quezon	Validation of GD results, due to TR4 realignment
March - April 2018	Alaminos, Laguna San Pablo City, Laguna Tiaong, Quezon	Validation of GD results, due to data lapse

Key stakeholders were requested to be invited through the barangay LGU, ensuring the following sectors are represented in the discussions; youth, women, the elderly, farmers, landowners, businessmen and barangay officials. A total of 19 meetings were conducted in 2018, 28 meetings in 2016 and 42 meetings in the earlier year of 2013. The reduction of meeting frequency from year 2013 is due to project realignment where a number of barangays was avoided to minimize the impact to the community.

2.4.8.1 Highlights of Major Issues and Concerns by Municipality

Affected Barangays of Calamba City, Laguna

Both Barangays Makiling and Puting Lupa are concerned with the issues relation to; relocation for affected families, as relayed that if relocation happens in their barangays, facilities and amenities should be available in the proposed relocation site; fair and just compensation was also brought forward during the discussions, specific query from Barangay Puting Lupa was on the affected families compensation coverage like land, structure and vegetation.

Land titling and tax declaration is also an issue for the affected families in both barangay. For most of the affected families who have no legal title to the lots, depends on tax declaration as an evidence to lot ownership. The loss of livelihood was tackled in Barangays Puting Lupa, suggesting that alternative livelihood should be available for the affected families.

Barangay Makiling signified concern on cutting off access to the other parts of the community and its effect on community social cohesion as well as access to basic services should the project divide the barangay into two parts. Along this line, Barangay Puting Lupa signified safety issues regarding this matter, in addition to its anxiety on noise disturbance as an effect of increased vehicle notwithstanding the bad experience from the SLEX project of other barangays of Calamba City.

The two barangays came to an understanding that the SLEX project would bring added income to the barangay LGUs nevertheless the stakeholders are requesting for a detailed project information and frequent engagement from SLEX (through a point person) in the future.

Table 2-104: Issues and Concerns Raised in Calamba City, Laguna

Issues/Concerns	Makiling	Puting Lupa
Relocation		
- <u>Facilities & amenities in relocation site</u> - <u>Affected families without legal documents</u>	✓	✓
Compensation		
Coverage; land, structures, vegetation		✓
System of compensation (fair and appropriate)	✓	✓
Land title, tax declaration	✓	
Loss of livelihood, provision of alternative livelihood		✓
Access to other parts of the community, effects on social cohesion and basic services	✓	
Need for project information	✓	
Project income for the LGU	✓	✓
Safety concerns		✓
Environmental concerns		
Noise		✓
SLEX experience		✓
More consultations, the need for an SLEX point person on the ground	✓	

Affected Barangays of Sto. Tomas, Batangas

From the consolidated issues and concerns matrix below, the common issue of all the affected barangays in Sto. Tomas is asset compensation. Much of the query centered on payment facilitation prior to the start of project as relayed by participants who attended the meeting.

Minor issues from the participants are determination of the specific areas to be affected along with the list of families residing on these lands; the design of the project and other considerations for the final design, like the access roads or the overpasses/underpasses. Flooding apprehension was also relayed as a possible impact of the project to the community.

Table 2-105: Issues and Concerns Raised in Sto. Tomas, Batangas

Issues/Concerns	**San Rafael**	**San Antonio**	**San Bartolome**	**San Miguel**	**San Vicente**	**San Felix**	**San Jose**	**San Juan**	**San Agustin**	**Santiago**	**San Pablo**
Relocation										*No Data*	
- <u>Facilities & amenities in relocation site</u> - <u>Affected families without legal documents</u>	✓			✓	✓			✓			
Loss of farmlands, properties and vegetation	✓		✓		✓		✓	✓			
Compensation											
Coverage; land, structures, vegetation	✓	✓						✓			
Valuation of property	✓	✓						✓			

Issues/Concerns	San Rafael	San Antonio	San Bartolome	San Miguel	San Vicente	San Felix	San Jose	San Juan	San Agustin	Santiago	San Pablo
Settlement of payment before the project starts	✓	✓		✓	✓			✓	✓		
Land tenants inclusion	✓	✓					✓				
System of compensation (fair and appropriate)	✓	✓	✓		✓	✓	✓				
Loss of livelihood, provision of alternative livelihood		✓		✓	✓		✓		✓		
Access to other parts of the community, effects on social cohesion and basic services	✓	✓		✓		✓	✓		✓		
Need for project information	✓		✓	✓	✓		✓		✓		
Project income for the LGU	✓							✓			
Safety concerns				✓							
Local hiring				✓							
Environmental concerns											
Noise					✓						
Air pollution									✓		
River and waterways pollution					✓						
Flooding			✓				✓	✓	✓		
SLEX 1 experience	✓						✓				
More consultations					✓						

Affected Barangays of Alaminos, Laguna

Six (6) barangays in Alaminos, Laguna were identified to be affected by the project. The most common concerns across these barangays are issues on fair and just compensation for affected assets; and whether relocation for the affected families will be implemented with a provision of an appropriate site equipped with facilities/amenities.

Usual concerns for some barangays are; query on what becomes of the community mortgage program (CMP) for the informal settler's family (ISF) in three (3) barangays; the stakeholders request for a frequent engagement from the proponent for project appreciation; the access within the community and to other parts of the barangay; the coverage of asset compensation (structures, land and/or vegetations) and; the potential increase in noise level in the community during project operations.

Emerging issues from the Barangays were mainly encroachment of informal settlers family (ISF) in the TR4 alignment and the perception on ambivalence of SLEX for the project. A buffer zone was also mentioned to act as an abatement of noise and dust as well as for safety concerns.

Table 2-106: Issues and Concerns Raised in Alaminos, Laguna

Issues/Concerns	San Andres	San Juan	Palma	San Miguel	San Agustin	San Benito
Relocation						
- Facilities & amenities in relocation site	✓	✓	✓	✓	✓	✓
Loss of - Farm lands - Properties - Vegetation - Livelihood	✓			✓		

Issues/Concerns	San Andres	San Juan	Palma	San Miguel	San Agustin	San Benito
Compensation						
Coverage; land, structures, vegetation	✓			✓		
Settlement of payment before the project starts			✓			
Land tenants inclusion				✓		
System of compensation (fair and appropriate)	✓	✓		✓	✓	✓
Land Title						
Tax Declaration			✓			
No title/“ancestor’s title”			✓			
Free patent holders	✓					
Lot titling responsibility	✓					
Recipient of government housing program; Community Mortgage Program (CMP)		✓		✓		✓
Access to other parts of the community, effects on social cohesion and basic services	✓	✓				✓
Need for project information; more consultations	✓	✓	✓	✓	✓	✓
Project income for the LGU		✓				
Safety concerns			✓			
Local hiring	✓	✓				
Environmental concerns						
Noise	✓			✓		
Flooding				✓		
Emerging issues and concerns:						
Buffer zone from the project			✓			
Project ambivalence			✓	✓		✓
Presence of ISF in TR4 alignment	✓		✓	✓	✓	✓

Affected Barangays of San Pablo City Laguna

The issues and concerns in the affected barangays of San Pablo City has not changed since the initial GD conducted almost five (5) years ago. As expressed, the issues center on the loss of assets and asset compensation for the affected families.

The issue of compensation involves the following: the entitlement of land tenants to compensation; question on affected asset (include infrastructure, agricultural crops, fruit trees) to be compensated; the assets valuation for residential and agricultural land and the details of system of asset compensation to be implemented by the proponent. Further, there are landowners who have no land titles to their names, relying on tax declaration documents to back up claim to the land.

Some barangays express concern residents whose access might be cut off from their barangay should TR4 traverse through their community. Farm and grazing landowners articulated that farm implements like tractors; and carabaos, cows and goats, will not be made to pass through a usual overpass upon TR4 operations. Aside from this, there are also apprehension that it might be tasking for the barangay to respond to emergency situations to the other side of the barangay during highway operations.

Environmental issues such as increase noise level, air pollution due to volume of vehicle plying the community and pollution of waterways were brought forward by the stakeholders, as perceived impacts of the project during construction and operations phases.

A social development program was requested by barangay stakeholders, so too is an alternative livelihood for the affected families. Further, the need to resolve their issues and concerns should be addressed first before start of project. the participants want to see the final plan or a detailed map of the affected areas.

Common to the barangays are their need for a systematic process for compensation; compensation that is just and reasonable; provision of alternative livelihood for displaced affected families; consultations and construction of access roads/ overpasses that will link the barangay to other barangays as well as their social networks.

Table 2-107: Issues and Concerns Raised in San Pablo City, Laguna

Issues/Concerns	Sta. Veronica	Sta. Monica	San Gabriel	San Miguel	Soledad	Sta. Maria	S. Rosario	San Antonio II
Relocation								
- Facilities & amenities in relocation site - Affected families without legal documents - Community mortgage program				✓				✓
Loss of farm lands, properties, vegetation and livelihood	✓	✓	✓	✓	✓	✓	✓	✓
Compensation								
- Coverage; land, structures, vegetation	✓	✓	✓	✓	✓	✓		✓
- Valuation of property	✓	✓	✓	✓	✓	✓		✓
- Settlement of payment before the project starts					✓	✓		✓
- Land tenants inclusion	✓	✓		✓	✓	✓	✓	
- System of compensation (fair and appropriate) Computations	✓	✓		✓	✓	✓	✓	✓
Payment scheme	✓							✓
Land Title								
Tax Declaration	✓	✓		✓	✓			
No title "ancestor's title"								
Free patent holders			✓					
Lot titling responsibility			✓					
Land Title, tax declaration	✓							
Access to other parts of the community, effects on social cohesion and support network	✓	✓	✓		✓	✓	✓	

Issues/Concerns	Sta. Veronica	Sta. Monica	San Gabriel	San Miguel	Soledad	Sta. Maria	S. Rosario	San Antonio II
Safety and security concerns		✓	✓			✓		
Local hiring			✓			✓		
Environmental concerns								
- Noise		✓		✓	✓	✓	✓	✓
- Air pollution		✓		✓	✓	✓	✓	✓
- River and water ways pollution	✓		✓	✓	✓	✓	✓	
- Solid /hazardous wastes during construction						✓		
- Flooding							✓	
Faster transportation								
More consultations, a need for an SLEX ground coordinator		✓	✓	✓	✓	✓		✓
SDP implementation Alternative livelihood		✓	✓	✓	✓	✓	✓	✓
Resolution of issues and concern	✓	✓	✓	✓		✓		✓
Other issues in Barangay Antonio II: -Previous signatory for land acquisition may be change due to barangay elections -South railway project will also affect the ISF in the barangay								

Affected Barangays of Tiaong, Quezon

The GDs in the affected barangays of Tiaong, Quezon; surfaced similar issues and concerns like those of the other barangays. Issues related to compensation; relocation; livelihood and access surfaced during the course of the discussions.

On the issue of compensation, participants from Anastacia would want to know how awardees of a CMP project will be paid if they will be affected. Farmer participants from Lagalag are concern on land tax declaration documents as their claim to their properties that not under their names. Some claim that the barangay has 54 hectares that is classified as industrial zone and that the project would increase investments/businesses will flourish however they forsee that these developments may contribute to moral issues as more leisure houses/beer houses will flourish in the area.

Participants requested for a priority local hiring in Tiaong should road construction commences.

Table 2-108: Issues and Concerns Raised in Tiaong, Quezon

Issues/Concerns	Bulakin	Lalig	Anastacia	Lagalag	Cabatang
Relocation					
- Facilities & amenities in relocation site	✓		✓	✓	
- Affected families without legal documents					
- Community mortgage program			✓		
Loss of farm lands, properties, vegetation and livelihood			✓	✓	
Compensation					
- Coverage; land, structures, vegetation		✓			
- Valuation of property		✓			
- Settlement of payment before the project starts					

Issues/Concerns	Bulakin	Lalig	Anastacia	Lagalag	Cabatang
- Land tenants inclusion	✓	✓			
- System of compensation (fair and appropriate)	✓	✓	✓	✓	✓
Land Title, tax declaration	✓	✓			
Loss of livelihood, provision of alternative livelihood	✓			✓	✓
Access to other parts of the community, effects on social cohesion and basic services		✓	✓	✓	✓
Need for project information	✓	✓	✓		✓
Project income for the LGU					
Safety concerns				✓	
Local hiring	✓	✓	✓	✓	✓
Environmental concerns					
- Noise					
- Air pollution					
- River and waterways pollution	✓	✓	✓	✓	✓
- Flooding					
Road diversion experience (Tiaong)	✓		✓		
Faster transportation				✓	
More consultations					

Affected Barangays of Candelaria Quezon

Six (6) barangays in Candelaria Quezon are expected to be affected by the SLEX 4 project. While generally there was no expressed resistance to the project, there were various issues surfaced by residents.

The most common issue raised is compensation, concerns on; the basis of compensation for the affected properties to including fruit trees/plants in affected land; the timing of compensation as well as clarification if both landowners and tenants shall be compensated. Participants from Masalukot 1 and 2 expressed anxiety due to unresolved issues related to compensation on the local by-pass road project. Relocation issue surfaced, participants are seeking clarification if the project will implement relocation project for the affected families. Land titles were also discussed, because some lands in Candelaria are not titled.

The need for livelihood and job assistance for the affected household was expressed. Access to the main road and basic service might be hindered as articulated by the participants. Project information is expressed lacking in Candelaria, some said that the project might not push through because SLEX has taken long time to begin road construction. There are fears that Masin River in Candelaria will be used for gravel quarrying for during road construction.

Table 2-109: Issues and Concerns Raised in Candelaria, Quezon

Issues/Concerns	Masalukot 2	Bukal Norte	Masalukot 1	Malabanan Norte	Mangilag Sur
Relocation					
- Facilities & amenities in relocation site - Affected families without legal documents - Community mortgage program		✓		✓	✓
Loss of farm lands, properties, vegetation and livelihood	✓	✓	✓		
Compensation					
- Coverage; land, structures, vegetation	✓	✓	✓		
- Valuation of property					
- Settlement of payment before the project starts	✓	✓	✓		
- Land tenants inclusion					

Issues/Concerns	Masalukot 2	Bukal Norte	Masalukot 1	Malabanan Norte	Mangilag Sur
- System of compensation (fair and appropriate)	✓	✓	✓		✓
- Community Mortgage Program		✓			
Land Title, tax declaration		✓	✓		
Loss of livelihood, provision of alternative livelihood	✓	✓	✓	✓	
Access to other parts of the community, effects on social cohesion and basic services	✓	✓	✓	✓	
Need for project information	✓				
Project income for the LGU					
Safety concerns					
Local hiring					
Environmental concerns					
- Noise					
- Air pollution			✓		
- River and waterways pollution			✓		
- Flooding	✓				
Road diversion experience					
Faster transportation					
More consultations					

Affected Barangays in Sariaya, Quezon

A total of seven (7) barangays shall be affected by the project in Sariaya, Quezon. Across seven affected barangays, the issue of compensation the main issues raised.

These concerns revolved on query about assets to be compensated, participants want to know if concrete structures, pig pens, water wells/water systems to include submersible pumps will also be compensated. Participants from Barangay Concepcion want to know if natural resources such as springs will be paid if affected by the project. Others are inquiring on the basis for compensation and the timing of the payment, suggests that payment be done prior to project implementation.

Farmers wants to know whether tenants have a share in land and harvest compensation, concern on payment (if any) to farmer CLOA holders who are still amortizing the land. Some participants claimed that they were paid minimal amount for the land affected by SLEX 1 and Maharlika Highway projects, it also surfaced that contractors did not fulfill promise of local hiring during these constructions.

Environmental issues raised are air and water pollution and; wastes generation and management from the project construction activities. Project information and clarification are also wanted by the participants, such as time table, design and location of over passes/connections, road entry and exit. Importantly the participants want to know if LGU will benefit from the project from share from the tolls fees collected.

Table 2-110: Issues and Concerns Raised in Sariaya, Quezon

Issues/Concerns	Conception I	Sampaloc Sto. Cristo	Pili	Gibanga	Balubal	Malala II
Relocation					No data	
- Facilities & amenities in relocation site - Affected families without legal documents - Community mortgage program		✓				
Loss of farm lands, properties, vegetation and livelihood		✓				

Issues/Concerns	Conception I	Sampaloc Sto. Cristo	Pili	Gibang a	Balubal	Malala II
Compensation						
- Coverage; land, structures, vegetation	✓	✓	✓	✓		
- Valuation of property						
- Settlement of payment before the project starts				✓		
- Land tenants inclusion			✓	✓		
- System of compensation (fair and appropriate)	✓	✓	✓	✓		
- CLOA	✓					
Land Title, tax declaration						
Loss of livelihood, provision of alternative livelihood						
Access to other parts of the community, effects on social cohesion and basic services						
Need for project information			✓	✓		
Project income for the LGU	✓					
Safety concerns						
Local hiring						
Environmental concerns						
- Noise		✓	✓			
- Air pollution		✓	✓			
- River and waterways pollution	✓		✓	✓		
- Flooding	✓					
SLEX experience			✓			
Faster transportation						
More consultations				✓		

Affected Barangay of Tayabas City, Quezon

The issues raised by the participants in Tiaong, Quezon were the following: foremost is the need for project information such as project timeframe and progress and project point of contact to raise issues and concerns from the community. Other issues related to affected asset compensation and land titling, the inclusion of tenants for compensation, the request for relocation program for the affected houses.

Table 2-111: Issues and Concerns Raised in Tayabas City, Quezon

Issues/Concerns	Calumpang
Relocation	
- Facilities & amenities in relocation site - Affected families without legal documents - Community mortgage program	✓
Loss of farm lands, properties, vegetation and livelihood	
Compensation	
- Coverage; land, structures, vegetation	
- Valuation of property	
- Settlement of payment before the project starts	
- Land tenants inclusion	✓
- System of compensation (fair and appropriate)	✓
Land Title, tax declaration	✓
Loss of livelihood, provision of alternative livelihood	

Issues/Concerns	Calumpang
Access to other parts of the community, effects on social cohesion and basic services	
Need for project information	
Project income for the LGU	✓
Safety concerns	
Local hiring	
Environmental concerns	
- Noise	
- Air pollution	
- River and waterways pollution	
- Flooding	
SLEX experience	
Faster transportation	
More consultations	

2.4.9 Potential Impact on Traffic

Traffic experiences derived from the construction of the SLEX in the mid-70’s and the more recent tollway projects like the STAR, Subic-Clark-Tarlac (SCTEX) and Tarlac-Pangasinan-La Union (TPLEX) tollways demonstrated that traffic is minimal or hardly felt when a new highway is constructed in unopened areas. Comparing the traffic situation during the construction of these tollways with the fairly recent expansion works done on SLEX and NLEX and in most highways that are either being widened or repaired, one can readily see the difference. Travel is generally slowed down by build-up traffic in expansion or repair projects. On the other hand, the construction of SLEX in the mid-70’s was not felt by, and hardly known to, many travelers who were taking the present Maharlika highway from Alabang to Calamba City. SLEX was specifically aimed at hastening travel and reducing traffic from Alabang to Calamba City, and to the other southern destinations, including the Batangas Port.

Similarly, the completion of the SLEX extension from Sto. Tomas (Batangas) to Tayabas City (Quezon) is expected to shorten travel time to the Quezon areas and further southeast. However, as noted in other expressways while the number of vehicles using tollways progressively increased as economic activities widen and are enlivened, the old highways remain busy thoroughfares for travelers. This phenomenon can be verified in Daang Maharlika (from Alabang to Calamba City) and McArthur Highway (from Caloocan to Pampanga) even after the new tollways have become operational. The increase in use of TR4 is expected while the old highways is continued to be utilized by numerous vehicles.

This is not to say that the construction of TR4 will create a traffic-free situation. The expressway will generally traverse areas that are not open to vehicles, there are parts where traffic build-up can be expected at certain time of the day during the construction phase. These are:

1. At the MakBan road - during the first 18 months while the expressway is being constructed from Sto. Tomas to the Makban Interchange. This will create disturbance of normal travel for those going to the upland barangays of Bay, Laguna. After 18 months, traffic will resume to normalcy.

2. The potential traffic implication on existing MakBan road has already been recognized during the design stage of the proposed TR4 project. The plan is that DPWH will widen the existing MakBan Road leading to the town of Bay, Laguna (**Annex H** to **Annex J**). The proposed TR4 Interchange is designed to cater to the motorists from northeast part of Laguna such as Bay, Sta. Cruz, Pila, Pagsanjan, etc.

3. Similar traffic situation can be expected in areas with barangay roads that connect to Daang Maharlika, when overpasses are constructed and as the interchanges are constructed in San Pablo City, Tiaong, Candelaria and Sariaya.

4. The super structure members, some of which are built using pre-cast, will be launched from trucks (prime mover and dollies). Traffic will likely be created along the Daang Maharlika and local roads as hauling to and from the site and staging of launching of girders have to be done. The movement of the equipment will be done during night time between 10:00 PM to 5:00 AM when traffic along the local roads is expected to be lowest.

Traffic build up will be localized as indicated above, and only for the duration of construction which is around 18 months per road section.

Except on intersection crossings between Daang Maharlika or local roads and the TR4, the construction of TR4 is not expected to cause/create heavy traffic congestion as most part of its alignment/route sits on a greenfield environment.

However, even if heavy traffic is not expected from the construction of TR4, a traffic management plan is still to be prepared for implementation to minimize disturbance and ensure safety to travellers near and along the construction sites. Parts of the traffic management plan are presented below.

2.4.9.1 Traffic Management Plan

A Traffic Management Plan (TMP) will be prepared that will ensure the smooth implementation and unhampered activities during construction. The major components of the TMP are the ff.: (a) identification of key personnel from the concerned LGUs and project contractors with their roles and responsibilities; (b) mode of TMP implementation and monitoring; and, (c) process of TMP review and approval. In addition, theTMP also presents the potential impacts at the work zone and its corresponding impact management strategies. The initial TMP for the project is shown in ***Annex V***.

The typical TR4 traffic management plan (TMP) and its proposed applications are illustrated below. However, it will still be dependent on the methodology of construction and the type of structures to be installed or placed that may cause traffic obstruction near existing road.

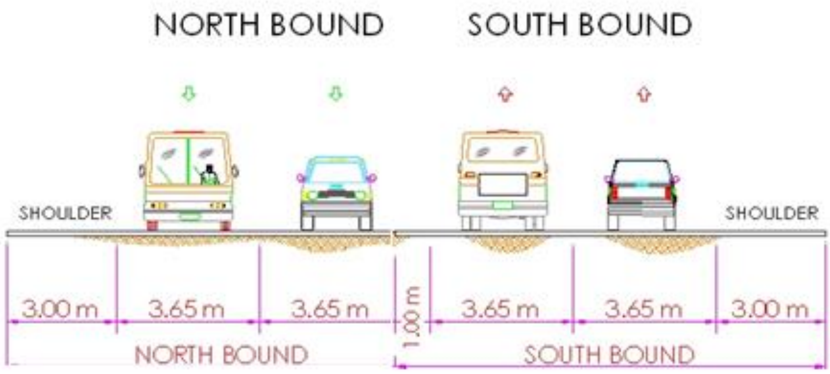


Figure 2-80: Existing Configuration of Daang Maharlika prior to TR4 Construction

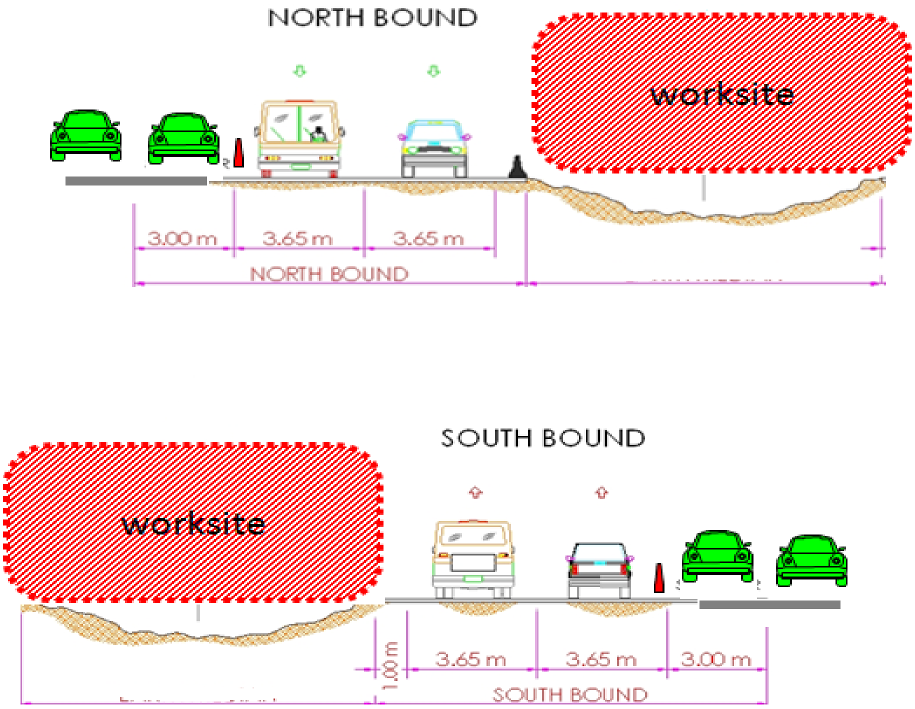


Figure 2-81: Typical / Proposed Configuration of Daang Maharlika during Construction

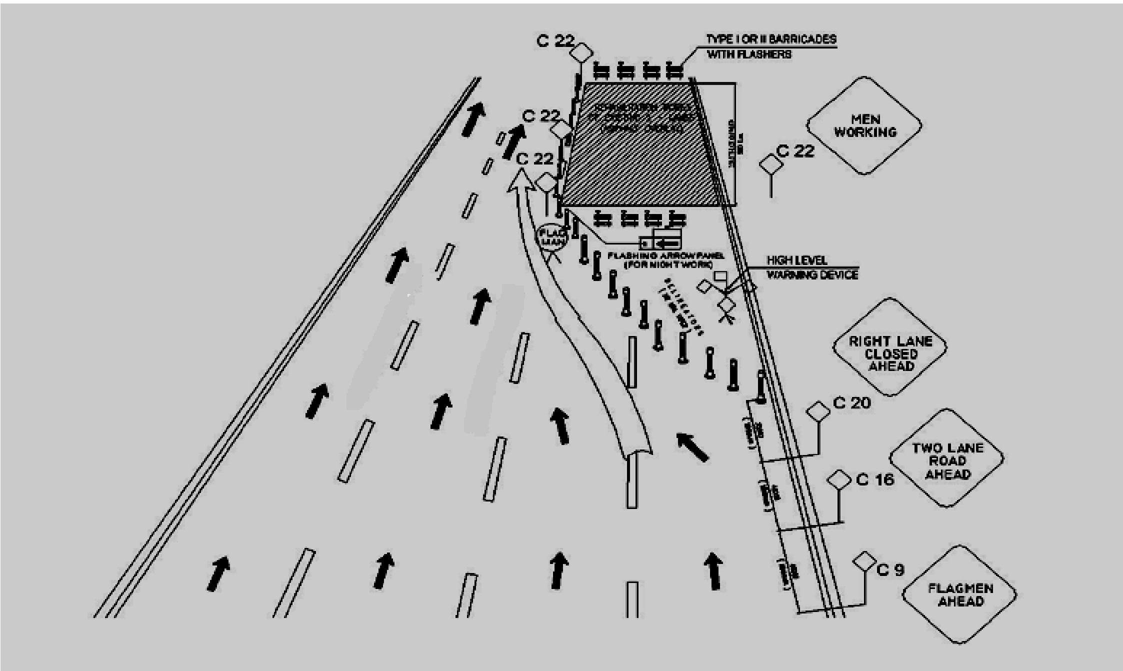


Figure 2-82: Typical Lane Management along Daang Maharlika during Construction

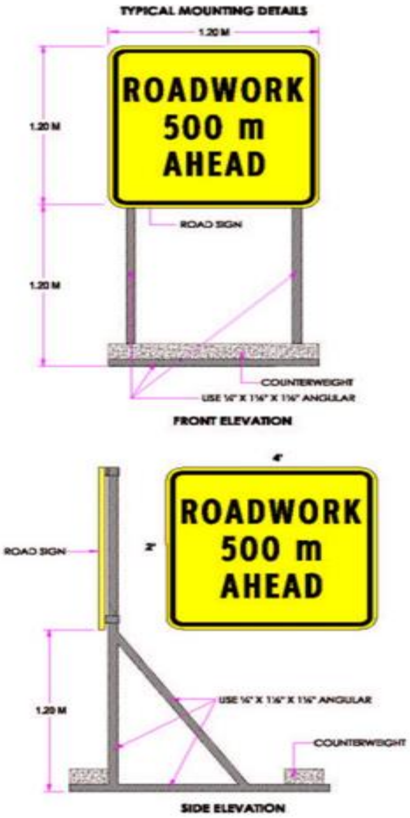


Figure 2-83: Typical Mounting Details of Signages during TR4 Construction

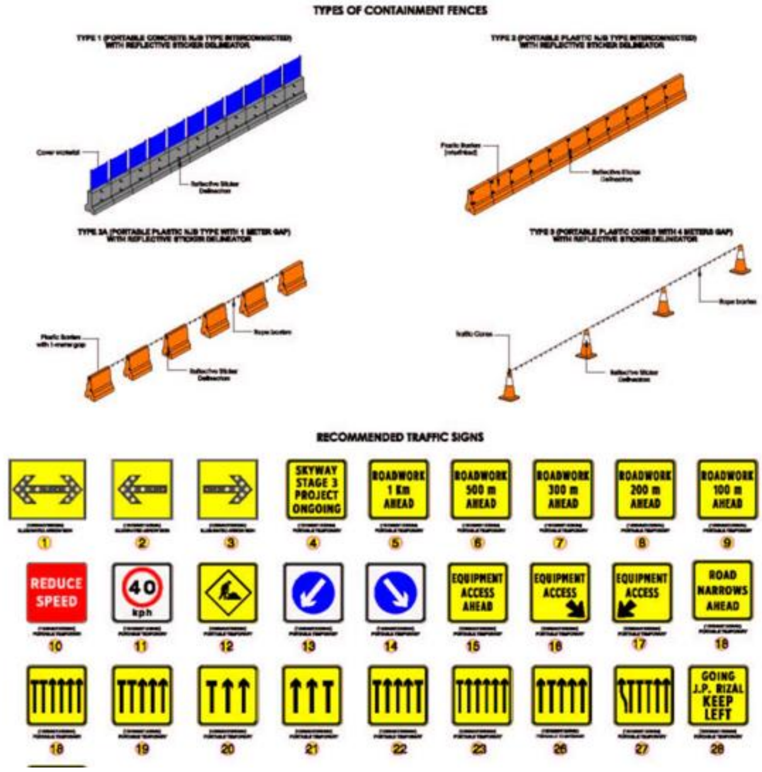


Figure 2-84: Recommended Traffic Signages for TR4 Construction

2.4.9.1.1 Key Features of the TMP

In general, the TR4 TMP has the following purposes and features:

- To accommodate the civil work contractors' equipment and for its manpower to safely operate and allow the construction works to proceed as planned.
- The worksite in the middle of any particular existing local road shall be kept to a minimum of 11 meters width to accommodate equipment placement and operation allowing the construction activities.
- Although it will entail reduction of traffic lanes along existing road, the work site will occupy only portion of it such that an available minimum 2 lanes vehicular traffic can be accessed by motorists on both directions.
- As early as practicable, a reconfiguration of the existing road (especially Daang Maharlika) will be done to pave the way for the utilization of existing shoulders and ample spaces (clear zones).
- Advance information and coordination with concerned LGUs on the proper warning signages complete with safety devices that will be installed on both directions to cover 100m distance prior to the worksite.
- Fencing the area for purposes of containment of worksite to include appropriate cover from visual and noise impacts of construction.
- Illumination of worksite to assure visibility during night for motorists travelling the road.
- To enhance traffic safety, the local road shall be declared No Stopping Zone (especially for passenger vehicles) and by putting relevant traffic signages.
- On-street and sidewalk parking near worksite will be prohibited especially in areas close to commercial zones.
- Corresponding No Parking signs will be installed to complement safety and will be part of the traffic scheme.

2.4.9.1.2 Pedestrian Access

The pedestrian access to establishments to be affected by TR4 construction will be maintained by providing necessary traffic signs, markings, and containment of areas as pedestrian paths.

2.4.9.1.3 Vehicle Access to Establishments

Similar to pedestrian, the vehicle access to establishments will be provided as practically as possible. Appropriate gaps in the construction site or similar provisions for admission will be allowed.

No Stopping / Loading / Unloading / Parking rules along the worksites near Daang Maharlika will be established and implemented. Appropriate signages to establish traffic rules will be installed to promote the proper implementation of traffic scheme.

Transition schemes from regular traffic lanes into narrowed lanes as may be caused by construction activities will be provided and with the necessary traffic control devices.

2.4.10 Responsible Entity

The South Luzon Tollway Corporation (SLTC) will be the organization accountable for the environmental management in the area.

2.4.11 Inventory of Affected Properties

Inventory of assets and loss data revealed a total of 506 structures will be affected in the proposed project area, breakdown of which are; 493 are houses and 13 are stores. Affected structures are concentrated in Tiaong, 139 structures; Sariaya, 124 structures and Alaminos, 87 structures.

Table 2-112: Affected Main Structures

Location	Main Structure		Total
	House	Store	
Calamba			
Makiling	1	0	1
Putting Lupa	0	0	0
Total	1	0	
Sto. Tomas			
San Rafael	7	0	7
Santiago	0	0	0
San Antonio	0	0	0
San Bartolome	0	0	0
San Miguel	0	0	0
San Vicente	0	0	0
San Pedro	0	0	0
San Pablo	0	0	0
San Felix	7	0	7
San Jose	0	0	0
San Juan	0	0	0
Total	14	0	
Alaminos			
San Andres	0	0	0
San Juan	57	1	58

Location	Main Structure		Total
	House	Store	
Palma 1	10	0	10
San Miguel	16	1	17
San Agustin	2	0	2
San Benito	0	0	0
Total	85	2	
San Pablo			0
Sta. Veronica	8	0	8
Sta. Monica	2	0	2
San Gabriel	0	0	0
San Miguel	8	0	8
Soledad	8	0	8
Sta. Veronica			
Sta. Maria	0	0	0
Sta. Rosario	0	0	0
San Isidro	21	0	21
San Antonio I			
San Antonio II	19	0	19
Total	66	0	
Tiaong			0
Bulakin	29	1	30
Anastacia	66	3	69
Cabatang	23	1	24
Lagalag	13	1	14
Total	131	6	
Candelaria			0
Bukal Norte	13	1	14
Masin Norte	3	1	4
Masalukot 1	3	0	3
Masalukot 2	11	0	11
Mayabobo	13	0	13
Mangilag Norte	8	0	8
Total	51	2	
Sariaya			0
Concepcion 1	34	0	34
SampalocSto Cristo	11	0	11
Mamala II	39	0	39
Balubal	19	0	19
Gibanga	5	1	6
Pili			
Sampaloc 1	2	0	2
Sampaloc 2	12	1	13
Total	122	2	

Location	Main Structure		Total
	House	Store	
Tayabas			0
Calumpang	19	0	19
Total	23	1	
TOTAL	**493**	**13**	**506**

There will be secondary structures to be affected in the area, totaling to 426 structures. These are non-core residence of the affected persons such as garage, sheds, and poultry among others (**Table 2-113**).

Location distribution of these structures are the same as that of primary structures – Tiaong, Sariaya and Alaminos in descending order of prevalence.

Table 2-113: Affected Secondary Structures

Location	Secondary Structures									
	Garage	Sheds	Poultry	Pavement	Concrete fence	House extension	Farm house	Maids room	Others	TOTAL
Calamba, Laguna	0	0	0	13	0	0	0	0	5	18
Sto. Tomas, Batangas	0	0	0	0	0	0	0	0	5	5
Alaminos, Laguna	6	0	3	4	7	0	0	0	45	65
San Pablo, Laguna	0	0	0	2	0	1	3	0	41	47
Tiaong, Quezon	2	1	1	4	3	0	0	0	107	118
Candelaria, Quezon	1	0	0	3	3	0	0	1	37	45
Sariaya, Quezon	2	0	2	6	3	0	0	0	100	113
Tayabas, Quezon	0	0	0	1	1	0	0	0	13	15
TOTAL	**11**	**1**	**6**	**33**	**17**	**1**	**3**	**1**	**353**	**426**

Executive Order No. 48 issued in October 2001, declared non-core properties of PNR as Socialized Housing Sites and to dispose it to bonafide occupants. The old PNR railway in Purok II, San Juan, Alaminos, Laguna was among the PNR properties considered as non-core asset thru a joint collaboration by the Housing and Urban Development Coordinating Council (HUDCC), PNR, and the Presidential Commission for the Urban Poor (PCUP). The Local Government of Alaminos and the Provincial Government of Laguna awarded portion of this non-core property to S.J. Marenosa II PNR Homeowners Association.

During the conduct of the inventory of loss (IOL) data gathering by the resettlement team, there are 58 affected household (AH) whose residence are on a non-core property of the PNR in San Juan, Alaminos, Laguna. The 58 AHs were among the awardees of a $61m^2$ lot and need to be relocated. The local government of the Municipality of Alaminos had identified several potential relocation sites for the AHs. The DPWH should coordinate with NHA and the LGU for the development of suitable relocation site for these AHs.

There are 39 household occupying parcel of land under Certificate of Land Ownership Award (CLOA) issued by the Department of Agrarian Reform (DAR), who are heirs of the original landowner. Severely affected by the project, the AHs are opting for a land swap instead of cash compensation for their affected land. They are proposing a swap with idle and vacant land adjacent to their present location.

The parcellary survey is still on-going in Section E (parts of Candelaria, Sariaya and Tayabas), hence affected lands in this section were not included in calculating the total area affected of the project as well as computation of the total cost of affected lands.

The total land area affected by the TRA 4 project (excluding parts of Tiaong and Candelaria and whole area of Sariaya and Tayabas) is247 hectares (has)comprised of 980 lots. Affected residential land is estimated at 21.34 hectares comprised of 542 lots. Agricultural land totals to 207.89 has comprised of 424 lots. Industrial land is 7.70 hascomprised of 9 lots. Commercial land is 10.16 has comprised of 5 lots.

Based from the BIR zonal value, the total cost of land is Php 1,686,978,065.35. Cost of affected residential land is PhP 596,627,257.50; Agricultural land is PhP 400,387,449.65; industrial land costs PhP 305,500,138.20 and commercial land costs PhP 384, 464, 220.

Table 2-114: Area and Zonal Classification of Affected Lands

Location	Residential	Agricultural	Industrial	Commercial
	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)
Calamba, Laguna				
Makiling	88,665.80		75,715.64	26,540.37
Puting Lupa	30,856.48	18,861.99		
Total	119,522.28	18,861.99	75,715.64	26,540.37
Sto. Tomas, Batangas				
San Rafael		29,523.62		
San Tiago		50,578.64		
San Antonio		93,931.58		
San Bartolome		90,155.10		
Sab Miguel		50,823.71		
San Vicente		58,396.31		
San Pedro	10,457.29	33,260.00		
San Pablo		76,334.90		
San Felix	35,137.45	68,915.38		
San Jose	10,124.42	30,486.81		
San Juan		63,030.83		
Total	55,719.16	645,436.88		
Alaminos, Laguna				
San Andres		96,017.69		
San Juan		62,651.87		
Palma 1	31.00	43,745.00		
San Miguel	2,380.00	58,935.00		
San Agustin	19,170.00	65,455.00		
San Benito		67,674.00		
Total	21,581.00	394,478.56		
San Pablo, Laguna				
Sta. Veronica		81,915.00		
Sta. Monica		45,449.00		
San Gabriel	2,194.00	34,116.00	1,255.00	
San Miguel	8,007.00	111,876.00		
Soledad	4,689.00	52,484.00		
Sta. Maria		75,620.00		
Sta. Rosario		205,127.00		
San Antonio		5,365.00		

Location	Residential	Agricultural	Industrial	Commercial
	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)
Total	14,890.00	611,952.00		
Tiaong, Quezon				
Bulakin		22,312.00		74,933.00
Cabatang		93,387.00		
Lagalag		46,174.00		
Anastacia				
Lalig				141.00
Total		161,873.00		75,074.00
Candelaria, Quezon				
Bukal Norte		54,112.00		
Masin		21,450.00		
Masalukot 1		170,795.00		
Mangilag Norte				
Mangilag Sur				
Total		246,357.00		
SUBTOTAL	**211,712.44**	**2,078,959.43**	**75,715.64**	**101,614.37**
Sariaya, Quezon				
Conception 1				
Sampaloc Sto Cristo				
Pili				
Mamala II				
Balubal				
Gibanga				
Sampaloc 1				
Sampaloc 2				
Tayabas City, Quezon				
Calumpang				
TOTAL				

2.4.12 Potential Impact on existing Properties

Toll road expansion project would impact 247 has of land, comprised of 980 lots from the project area (discounting affected lands from Sariaya and Tayabas City, Quezon) Agricultural land comprises 84.2%, while residential, industrial and commercial total the rest of 15.8%.

The properties along the 60-m RROW alignment which traverses 45 barangays of eight (8) municipalities/cities and covers a length of 56.682 km. is needed for the expressway extension, thus it will be adversely affected through project acquisition.

Project affected household will be relocated and their properties compensated. A resettlement action plan will be carefully implemented so that the affected persons and families' welfare will be safeguarded.

The value of affected land along the proposed highway extension has the potential to appreciate in cost due to the change in zoning classifications. This might benefit some landowners who might wish to market or invest in their property.

2.4.13 Income Restoration

A definitive social development program will be developed and implemented at a later phase of the project. This will be done on a basis of a thorough study on the economic activities, needs and capacity assessment of the affected households.

The program should additionally provide skills development training for those who might opt to acquire skills and be employed in the industry locators within the vicinity. This can be implemented in coordination with the Technical Education and Skills Development Authority (TESDA) and the LGUs.

It is also recommended that the contractors prioritize local labor. The company should look into the possibilities of empowering the women sector through skills development and possibly hire them for appropriate jobs during civil works stage of the project and beyond.

Table 2-115: Summary of Potential Impacts to People and Mitigation Measures

Potential Impacts	P	C	O	A	Option for Prevention, Mitigation or Enhancement
Change in the land use	x	x			Coordination with the concerned LGUs for possible amendment of the zoning plan along the RROW
Possible tenurial/ land issue	x	x			• Completion of the parcellary survey
	x	x			• Formulation of a Compensation Plan for affected properties based on ROWA guidelines
Displacement of settlers, properties, conflict with land ownership	x	x			Formulation of a Compensation Plan for affected properties based on ROWA guidelines
Cultural / Lifestyle Change due to relocation	x	x			• Provision of adequate financial compensation coupled with sound financial management for the affected households
	x	x	x		• The plan should include availability of access to basic services for both relocatees and remaining communities adjacent to the project
Change in Physical Resources		x	x		SLTC may assist in the improvement of Mt. Makiling watershed to enhance its environmental condition and resources
Threat to food security from loss of economic opportunities and assets		x			Provision of livelihood and skills training to affected households
In-migration		x	x		• Prioritize hiring of qualified local residents
		x			• Provision of temporary housing, amenities, and sanitary services to the workers
Resource competition		x	x		• Prioritize hiring of local residents to minimize resource competition in the area
		x	x		• Resources/Assistance to host communities of relocatees for the delivery of basic services
Threat to Public Health and Safety		x	x		• Coordination with RHUs for possible regular monitoring of residents' health conditions and in the implementation of health care interventions
		x	x		• Resettlement Plan should provide strategy for livelihood / income restoration among the affected households

Potential Impacts	P	C	O	A	Option for Prevention, Mitigation or Enhancement
Expected Local Benefits - *Opportunities for Employment*		x	x		Prioritize hiring of qualified local residents
- Income generation opportunities		x x	 x		• Prioritize purchase of construction materials from local suppliers • Flourishing of entrepreneurial establishments to cater to the needs of project workers and users
- Increase revenue to host LGUs		x	x		Prompt payment of taxes and business permits
Traffic Buildup *Disturbance to travellers particularly at MakBan road and barangay roads that connect to Maharlika highway which will be used as access roads to the project*		x x x x x			Implementation of Traffic Management Plan (TMP) which incorporates the following: • Installation of signages and warning systems at designated areas before, along and after the construction sites; • Enclosure / Barricading of construction sites; • Provision of lighting system for the safety of road users and workers; • Road widening in identified areas like MakBan road; and • Delivery of pre-cast super structure members during nighttime between 10:00PM to 5:00AM when traffic is expected to be lowest.

3.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Environmental Management Plan (EMP) is a matrix summarizing proposed management measures that will be developed and implemented by SLTC to manage the potential adverse and beneficial impacts of the TR4 Project. The EMP includes statement on potential impacts, options for mitigation or enhancements, entities for implementation, funding, and guarantees. The EMP is primarily based on the initial EIS and updated to incorporate the issues and concerns applicable to the areas covered by the re-alignment. The project and the EMP are still on hold due to the proposed re-alignment. Consequently, the EMP could be considered preliminary at this stage which is subject to revision to correspond with the requirements during project implementation. The EMP shown in **Table 3-1** used the recommended format *in Annex 17 of RPM DAO 2003-30*.

The project implementation will consist of the following phases:

- Pre-Construction Phase – involves survey, negotiation and acquisition of the right-of-way limits, and the acquisition of government permits and clearances,
- Construction Phase - land preparation, and actual construction works;
- Operation Phase - involves operation of the project; and,
- Abandonment Phase – systematic decommissioning and removal of project facilities, and rehabilitation.

Table 3-1: Environmental Management Plan

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
I. PRE-CONSTRUCTION PHASE						
Primary Activities with no Inherent Impact to the Environment • *Preliminary Design Phase* • *Surveys and Stakeout* • *Parcellary Mapping* • *Securing Clearances and Permits* • *Consultations with Stakeholders* • *Land or Right of Way Acquisition* • *Securing Notice to Proceed Construction*						
II. CONSTRUCTION PHASE						
A. The Land						
Actual site preparation and development activities;	Land use	Change/Inconsistency in land use	Amending zoning plan along the RROW	concerned LGUs	N/A	N/A
Construction of the road, interchanges, and associated structures	Geology *Change in Surface Landform/ Topography/ Terrain/ Slope*	Induce mass movement (landslide, creeps, etc.)	• Confine land excavation and disturbance to the RROW	EPC contractor in coordination with SLTC	N/A	Include in the design &scope of works of EPC and sub-contractors
			• Incorporate results of geotechnical studies on unstable slopes and embankments in the design and to provide slope stabilization measures, as needed		N/A	

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
	Geohazards (*Effect of geohazards such as ground acceleration, settlement, lateral spread, and liquefaction to the Project*)	Structure failure with potential risk to people and property	• Design of structures to include seismic loading • Slope stability analysis • Embankment settlement assessment	EPC contractor in coordination with SLTC	N/A	Include in the design &scope of works of EPC and sub-contractors
	Pedology	Soil erosion	• Minimize exposed work areas and clearing of vegetation • Immediate re-vegetation in areas where construction activities are completed • Implement a soil erosion and sediment control plan (ESCP) • Install silt ponds at bridges and other areas in the alignment adjacent to water bodies • Use slope stabilization measures along exposed slopes	EPC contractor in coordination with SLTC	50,000.00/km for the reforestation and provision of buffer zones	Include in the design &scope of works of EPC and sub-contractors
	Terrestrial biology	Vegetation removal and loss of habitat	• Initiate reforestation of potential impact areas prior to ground preparation • Implement properly designed reforestation after work completion	EPC contractor in coordination with SLTC	50,000.00/km for the reforestation and provision of buffer zones	Include in the design & scope of works of EPC and sub-contractors

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
B. The Water						
	Hydrology/ Hydrogeology	Change in drainage morphology	• Progressive rehabilitation and tree plantation at the break of slopes and water channel banks	EPC contractor in coordination with SLTC	50,000.00/km for the reforestation and provision of buffer zones	Include in the design &scope of works of EPC and sub-contractors
			• Construction and regular de-silting of silt ponds		N/A	
		Change in stream depth	• Apply slope stability measures to prevent erosion and siltation	EPC contractor in coordination with SLTC	N/A	Include in the design &scope of works of EPC and sub-contractors
		Reduction in stream volumetric flow	• Construction and regular de-silting of silt ponds • No backfilling along the creeks or provide retaining walls if it could not be avoided	EPC contractor in coordination with SLTC	N/A	Include in the design &scope of works of EPC and sub-contractors

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
		Inducement of flooding	• Schedule earthworks during summer, if possible • Improvement and maintenance of existing road / drainage canals. • Proper waste and garbage disposals • Construction and regular de-silting of silt ponds • Application of slope stabilization measures • The drainage system design should consider the topography, maximum flood level, existing structures, etc. • Possible reduction of flow in the waterways traversing flood-prone areas	EPC contractor in coordination with SLTC	N/A	Include in the design & scope of works of EPC and sub-contractors
	Water Supply	Obstruction / Reduction in water supply	• Provision of lined waterway if the alignment will be traversing a small stream • Diversion of flow to a temporary channel that will cross the road alignment to maintain the streamflow • Coordination and support to the Sariaya LGU in the replacement and setting-up of the pipeline across the TR4 alignment	EPC contractor in coordination with SLTC	N/A	Include in the design & scope of works of EPC and sub-contractors

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
		Pollution of water supply	• Provision of barrier in case of adjacent open waterway and flowing parallel to TR4 • Provision of silt ponds during construction and revegetation of cleared area upon construction completion	EPC contractor in coordination with SLTC	N/A	Include in the design & scope of works of EPC and sub-contractors
	Water Quality	Water pollution	• Training of concerned personnel on oil spill response plan	EPC contractor in coordination with SLTC	20,000.00	Include in the design &scope of works of EPC and sub-contractors
	Water Quality Freshwater ecology	Water pollution Siltation of freshwater bodies reducing the growth and development of aquatic organisms	• Provision of drainage leading to an oil-water separator at the motor pool	EPC contractor in coordination with SLTC	10,000.00	Include in the design & scope of works of EPC and sub-contractors
			• Designation of paved area for the storage of used oil and oil-contaminated materials		10,000.00	
			• Provision of silt traps, sediment control dams, and siltation ponds at stockpiles, staging areas, and active construction sites		N/A	
			• Location of labor camps at least 500m away from a waterbody		N/A	
			• Collection and treatment of hazardous wastes prior to final disposal		50,000.00 /yr	
			• Provision of temporary sanitary facilities at the labor camps		N/A	

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
			• Stockpiling of collected silt/sediment for possible reuse		N/A	
			• Disposal of solid wastes according to environmental regulations		N/A	
			• Prohibit parking, cleaning and repair of vehicle or heavy equipment near the water body		N/A	
			• Properly constructed drainage system along strategic areas to minimize siltation during a heavy downpour supplemented with silt curtains, geotextiles or coconets		N/A	
	Freshwater ecology	High volume of organic materials in freshwater bodies may result in eutrophication	Regular removal of accumulated silts and proper disposal or storage to minimize further mobilization.	EPC contractor in coordination with SLTC	N/A	Include in the design &scope of works of EPC and sub-contractors
C. The Air	Meteorology *Change in local micro-climate*	Increase in local temperature due to vegetation removal	Immediate planting of open areas to minimize the exposed areas and the possible increase in temperature along the RROW	EPC contractor in coordination with SLTC	50,000.00/km for the reforestation and provision of buffer zones	Include in the design &scope of works of EPC and sub-contractors
	Ambient air quality	Increase in fugitive dust during construction	• Implement properly designed reforestation on both sides of the road	EPC contractor in coordination with SLTC	50,000.00/km for the reforestation and provision of buffer zones	Include in the design &scope of works of EPC and sub-contractors
			• Conduct of water spraying at dry and exposed areas	EPC contractor in coordination with SLTC	N/A	Include in the design &scope of works of EPC and sub-contractors

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
			• Provide wheel washing facilities at the construction site to remove muds at the tires of heavy equipment • Impose speed limit • Re-routing of construction vehicles at considerable distance from Area Sensitive Receptors (ASRs), if possible • Possible suspension of construction works during very dry weather and/or windy conditions when dusts are apparently to be dispersed at nearby ASRs • Regular visual inspection at the project site and conduct of mitigation measures to control high fugitive emissions, if necessary		N/A N/A N/A N/A N/A N/A	
		Gaseous emission from fuel-burning equipment	• Implement properly designed reforestation on both sides of the road • Monthly monitoring of TSP, PM_{10}, NO_2 and CO at ASRs during the 1st year of operation; and, reduce frequency of monitoring thereafter as necessary	EPC contractor in coordination with SLTC	50,000.00/km for reforestation and provision of buffer zone 120,000.00 / mo.	

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
	Air quality	Air pollution due to SO_2, NO_2, CO, and TSP emissions from vehicles and heavy equipment	• Regular maintenance of heavy equipment and motor vehicles • Installation of off-site ambient air quality monitors	EPC contractor in coordination with SLTC	N/A Part of monitoring cost or total of 120,000.00 /mo.	Include in the design &scope of works of EPC and sub-contractors
	Ambient sound levels	Increase in ambient noise level	• Enclosure of the project area during construction • Minimize, if not totally avoid, construction works during nighttime • Operation of heavy equipment only during daytime • Provision of noise barriers such as walls or earth embankment particularly adjacent to schools, churches, and residential areas • Planting of trees along the edge of RROW or adjacent to the road fence for blocking the line-of-sight between the noise source and the receptors.	EPC contractor in coordination with SLTC	50,000.00/km for reforestation and provision of buffer zones	Include in the design & scope of works of EPC and sub-contractors
D. The People	Acquisition of RROW	Possible tenurial/ land issue	Completion of the parcellary survey	SLTC	N/A	Include in SLTC TR4 project activities
	Acquisition of RROW Site Selection	Possible tenurial/ land issue Displacement of settlers, properties, conflict with land ownership	• Implementation of a Compensation Plan for affected properties based on ROWA guidelines	DPWH in coordination with SLTC and EPC contractor	N/A	Absence of lodged complaints by land owners

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
		Cultural / Lifestyle Change due to relocation	• Provision of adequate financial compensation coupled with sound financial management for the affected households The plan should include availability of access to basic services for both relocatees and remaining communities adjacent to the project	DPWH in coordination with SLTC and EPC contractor	N/A	Include in SLTC TR4 project activities
		Change in Physical Resources	• SLTC may assist in the improvement of Mt. Makiling watershed to enhance its environmental condition and resources	SLTC in coordination with EPC contractor	To be determined during coordination with UPLB	Include in SLTC TR4 project activities
	Relocation of Affected Households	Threat on food security from loss of economic opportunities and assets	Provision of livelihood and skills training to affected households	SLTC in coordination with EPC contractor	N/A	Include in SLTC TR4 project activities
	Manpower Requirement for the Project Construction	In-migration	• Prioritize hiring of qualified local residents • Provision of temporary housing, amenities, and sanitary services to the workers	EPC contractor in coordination with SLTC	N/A N/A	Include in the scope of works of EPC and sub-contractors
	Manpower Requirement for the Project Construction	Resource competition	• Prioritize hiring of local residents	EPC contractor in coordination with SLTC	N/A	Include in the scope of works of EPC and sub-contractors
	Health and Safety	Resource competition Threat to Public Health and Safety	• Resources / Assistance to host communities of relocatees for the delivery of basic services	SLTC in coordination with EPC contractor	To be determined upon coordination with	Include in SLTC TR4 project activities

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
					concerned LGUs depending on the needs assessment	
			• Coordination with RHUs for possible regular monitoring of residents' health conditions and in the implementation of health care interventions	SLTC in coordination with EPC contractor	To be determined upon coordination with concerned RHUs depending on the needs assessment	Include in SLTC TR4 project activities
	Expected Local Benefits	*Opportunities for employment*	• Resettlement Plan should provide strategy for livelihood / income restoration among the affected households	SLTC in coordination with EPC contractor	N/A	Include in SLTC TR4 project activities Include in the scope of works of EPC and sub-contractors
			• Prioritize hiring of qualified local residents	EPC contractor in coordination with SLTC	N/A	
	Expected Local Benefits	*Income generation opportunities*	Flourishing of entrepreneurial establishments to cater to the needs of project workers and users	SLTC	N/A	N/A

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
		Increase revenue to host LGUs	Prioritize purchase of construction materials from local suppliers	EPC contractor in coordination with SLTC	N/A	Include in the scope of works of EPC and sub-contractors
			Prompt payment of taxes and business permits	SLTC	N/A	Include in SLTC TR4 project activities
	Traffic Conditions	Disturbance to travellers particularly at MakBan road and barangay roads that connect to Maharlika highway which will be used as access roads to the project	Implementation of Traffic Management Plan (TMP) which incorporates the following: 1. Installation of signages and warning systems at designated areas before, along and after the construction sites 2. Enclosure / Barricading of construction sites 3. Provision of lighting system adjacent and within the construction sites for the safety of road users and workers 4. Road widening in identified areas like MakBan road Delivery of pre-cast super structure members during nighttime between 10:00PM to 5:00AM when traffic is expected to be lowest.	EPC contractor in coordination with SLTC	N/A	Include in the scope of works of EPC and sub-contractors
	Operation of Existing Facility	Hampering operation of the PGI	• Widening of access road • Limit construction and associated activities within the designated area according to the road design	EPC contractor in coordination with SLTC	N/A	Include in the scope of works of EPC and sub-contractors

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
			• Prohibit loitering of workers outside the worker's camps and construction area • Strictly follow the policy of no entry at off-limits area			
	Land and Properties	Disturbance / Damage to adjacent properties	• Limit construction and associated activities within the designated area according to the road design. • Prohibit loitering of workers outside the worker's camps and construction area.	EPC contractor in coordination with SLTC	N/A	Include in the scope of works of EPC and sub-contractors
III. OPERATION AND MAINTENANCE PHASE						
A. The Land	Terrestrial biology	Effects of air emissions and noise on terrestrial fauna	Planting of appropriate plant species or sound barriers at the road perimeter to attenuate noise	TR4 operator in coordination with SLTC	100,000.00 / yr for replanting and additional landscaping activities	Include in the environmental monitoring plan
	Terrestrial biology	Effects of air emissions and noise on terrestrial fauna	• Prohibit vehicles without exhaust mufflers	TR4 operator in coordination with SLTC	N/A	• MOA between SLTC and TR4 operator
			• Impose speed restriction in sensitive areas		N/A	• MOA between SLTC and TR4 operator
B. The Water	Hydrology	Change in drainage morphology	Progressive rehabilitation and tree plantation at the break of slopes and water channel banks.	TR4 operator in coordination with SLTC	100,000.00 / yr	• Include in the environmental monitoring plan

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
						• MOA between SLTC and TR4 operator
		Change in stream depth	Monitoring and maintenance of slope stabilization measures along the alignment.	TR4 operator in coordination with SLTC	Minimal / part of regular maintenance activities	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
	Water quality	Reduction in stream volumetric flow	• Monitoring and maintenance of slope stabilization measures along the alignment. • Regular cleaning and maintenance of drainage system • Monitoring and maintenance of slope stabilization measures along the alignment. • Proper waste and garbage disposal	TR4 operator in coordination with SLTC	Minimal / part of regular maintenance activities	
		Flooding		TR4 operator in coordination with SLTC	Minimal / part of regular maintenance activities	
		Flooding	• Regular cleaning and maintenance of drainage system • Monitoring and maintenance of slope stabilization measures along the alignment	TR4 operator in coordination with SLTC	Minimal / part of regular maintenance activities	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
		Sedimentation of water bodies	• Proper waste and garbage disposal • Maintenance of embankment slope ratio.		N/A	

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
			• Maintenance of retaining structures or stone pitching along the alignment, if necessary • Maintenance of vegetation along embankment slopes particularly near bridge location		Minimal / part of regular maintenance activities. 100,000.00 / yr	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
	Water quality	Water pollution	• Training of concerned personnel on oil spill response plan • Disposal of solid wastes according to environmental regulations • Collection and treatment of hazardous wastes prior to final disposal • Designation of paved area for the storage of used oil and oil-contaminated materials • Provision of sanitary facilities in the toll plazas	TR4 operator in coordination with SLTC	20,000.00 As need arises ~ 50,000.00 / yr	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
C. The Air	Change in the local micro-climate	Increase in local temperature due to presence of road and its operation	Maintenance of properly designed reforestation on both sides of the road	TR4 operator in coordination with SLTC	100,000.00 / yr	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
	Air quality	Gaseous emission from fuel-burning equipment	• Maintenance of properly designed reforestation on both sides of the road • Monthly monitoring of TSP, PM10, NO2 and CO at ASRs during the 1st year of operation; and, reduce frequency of	TR4 operator in coordination with SLTC	100,000.00 / yr	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
			monitoring thereafter as necessary Prohibit entry to the expressway of vehicles emitting excessive smoke (visual observation)		120,000.00 / mo.	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
	Ambient air quality	Noise generation from vehicular movement along the TR4 alignment	• Provision of noise barriers such as walls or earth embankment particularly adjacent to schools, churches, and residential areas • Planting of trees along the edge of RROW or adjacent to the road fence for blocking the line-of-sight between the noise source and the receptors	TR4 operator in coordination with SLTC	Minimal, part of maintenance activities of facilities / structures provided during construction phase 100,000.00 / yr	
D. The People	Project Operation	Change in Physical Resources	SLTC may assist in the improvement of Mt. Makiling watershed to enhance its environmental condition and resources	SLTC in coordination with TR4 operator	To be determined based on coordination with the UPLB	• Possible inclusion in the environmental monitoring plan • MOA between SLTC and TR4 operator

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee / Financial Arrangements
	Manpower Requirement	In-migration	Prioritize hiring of qualified local residents	TR4 operator in coordination with SLTC	N/A	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
	Manpower Requirement Health and Safety	Resource Competition	Resources / Assistance to host communities of relocates for the delivery of basic services	TR4 operator in coordination with SLTC	To be determined by the MMT	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator
		Threat to Public Health and Safety	• Coordination with RHUs for possible regular monitoring of residents' health conditions and in the implementation of health care interventions	TR4 operator in coordination with SLTC	To be determined by the MMT	• Possible inclusion in the environmental monitoring plan • MOA between SLTC and TR4 operator
	Safety	Traffic accidents	• Provision of proper and adequate signages • Impose speed restrictions • Provide emergency response medical team • Implementation of Social Development Plan and IEC	TR4 operator in coordination with SLTC	Minimal, part of maintenance activities To be determined based on the final SDP	• Include in the environmental monitoring plan • MOA between SLTC and TR4 operator

4.0 EMERGENCY RISK ASSESSMENT (ERA) AND EMERGENCY RESPONSE POLICY AND GUIDELINES

4.1 Emergency Risk Assessment (ERA)

The Environmental Risk Assessment (ERA) in the context of Philippine EIS System (PD 1586) is concerned with human safety where risks are characterized by probabilities, consequences, accidental nature, and acute effects.

On the other hand, geological risks are covered by the Engineering Geological and Geohazard Report (EGGAR) requirement of the Mines and Geosciences Bureau (MGB) and health risks characterized by exposures and chronic human health effects are assessed in the Environmental Health Impact Assessment (EHIA) under the DOH mandate. The EGGAR and EHIA have their own procedural processes that are not covered by the EIA System and not required by the ECC application.

Annex 2-7 of the Revised Procedural Manual (RPM) of the Department Administrative Order No. 30 Series of 2003 (DAO 03-2003) or Implementing Rules and Regulations of PD1586 defines how the ERA should be done in the context of the Philippine EIS System.

In general, an ERA is required if a proposed project will use, handle, transport, store substances that are explosive, flammable, oxidizing, or toxic. The RPM provides the following list to determine whether or not an ERA is required for a proposed or existing project:

a. Facilities for the production or processing of organic or inorganic chemicals using:

- Alkylation, amination by ammonolysis, carbonylation, condensation, dehydrogenation, esterification;
- Halogenation and manufacture of halogens, hydrogenation, hydrolysis, oxidation, polymerization;
- Sulphonation, desulphurization, manufacture and transformation of sulfur-containing compounds;
- Nitration and manufacture of nitrogen-containing compounds;
- Manufacture of phosphorus-containing compounds;
- Formulation of pesticides and of pharmaceutical products; and
- Distillation, Extraction, or Solvation.

b. Installations for distillation, refining, or processing of petroleum products
c. Installations for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition
d. Installations for the production or processing of energy gases, for example, LPG, LNG, SNG
e. Installations for the dry distillation of coal or lignite
f. Installations for the production of metals or non-metals by a wet process or by means of electrical energy
g. Installations for the loading/unloading of hazardous materials as defined by RA 6969 (or DAO 29)

Since the TR4 does not fall in any of the abovementioned categories, an ERA is not being required for the EIS.

4.2 Emergency Response Policy and Guidelines

SLTC has a company policy to address the safety, health, and environmental concerns of the project. Based from the company policy, emergency guidelines will be implemented to address the two main aspects of the project: 1) Health and Safety; and 2) Environment.

4.2.1 Health and Safety Guidelines

4.2.1.1 Construction Phase

SLTC will ensure that contractors have approved Construction Safety and Health Programs (CSHP) from the Bureau of Working Conditions (BWC) of the Department of Labor and Employment (DOLE). The following are the important components of the CSHP applicable to the proposed project:

a. Company Safety and Health Policy

The SLTC has a Company Safety Policy which serves as the guiding principle in the implementation of safety and health programs onsite. The policy includes the contractors' policies on occupational safety, worker's welfare and health, and environment. The Safety Policy includes the commitment that the contractor(s) will comply with DOLE minimum safety requirements, reporting requirements of the Occupational Health and Safety Standards (OSHS), and other relevant DOLE issuances. These are:

- Registration (Rule 1020 and D.O. 18-02)
- Report of Safety Committee Organization (Rule 1040)
- Notification of Accidents and Occupational Illnesses (Rule 1050)
- Annual Work Accident/Illness Exposure Data Report (Rule 1050)
- Annual Medical Report (Rule 1960)

b. Construction Safety and Health Committee

A construction safety and health committee is required, the structure and membership of which should be consistent with the requirements of Section 11 of D.O. 13, series of 1998.

c. Safety and Health Personnel

The following are the requirements for the different personnel relating to the Occupational Health and Safety Program (OHSP):

- First-aid personnel: should be certified by the Philippine National Red Cross with a valid PNRC ID Card.
- Safety Officers: must complete the 40-hour BWC prescribed safety and health course as required by Rule 1030 of the OSHS, as amended by DO. 16. All full-time safety personnel shall be accredited by the BWC pursuant to DO. 16.
- Physicians and nurses: must complete the BWC prescribed course on occupational safety and health course, pursuant to Rule 1960 of the OSHS.

d. Specific Duties and Responsibilities of the Safety Officer

Specific duties and responsibilities are outlined in Rule 1047 of the Occupational Safety and Health Standards (OSHS).

f. Applicable Safety and Health Promotion and Continuing Information Dissemination

- Information dissemination or advisories to the new employees prior to on-site assignment, e.g., conduct of safety orientation, company's health and safety policies, hazards related to the job, safety measures, safe work procedures.
- Programs on continuing education such as trainings and seminars, if any, that shall be given to employees, e.g., refresher course, first aid training, refresher course toolbox meeting, construction safety training for site safety officers.
- Arrangements for conveying information on safety and health IEC materials, e.g., Posters/*comics*/flyers, safety signage, handbooks/manuals, bulletin boards
- Arrangements for setting up sub-committees on safety and health, if necessary.
- Schedule of safety related activities, e.g. toolbox meeting, health and safety committee meeting.

g. Accident and Incident Investigation, Recording, and Reporting

- Investigation and recording of all accidents or incidences.
- Notification of the appropriate DOLE Regional Office within 24 hours in case of fatal accidents.

h. Provisions for the Protection of the General Public within the Vicinity of the Company Premises during Construction and Demolition

- Measures to ensure the safety of the general public
- Appropriate provisions and rules of the OSHS

  - Rule 1412.09: Protection of the Public
  - Rule 1412.12: Protection against collapse of Structure
  - Rule 1412.16: Traffic Control
  - Rule 1413: Excavation
  - Rule 1060: Premises of Establishments
  - DO. 13, Section 9: Construction Safety Signs

i. General Safety within Construction Premises

Provision for danger signs, barricades, safety instructions for workers, employees, public, and visitors such as, housekeeping; walkway surfaces; means of access i.e., stairs, ramps, floor openings, elevated walkways, runways and platforms, and lighting.

j. Environmental Control (Rule 1070 of the OSHS)

- Monitoring and control of hazardous noise, vibration and air-borne contaminants such as gases, fumes, mists and vapors.
- Provisions to comply with minimum requirements for lighting, ventilation and air movement.

k. Guarding of hazardous machinery (Rule 1200 of the Standards)

- Provisions for installation/design of built-in machine guards.
- Provisions for built-in safety in case of machine failure.
- Provisions for guarding of exposed walkways, access-ways, working platforms.

l. Provisions for and use of Personal Protective Equipment (PPE) - (Rule 1080 of the OSHS)

- Appropriate types and duly tested PPEs to be issued to workers after the required training on their use.
- Provisions for maintenance, inspection and replacement of PPEs.

The basic PPE required for all types of construction projects are hard hats, safety shoes and working gloves. Other PPEs shall be required depending on the type of work and hazards (**Table 4-1**).

Table 4-1: Examples of PPEs during Construction Phase

CONSTRUCTION WORK/ACTIVITY	SPECIALIZED PPE
Working on scaffolds and roofs	Safety belt
Laying concrete slab and pouring of concrete for beams and/or columns	Safety chemical resistant boots and gloves
Working with derricks and cranes	Color-coded vest with reflectorized markings Heavy leather gloves High visibility gloves
Working with earth moving equipment	Heavy duty safety footwear Ear muff or ear plugs High visibility gloves High visibility vest
Manual excavation or digging	Padded vest
Hot cutting and welding of metals	Heat resistant light filtering face shield Heat resistant and heat insulating gloves Metal fume filtering respirators Heat resistant protective clothing Light filtering and heat resistant face goggles
When working with live electricity above 50 volts AC or DC	Electrically insulated gloves Electrically insulated safety shoes
Work involving exposure to harmful dust	Dust filtering respirators Chemical goggles Chemical resistant protective clothing
Working near vehicular traffic	PPEs with reflectorized or luminous markings for high visibility Heavy duty safety shoes
Working at night under low lighting conditions	High visibility vest

The following health and safety procedures and guidelines shall be observed during construction phase:

1. General Materials Handling and Storage Procedures (Rule 1150 of the Standards)

- Safe use of mechanical materials handling equipment
- Secured and safe storage facilities
- Regular housekeeping
- Clearly marked clearance limits
- Proper area guarding of storage facilities

2. Testing and Inspection of Electrical and Mechanical Facilities and Equipment

The following rules of the OSHS apply:

- Rule 1210 - Electrical Safety
- Rule 1220 - Elevators and Related Equipment
- Rule 1410 - Construction Safety
- Rule 1415.10 - Training and Examination of Lifting Appliance

3. Workers Skills and Certification

- Provisions to ensure that workers are qualified to perform the work safely
- Provisions to ensure that only qualified operators are authorized to use and operate electrical and mechanical equipment

4. Provisions for Emergency Transportation Facilities for Workers

Rule 1963.02 of the OSHS - Emergency Medical and Dental Services applies.

5. Fire Protection Facilities and Equipment

- Fire protection facilities and equipment as required under Rule 1940 of the OSHS
- Proposed structure and membership of fire brigade
- Provision for training on emergency preparedness

6. First-Aid and Health Care Medicines, Equipment and Facilities

- Identification of the proposed first aid and health care facilities that the contractor will provide to meet the minimum requirements of OSHS.
- Identification of the medical and health supplies, such as medicines and equipment to be provided.
- Mandatory provision of first aid medicines and emergency treatment.
- In the absence of the required onsite health care facility, the contractor should attach a copy of a written contract with a recognized emergency health provider as required under the OSHS.

7. Workers Welfare Facilities

- Provision for toilet and sanitary facilities
- Provision for bathing and washing facilities
- Provision for supplying food and meals
- Provision for potable water for drinking and washing
- Provision for locker rooms, storing, and changing of clothes for workers

8. Proposed Hours of Work and Rest and Rest Breaks

- Work schedules, working hours, shifting schedules should be specified
- Frequency and length of meals and breaks
- Schedule of rest periods

9. Waste Disposal

- <u>Method of waste management should be provided.</u>

10. Disaster and Emergency Preparedness Contingency

Guidelines for the following will be prepared:

- Guidelines in responding to bomb threats
- Guidelines in emergency preparedness and response on vehicular/road accidents
- Preparedness and response for severe weather conditions
- Preparedness and response for fires and explosion
- Preparedness and response for earthquake
- Preparedness and response for accidents in workplace

11. Safety Program

Specified standard work procedures should be provided for the following activities:

- Site Clearing
- Excavation
- Erection and dismantling of scaffolds and other temporary working platforms
- Temporary electrical connections/installations
- Use of scaffolds and other temporary working platforms
- Working at unprotected elevated working platforms or surfaces
- Use of power tools and equipment
- Gas and electric welding and cutting operations
- Use of hand tools
- Use of mechanized lifting appliances for movement of materials
- Use of construction heavy equipment

4.2.1.2 Operation and Maintenance

The existing company ERP will be checked and revised accordingly to conform to the rules of the OSHS, examples of which are listed in **Table 4-2**.

Table 4-2: Examples of OSHS provisions of the DOLE

RULE 1030	TRAINING OF PERSONNEL IN OCCUPATIONAL SAFETY AND HEALTH
	This activity will be conducted by the BWC-DOLE in training the company safety personnel in carrying out their functions and in the implementation of the OSHP.
RULE 1040	HEALTH AND SAFETY COMMITTEE
	It is required that a Health and Safety Committee (HSC) be organized within one (1) month from the date a business starts operating with re-organization in January of the following year. The composition of the HSC is dependent on number of workers as specified in Rule 1042.
RULE 1050	NOTIFICATION AND KEEPING OF RECORDS OF ACCIDENTS AND/OR OCCUPATIONAL ILLNESSES
RULE 1060	PREMISES OF ESTABLISHMENTS
	Provides rules on safety requirements for: 1062 - Space Requirement 1063 - Walkway Surface 1064 - Floor and Wall Opening 1065 - Stairs 1066 - Window Openings 1067 - Fixed Ladders 1068 - Overhead Walks, Runways and Platforms 1069 - Yards
RULE 1070	OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL
	1974.01: Threshold Limit Values for Noise: 1074:02: Permissible Noise Exposure: 1075: Illumination: 1975.02: Natural Lighting 1075.03: Artificial Lighting 1075.04: Intensity 1075.06: Emergency Lighting 1076: General Ventilation: 1076.01: Atmospheric Conditions 1976.02: Air Supply 1076.03: Cleanliness 1076.04: Air Movement 1076.05: Temperature and Humidity 1077: Working Environment Measurement

RULE 1080	PERSONAL PROTECTIVE EQUIPMENT AND DEVICES
	The company is required to furnish the employees with protective equipment for the eyes, face, hands and feet, protective shields and barriers when necessary by reason of the hazardous nature of the work or environment.
RULE 1200	MACHINE GUARDING
RULE 1210	ELECTRICAL SAFETY
	Electrical safety concerns should conform to the Philippine Electrical Code.
RULE 1230	IDENTIFICATION OF PIPING SYSTEM
RULE 1960	OCCUPATIONAL HEALTH SERVICES
	Occupational Health Services are services that provide preventive functions and advices the employers, the workers, and their representatives, in the establishment/undertaking that will facilitate optimal physical and mental health in relation to work. This includes physical examinations during pre-employment and employment.

In general, contingency and emergency planning is necessary to address accidents during the operation phase of the proposed project. The main components of contingency planning include (a) measures to prevent accidents, (b) methods for response and clean-up, and (c) organizing and training of personnel to implement the plan. Among the measures to be instituted, these will include at the minimum:

1. ***Medical Assistance during Accidents***

A company staff shall be trained in first-aid techniques to provide medicines and treat minor wounds and ailments.

2. ***Communications***

Public address (PA) systems and other means of communication will be installed or provided. These will be used to issue forecasts, alarms, warnings and other information in case of accidents. Hand-held radios will also be issued to selected personnel to coordinate personnel movement during emergencies.

3. ***Emergency Response Teams***

An emergency response team will be organized, trained, and deployed to implement the necessary remedial measures during accidents.

4. ***Fire Hazards***

As prescribed by the Fire Code of the Philippines, fire extinguishers, hoses and other firefighting materials must be strategically located within buildings. Fire drills should also be conducted regularly to maintain the alertness of the personnel. To further strengthen the company ERP, the US OSHA emergency plan guides can also be used as reference. The OSHA provides two levels of emergency planning for facilities that manufacture, handle, use, or store hazardous materials. The OSHA ERP is required to have the following 11 elements according to 29 CFR 1910.120 (l) (2), at the minimum:

- pre-emergency planning;
- personnel roles, lines of authority, and communication;
- emergency recognition and prevention;
- safe distances and places of refuge;
- site security and control;
- evacuation routes and procedures;

- decontamination procedures;
- emergency medical treatment and first aid;
- emergency alerting and response procedures;
- critique of response and follow-up; and
- personal protective equipment and emergency equipment specification

4.2.2 Environmental Guidelines

Although an ERA is not required, an environmental guidelines will be formulated to address the potential exposure of TR4 to natural calamities. The guidelines is envisioned for implementation in coordination with the concerned government agencies and LGUs for disaster risk reduction (DRR) and climate change adaptation (CCA). Some of the factors to be considered and the key features of the guidelines are presented below.

4.2.2.1 Natural Hazards

The TR4 alignment, given its geological and geographical location, could be vulnerable to several natural hazards that are either geologic or hydrologic in nature that should be considered in its development. The MGB categorizes the geologic natural hazards that are relevant to the Project as fault related/seismic, volcanic and mass movements. The Project is located at least 15 km from the nearest known active faults and it is unlikely that a ground rupture due to the movement of this fault will affect the road alignment (*see* **Section 2.1.2.5**). In addition, the project area is categorized as having a low susceptibility to landslides except for river crossings where the river banks are steep and is prone to mass movement. Furthermore, the nearest active volcano is Taal Volcano which is more than 20 km from the project site. Thus, it is unlikely that the area will be directly and adversely affected by eruptions of Taal Volcano, if the scale of eruptions were of similar magnitude to those of historic times. Possibly, the area may be affected by minimal ashfall if the wind speed and direction are directed towards its location.

On the other hand, the TR4 alignment is located in low to moderate susceptibility to flooding as per geohazard evaluation of the MGB. However, there are some spots that are susceptible to flooding according to the historic records and information from local residents (*see* **Section 2.2.1.3**). Based from the PAGASA projection on climate change under the medium-range emission scenario, the project area will have a decrease in rainfall during dry season but rainfall intensification is expected for the wet season (*see* **Section 2.2.1.4**). The rainfall intensification could possibly result to more number of days of flooding occurrence and increase in flooding depth particularly in the flood-prone areas in Sto. Tomas, San Pablo City, Tiaong and Sariaya.

4.2.2.2 Control of Natural Hazards

Flooding is the most possible natural hazard that could affect the area based from the environmental assessment, although it will be confined at the few identified flood-prone areas. Thus, the design will incorporate measures to prevent flooding along the identified sections of the alignment and its vicinity. The size and sectioning of the drainage channels will ensure diversion of the expected volume of runoff within the area. The alignment along San Pablo City and Tiaong, Quezon will take into consideration the maximum flood level of the rivers, the existing topography, farm roads crossings and the presence of PNR railways (*see* **Section 1.3.1**). For the flood-prone areas in Sto. Tomas, Batangas and Sariaya, Quezon, the hydrologic study will be reviewed to determine if there is a possibility of minimizing the diversion of runoff to the river that causes flooding in the area. Possibly, some portion of runoff from these river catchments could be diverted to adjacent waterways if it could be incorporated in the TR4 design and it will not cause negative impacts to the receiving streams and its catchment area.

Regular clean-up and maintenance of the drainage system will be conducted to avoid possible blocking or constriction of flow which could result to localized flooding during heavy rainfall event.

4.2.2.3 Guidelines

The DPWH is the national agency mandated for the restoration of damaged roads and bridges, and other public infrastructures such as flood control structure, waterworks, buildings, etc. The TR4 is a joint project by the SLTC and DPWH being a public utility to be built, managed and operated by a private company. Since the TR4 will be linking to the other national roads thru the DPWH access roads, the SLTC and DPWH could collaborate in the implementation of emergency response plan.

4.2.2.3.1 DPWH Policy and Guidelines

The DPWH Department Order No. 15 series of 2015 (DPWH DO No. 15, s. 2015) is the DPWH Guidelines for Disaster Preparedness. It prescribes the preparation and activities at its different offices during typhoons and other calamities. An excerpts from the guidelines regarding the DPWH humanitarian logistics during disaster are presented below:

4.2.2.3.1.1 *Pre-Disaster Phase*

The DPWH Regional Office (DPWH-RO) and DPWH District Engineering Office (DPWH-DEO) shall activate the Disaster Risk Reduction Management (DRRM) Team upon advisory from PAGASA that a cyclone / typhoon has entered the Philippine Area of Responsibility (PAR). In addition, the concerned office will pre-position the available / operational equipment with operator to the landslide-prone areas.

4.2.2.3.1.2 *Occurrence of Calamity*

Submission of situational report, every six hours, by the concerned office containing the following: (1) name / location of the affected road section/s; (2) whether the affected road section is still passable or not passable; (3) actions taken on damaged section/s; (4) preliminary cost estimate for the repair of the damaged section/s; and, (5) remarks, whether the damaged section is open to all types of vehicles, detour routes available, estimated time of repair, etc.

4.2.2.3.1.3 *Response Phase*

During or immediately after the calamity, the DRRM Teams shall coordinate with the Regional / Provincial Disaster Risk Reduction Management Council (RDRRMC / PDRRMC) to provide logistical support to the response clusters such as Search Rescue & Retrieval (SRR),Camp Coordination and Management (CCM), Logistics, Education, etc.

In addition, the DPWH DO No. 23, s. 2015 presents the responsible DPWH field office for the design and implementation of drainage / slope protection projects depending on the road category and cost of project. However, the DPWH-DEO is responsible for the drainage maintenance along all national road and bridges.

4.2.2.3.2 SLTC Guidelines

The SLTC will coordinate with the DPWH and the LGUs Disaster Risk Reduction and Management Council (LGUs DRRMC) to support the concerned agencies implementation of *Disaster Preparedness and Response Mechanism during Typhoons and other Natural Calamities*. Some possible activities and/or cooperative measures on the part of SLTC include the following:

1. Identification of the rivers traversing the TR4 alignment that are still projected to cause flooding downstream during the project operation. A water level indicator could be established at the bridge location which should be readily visible from the road. This water level indicator will be read by designated SLTC personnel at an agreed time interval when there is PAGASA forecast of incoming typhoon or heavy downpour affecting the area. The water level reading will be transmitted immediately to the LGUs and DPWH field office that monitors the situation in the area. With reference to the flood study that will be commissioned by the SLTC after the project construction, the information could be used by the LGUs Disaster Risk Reduction and

Management Council (LGUs DRRMC) in providing warning advisory to the to-be-affected areas and in anticipating the level of assistance and resources that will be required. On the other hand, the DPWH could project the section/s of public road that may not be passable for the early warning of the motorists and riding public. This could also assist the DPWH in determining the need to pre-position manpower and equipment in disaster-prone area. Lastly, the study could be a possible source of inputs for the Integrated Water Resources Management (IWRM) being implemented by DPWH and DENR as part of the National Climate Change Action Plan (NCCAP).

2. If needed during typhoon and/or calamities, free access at TR4 by the vehicles and equipment for humanitarian logistics from LGUs and DPWH could be allowed to facilitate mobility.

3. SLTC could provide advisory either thru overhead variable message signages (VMS) or posting message boards along the road alignment to inform the motorists about the condition of access roads after TR4 if these are still passable or already flooded.

5.0 SOCIAL DEVELOPMENT PLAN (SDP)

5.1 Social Development Plan Framework

The Social Development Plan Framework (SDPF) addresses the issues and concerns and impacts identified during the second level scoping meeting and the results of the environmental impact study, which includes focused group discussions, through the design of mitigating measures. The social development plan framework incorporates the proposed interventions of the project in favor of the various stakeholders of the project (**Table 5-1)**.

As part of its social responsibility, the proponent aims to empower the stakeholders, especially the affected residents as partners of development. To the extent that the project allows, it will also strive to develop strategies that will alleviate poverty and improve the standard of living of communities through sustainable programs and projects that will harness their productivity to the fullest, strengthen their self-reliance values and enhance their dignity as members of civil society.

5.1.1 Background/Rationale

The Social Development Plan Framework (SDPF) of the SLEX- TR 4 Project seeks to address the issues and concerns and impacts identified during IEC, scoping meetings as well as the result of the socio economic survey (SES)/perception survey in affected ROW alignment through the design of mitigating measures. The social development plan framework incorporates sustainable interventions and makes use of gender sensitive approaches in mitigating project.

This SDPF was culled out from the previously submitted document by the company in 2014; some of the contents were enhanced to make it current as well as incorporate DRR-CCA programs.

As part of its social responsibility, SLTC, the proponent, will target the primary stakeholders, especially the affected informal settlers, tenants/farmers and various sectors (youth, women, elderly /PWDs) as partners of its development efforts.

For the long term, it will strive to develop strategies that will alleviate poverty and improve the standard of living of relocated APs/ communities through programs and projects that will harness their productivity to the fullest, strengthen their self-reliance values and enhance their dignity as members of civil society.

5.1.2 The Legal Basis

The SDP is required as an integral aspect of the EIS to respond and mitigate project impacts, particularly to affected families and communities, as stated in DAO No.30 series of 2003 (DAO 03-30) and the Implementing Rules and regulations of Presidential Decree No.1586, Establishing the Philippine Environmental Impact Statement System.

Aside from this, basic rights of affected stakeholders are contained in (i) RA 8974 (land owners' compensation of loss assets and properties at current market price), (ii) EO 1035 (informal settlers benefits and entitlement), and (iii) RA 7279 (UDHA ACT 1997) displaced informal dwellers/tenants' entitlement to a relocation site and housing, to be amortized by them and the provision of amenities and basic social services.

The Social Development Plan Framework establishes parameters for intervention for the direct and indirectly affected communities, the LGUs and other stakeholders that may be affected as a result of the operations of the SLEX-TR 4 project.

5.1.3 Basic Features of the SDP: Development Strategies/Approach

While it looks at addressing project impacts, the SDP framework is hinged on sustainable development and participatory interventions. Its goal is to empower communities and stakeholders to undertake continuing development efforts even during the operation of the project or in the case of other projects, even after decommissioning.

The full benefits of the project should be able to trickle down to the most vulnerable sectors of affected communities such as the informal settlers and tenants who will be physically and economically displaced. Project benefits shall be inclusive and that participation of vulnerable sectors (youth, women, elderly, fishermen, farmers, small traders and enterprise owners, etc.) in development activities should be observed from planning, implementation to evaluation of identified projects.

The SDP should be able to complement the existing Municipal/Provincial Development Plans and consider their basic priorities identified by the LGUs, and more importantly, the project impact and stakeholders' concerns and issues.

5.1.4 Consideration in the Preparation of SDP Plan

5.1.4.1 SDP Preparation and Planning and Implementation Process

The SDP preparation will include the use of community organizing (CO) and organizational development (OD) approaches to ensure the participation of various stakeholders, residents and barangays who will be involved in the empowerment process. The process will include: (i) Validation of the issues and concerns identified during data gathering assessment, (ii) Formation of the SDP Framework, (iii) Integration/Interface of the SDP Framework with LGU Development Plans, (iv) Program and Project Identification and Prioritization, (v) Formulation of Project Implementation Strategies, (vi) Registration of Partner Cooperatives/organizations based on eligibility criteria, (vii) Organization of Local Development Councils, (viii) Implementation of approved projects and (ix) Capacity enhancement of individual/organizations involved in development projects.

All throughout the project cycle, various stakeholders will be involved from planning to evaluation of implemented projects.

Capacity enhancement of partner organizations and cooperatives and their members will be undertaken to ensure the viability of projects and business undertakings. Capital build-up and savings formation will be an important element for ensuring their financial stability and to be able to serve more members even after project decommissioning.

5.1.4.2 Institutional/Project Proponent Responsibility

a) Environmental Health and Safety Division of the project proponent will serve as the focal unit to address the concerns and issues of various stakeholders of affected communities. It will be responsible for initiating the planning and implementation of SDP in partnership with various stakeholders, LGUs, sectoral groups and affected communities. Basic tasks and roles of the proponent staff will be to: facilitate, catalyze, enable, coordinate, monitor and evaluate milestones of the implementation of the SDP. Capacity of the Environmental Health and Safety Division staff will be strengthened to ensure they will be able to discharge their tasks and functions effectively.

b) A core SDP committee will be organized to be represented by all sectors at the LGU level.

c) The SDP targets various sectors of the communities (farmers/tenants, women, youth, etc.) as partners in the planning, implementation and the evaluation process.

Specifically, the following spells out the roles of the various stakeholders in the SDP preparation process:

Barangay Level

Representatives from host barangays will also be part of the SDP committee (Key barangay officers, women, youth, elderly, etc.). They will also have the opportunity to define their needs and priorities.

NGOs/POs/Cooperatives

The NGOs will also be represented in the SDP Committee and will provide support to the planning and implementation of various projects and programs that will be identified by various sectors.

LGUs/Agencies and Departments/Proponent

The LGUs will be the prime movers of the social development plan that will be developed with various sectors. They will provide the technical expertise, knowhow as well as funding for identified projects.

d) Appropriate budget shall be allotted by the project for the SDP to ensure and facilitate its smooth implementation. The budget should be able to cover various programs and projects that will be prioritized or identified by affected communities and various stakeholders.

e) Other intervention efforts will be designed based on the needs and concerns of affected communities.

5.1.4.3 Establishing Network and Linkages

Network and linkages will be expanded to further mobilize support and assistance reaching out to other international agencies, NGOs, and other institutions at the regional and national levels. The objective is to strengthen linkages established to tap external resources aside from those internally generated among members of cooperatives and associations. This will provide opportunity to expand existing development intervention and assistance to residents of affected LGUs and barangays.

5.1.5 Monitoring and Evaluation of the Social Development Program

A local development council will be organized comprising of various sectors, NGOs, and LGU representatives to monitor the programs and milestones of project activities as well as assess their outcomes and effects on the socio-economic status of beneficiaries on a periodic basis. Recommendations and suggestions will be documented and feedback will be given to various development partners to further improve development efforts.

Table 5-1: Social Development Plan/Framework

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
1. Relocation a) Prepapartoy activities: Resettlement planning, and develoment of relocation site b) Actual relocation activities c) Post relocation activities	• Barangay Chairman • Project physically and economically displaced families (tenants,informal settlers)	• LGU Municipal Planning and Development Office (MPDO) – Provide overall support in the planning and implementation of the relocation activities, if any. – As host LGU, provide the necessary logistics, food, first aid and assistance during relocation. – Assist in the conduct of social preparation activities for affected families; define roles and responsibilities and possible programs and services. • DSWD – Identify possible social services (i.e. food subsidy, medicines, etc.) that will be accessed by the affected persons. – Assist in the conduct of social preparation activities. – Assist in the provision of social services for affected persons including youth,elderly/senior citizens/PWDs/single parent,women,etc. • DPWH – Provide compensation for lost assets and logistics before transfer to the	SLEX-Environmental Health and Safety Officer	Pre-Construction	LGU-IRA/ Proponent

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
		relocation site, if any, such as trucking, food allowances. • NGOs – Conduct social preparation activities together with proponent – Conduct skills assessment survey to determine APs skills to match possible work during tollway construction and operations and livelihood activities at affected barangays and relocation site. – Provide linkages and referrals to concerned agencies for skills training,capital/loan assistance and employment.			

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
2. Gender Responsive Livelihood / Employment and Credit Facilities (Men, Women, Youth & elderly)	• Relocatees • Association Chairperson • Cooperatives • Qualified Project Affected Men, Women, Youth & Elderly	• LGU/ Municipal Planning Office/MSWD – Provide updated socio-economic profile of the municipality, Land Use Plan Development Plan and Strategy – Provide appropriate data that will be used in the formulation of SDP – Initiate the consultation with proponent and other agencies concerned at the municipal level – Provide technical support in the preparation of sectoral projects identified by sectors in potentially affected communities, including budgetary estimates. – Develop criteria for the selection and distribution of employment opportunities among affected sectors during construction and to coordinate with proponent/contractor's re: employment plan.	SLEX-Environmental Health and Safety Oficer	Pre-Construction	LGU –IRA/ Proponent
		– Monitor the implementation of identified sectoral projects in affected communities and provide technical guidance in effective implementation – Ensure the implementation of employment distribution system among	SLEX-Environmental Health and Safety Oficer	Construction	

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
		sectors in affected barangays where the ROW alignment will traverse			
		– Initiate periodic evaluation of on-going employment distribution system and livelihood programs set-up by sectoral groups – Set up mechanism for ensuring sustainablility of livelihood projects implemented by sectoral groups		Construction Operation	
		• TESDA – Will be invited to provide manpower skills training program responsive to proponent's manpower requirements in coordination with LGUs – Develop livelihood skills training program responsive to identified livelihood activities by sectoral groups – Evaluate outcome of technical and livelihood skills training and ensure appropriate improvements, if necessary – Provide the proponent a technical assistance on program evaluation		Pre- Construction	• LGU • Proponent
		• Cooperatives – Will be enjoined to conduct continuing membership education to members of cooperatives focused on value		• Construction • Operation	

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
		formation, savings and capital build-up and self-reliance building initiatives – Provide services to members including credit and loan assistance, enterprise development, business counseling and other social services to members.			
3. Health and Safety	Barangay Kagawad for Health • Project Affected Communities	• Municipal Health Office (MHO) - Develop baseline health profile of affected barangays and identify prevailing morbidity/mortality causes/ - Coordinate with proponent for potential heatlh impacts and occupational health hazards from the tollway project. - Develop IEC awareness campaigns to promote health and safety standards, disaster management program together with proponent.	Environmental Health and Safety Division	• Pre-Construction • Construction • Operation	LGU –IRA/ Proponent
		- Conduct health impact studies to determine, if there is any change in the health of affected communities. - Conduct periodic health monitoring and occupational safety checks together with proponent and MMT.		• Construction • Operation	LGU –IRA/ Proponent
		• Barangay Disaster Risk Reduction Management (BDRRM) Committee - Prepare Barangay Disaster Risk Reduction Management Plan in	Environmental and Health Safety Division	Pre-Construction	LGU –IRA/ Proponent

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
		collaboration with proponent and stakeholders concerned. - Conduct Community-Based Risk Reduction Management (RA 10121)/CCA refresher course to new and incumbent barangay officials and other stakeholders - Conduct periodic disaster risk management drills as mandated by NDRRMC for affected communities in coordination with proponent			
4. Education and Recreation	Barangay Kagawad for Education Project Affected Families	• Department of Education (DepEd) – Prepare plan for the entry and increase number of enrollees in case of relocation, additional classrooms and teachers, if needed – On the students level and in coordination with proponent, develop IEC and values education training program to cope up and manage change as a result of project activities. – Provide support in the design of cooperative development programs and educational training on savings formation and capital build-up in coordination with proponent – Develop sports and recreational program for the youth to improved physical and mental health	Environmental and Health safety Division -SLEX Corp.	• Pre-Construction • Construction	LGU –IRA/ Proponent

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
5. Environment and Sanitation	• Barangay Kagawad for Environment • Project Affected Community	• Environmental and Natural Resource Office (ENRO) – Support IEC awareness program on impact of project activities on the environment and mitigating measures that will be undertaken for affected communities and other stakeholders – Support preparation of environmental and resource management plan in coordination with LGU and affected communities to support rehabilitation measures of proponent	Environmental Health and Safety Division	• Pre-Construction • Construction	LGU –IRA/ Proponent
		– Conduct technology training programs for affected communities who will be involved in rehabilitation measures (agro-forestry, reforestation, tree farming, etc.) focused on Knowledge, attitude and practice. – Supportthe implementation of environment and resource management program and monitor its status and progress and provide measures to improve implementation in coordination with proponent in a sustainable manner – Support the timely organization of the MMT plan and implement project activities.		• Construction • Operation	LGU –IRA/ Proponent

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
	• Barangay Kagawad for Environment	• Municipal Health Office (MHO) – Prepare plan on how to monitor possible impact of project activities in regard to pollution of water ways and river systems, etc. – Orient Barangay Officers in-charge for environment and sanitation on ways to detect possible pollution in water ways, river systems etc. – Conduct periodic monitoring activities to assess possible pollution cases surrounding affected communities.	Environmental Health and Safety Division	Construction Operation	LGU –IRA/ Proponent
6. Peace and order	• Barangay Kagawad for Peace and order • Project Affected Communities	• Local Government Unit (LGU) – Assess peace and order situation in potentially affected communities and prepare appropriate security measures to ensure an environment conducive to project operations and the conduct of downstream economic and business activities within the affected communities – Coordinate with Barangay Kagawad in-charge for Peace and Order for the implementation of the peace and order plan, and mobilize peace officers that will be responsible for ensuring peaceful environment and who will monitor at cases of misconducts, theft, etc.	Chief Security Officer	Pre-Construction	LGU –IRA/ Proponen

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Non-government Agency and Services (indicate specific services)	Proponent	Indicative Timeline	Source of fund
7. Safety and security		• PNP – Assign police officers who will be responsible for the upkeep of peace and order situation for a continued business operations in affected communities		Construction Operation	LGU –IRA/ Proponent
8. Spiritual	• Barangay Assigned Catholic Priest, Pastor of different denomination	• Parish Priest – Develop counseling and value formation and family guidance program for affected communities to cope up with change brought about by the project – Conduct family oriented guidance, leadership formation activities, bible studies as well as retreats involving affected communities to enhance Christian and Spiritual values. – Mobilize youth as peer guidance counselors to help the youth visualize their plans and chart their future to keep them away from vices, gambling, drinking, drugs, etc.	Environmental Health and Safety Division		Church/ Project Proponent

5.1.6 Social Issues, Concerns and Proposed Sample Programs/Projects

Based on the identified social issues and concerns of various stakeholders as well as their socio-economic status, programs and projects may be planned and implemented based on the priorities set by the various stakeholders and affected communities. Actual project planning, prioritization and proposal preparation will be undertaken by various stakeholders, interest groups, or cooperatives who will be partners of the implementation of Social Development Plan. Sample of projects and programs are as follows:

Table 5-2: Sample Projects and Programs

Perceived Project Impact, Social Issues and Concerns	Sample Programs/Projects
A. Environment and Health	
1. Environment and safety measures at the Toll Expressway	• Tree Planting/Maintenance Program Tree planting program along the SLEX Tollway may be planned with affected communities to be implemented as buffer zones along the ROW Alignment/Expressway for aesthetic and safety measures. This shall be implemented under the technical supervision of the project proponent and DENR which is the agency in-charge of environmental and community resource re-generation. • Periodic conduct of Disaster/CCA-hazard drill Community drill mandated by the NDRRMC to be conducted on a barangay/community level.
2. Potential loss of forests cover, vegetation, soil degradation, flooding, etc. as well as decrease volume of agricultural production.	• Replacement of lost trees and vegetation will be undertaken in relatively upland areas to be traversed by the expressway. The proponent under the Environmental Health and Safety Division shall ensure residents who are eligible to join the program will be guided appropriately and organized for sustainable reforestation effort in areas that are vulnerable to erosion and landslides along the express way.
3. Lack of know-how and technology on how to sustain upland rehabilitation measures	• The proponent shall ensure participants are provided adequate technology know-how and skills in implementing various tree planting and maintenance activities. The programs should be sustained beyond the life of the project and organizations involved should be able to sustainably manage them until vegetative covers and resources shall have been fully re-generated.
4. Potential loss of livelihood for displaced tenants/farmers/informal settlers in some barangays in the project area	• Livelihood assistance projects should be able to provide livelihood alternatives and sources including: Nurseries and orchard development • Where applicable, provide assistance in improved agricultural production technology, skills training, enhancing farmer's organization and agricultural trading and marketing.
5. Health and related risks as a result of expressway/toll operations due to possible pollution: air, water, soil, etc.	• Comprehensive Health Development and Health Care Program This program will address the health needs and issues of affected communities and families near the ROW alignment due to potential vehicle gas emissions, air

Perceived Project Impact, Social Issues and Concerns	Sample Programs/Projects
	pollution and noise. It would be two-pronged: one, that is promotive and another, curative. It would also address potential health risks involved, if any. The objective is to ensure that over-all health and well-being of affected communities will be addressed. Various projects may be developed: (i) Community Health Education/Nutrition Project Collaborate with local health office in strengthening current promotive programs of government focused on primary health care, nutrition, maternal and child health, family health and responsible parenthood, among others. The primary participants will be mothers and women who are in charge of the overall health and well-being of their children and family members. (ii) Capacity Strengthening of the BHWs/Health Care Providers Collaborate with local health office in strengthening the knowledge and skills of community-based health workers (BHWs, BNS, etc.) to provide appropriate assistance to families and households through IEC and community health education seminars.
6. Lack/limited livelihood and employment opportunities resulting to poverty situation of majority of upland/lowland communities due to the project. 7. Equitable distribution of benefits and gains of the project (i.e. employment, socio-economic projects, self-employment schemes)	Livelihood Development/Employment Strategy Current socio-economic situation of the affected communities show very limited opportunities for livelihood and employment. The proposed livelihood development/employment strategy will consider current sources of livelihood, skills of residents, opportunities created by the tollway project. Two approaches may be made: Employment-based approach The residents will be provided the opportunity to be employed by the toll way project based on their skills or will be referred to sub-contractors in various activities of the proponent. Equitable distribution system will be drawn to provide each LGU, barangay and every sector of the communities the chance to be included in the employment program. Enterprise Development Affected persons, particularly, women who will be interested to engage in micro-enterprises will be assisted in setting-up their own business to capture the opportunity due to the increase of disposable income of households. The range of enterprises that will be developed may include agri-based projects, retail, trading, services, food, etc.

Perceived Project Impact, Social Issues and Concerns	Sample Programs/Projects
	For agri-based enterprises, adequate technology support would be provided for related processing activities and value added. To ensure the profitability of the business enterprises, monitoring and business counselling will be undertaken.
B. Enhance Sustainability Mechanism to Sustain Development Efforts	
8. Sustainability Mechanisms to be Established/Strengthened	In order to sustain development efforts, mechanisms shall be set-up and existing network will be strengthened to ensure development activities beyond the life of the project, in coordination with concerned agencies, including the LGUs.
9. Lack of capacity of affected communities to sustain development achieved in the short term	(i) Cooperatives Development Where needed, assistance in cooperatives or associations development or in strengthening existing organizations as conduits of development assistance during and after project completion. Cooperatives, in particular, promote self-reliance among members through continuous savings and capital build-up. Through initial capital assistance from the proponent, continuing capital build-up and savings formation of members will further increase financial capability of the cooperatives to serve their members' needs, particularly, to finance various projects and enterprises of members. Entrepreneurial activities will be supported such as those in food processing, agri-based enterprises, retailing and trading, among others. (ii) Continuing Membership Education Continuing membership education will strengthen values of members on self-reliance and cooperation. It will further strengthen the members' cooperative values that will enhance "sense of ownership" and responsibility among members. It will further reduce incidence of delinquency in case of the loan programs of cooperatives. (iii) Technology and Marketing Support The cooperatives will also act as conduit for technology support from various NGO and government agencies (DOST, TLRC, TESDA, etc.) that will provide vocational skills training to members. The cooperatives could also serve as the marketing arm of members engaged in various enterprises in order to command better prices of their produce and commodities. Link to existing trading posts will be established to expand trading activities of the cooperatives.
C. Institutional Development/Capacity Enhancement	

Perceived Project Impact, Social Issues and Concerns	Sample Programs/Projects
	<u>Strengthening Organizational/Management Capacity of Local Development Councils/Cooperatives/IP Council of Elders</u> To further ensure sustainability of development efforts, management capacity of local development councils and cooperatives will be strengthened, in collaboration with concerned agencies. Various seminars and workshops will be designed to focus on the following skills: (a) Self-Awareness/Leadership (b) Communications and Human Relations (c) Planning and Organizing (d) Problem Solving/Decision-Making (e) Conflict Resolution (f) Organizational and Work Values (g) Business Management (h) Monitoring and Evaluation (i) Enterprise Development (j) Entrepreneurship Development (k) Bookkeeping and Record Management (l) Simple Project Feasibility Study Preparation All other skills will be identified depending on the needs of these organizations. In cooperation with LGUs and other concerned agencies, field exposures and visits to successful cooperatives will be initiated for the residents to assess for themselves what lessons and experiences can be replicated for their organizations. OD intervention will be designed to set-up and install policies, systems and procedures in various aspects including membership, financial management, loan/capital assistance, savings formation and capital build-up, marketing, among others. The goal is to empower cooperatives and organizations to manage effectively their business and operations and to enhance their financial viability.
D. Strengthen Vocational/Technical Skills and Other Related Development Skills	
	<u>Vocational/Technical/Technology Skills Training</u> To enable the residents to compete for jobs/employment at the project or outside, necessary technical and vocational skills will be designed and developed for various sectors such as the youth, women, farmers, fisher folks, small businessmen, among others. Before construction, local development councils and the proponent will discuss possible job opportunities and what type of skills would be needed to make them eligible for some jobs to be offered.

Perceived Project Impact, Social Issues and Concerns	Sample Programs/Projects
	Technology training will also be designed for other sectors like the farmers to improve their skills with the use of more sustainable methods and technology in farming. Focus will include various methods of conservation, protection and management of upland and lowland agriculture.

5.2 Land Acquisition and Resettlement Framework

5.2.1 Introduction and Rationale

The Land Acquisition and Resettlement Framework (LARF) is being developed to ensure that all project affected persons or parties share in Project benefits, and are compensated and rehabilitated to assist them to improve, or at least maintain, their living conditions and income earning capacity at pre-Project levels. This will be followed by the preparation of a Land Acquisition and Resettlement Action Plan (LARAP) during the detailed engineering design (DED) phase. The South Luzon Tollway Corporation (SLTC) will prepare the LARAP and allocate budget for its implementation within a reasonable timeframe. It will also coordinate with the DPWH for land acquisition and LGUs concerned for LARAP preparation and implementation.

In the absence of comprehensive information, as the final detailed engineering design has yet to be finalized, this framework has been prepared using the preliminary information collected through rapid appraisal surveys, socio-economic survey (SES) and consultations with LGUs and selected residents along the project corridor. This framework shall serve as basis for the preparation of the comprehensive LARAP for the project.

5.2.2 Project Description/Rationale

The Philippine Government through the Toll Regulatory Board (TRB) has entered into a contract with South Luzon Tollway Corporation (SLTC) to improve the existing condition of the SLEX and to extend the expressway from Calamba, Laguna to Tayabas in Quezon. The proposed South Luzon Expressway (SLEX) Phase II Toll Road 4 (or TR 4 Project) will ensure faster and safer access to Regions IV and V, and alleviate the worsening traffic congestions in the area. The project will also contribute to the economic development of the growth centres in Regions IV and V and other nearby regions.

The project will involve the construction and operation of a 56.682 km expressway interfacing in SLEX Phase 1 in Calamba. It will comprise four lanes (2 for each direction). Its construction will be divided into five sections. The major components are the main carriageway, bridges, overpasses, underpasses, interchanges, and toll plazas. Other facilities will include drainage system, lighting system, offices, warehouse, service area, stalls, restaurants, gasoline stations, warehouses, and waste management and safety/ emergency facilities and water system, traffic equipment/signages and related appurtenances.

5.2.3 Project Location

The project will interface with the existing SLEX Phase I in Calamba, Laguna, and end in Tayabas, Quezon. The project will traverse 45 barangays located in the following municipalities and cities: (i) Calamba City, Laguna, (ii) Sto Tomas, Batangas, (iii) Alaminos, Laguna, (iv)Tiaong, Quezon, (v) Candelaria, Quezon, (vi) Sariaya, Quezon and (vii) Tayabas, Quezon. The proposed route /alignment will enclose an easement or right-of-way (RROW) limits of 60 meters across. The proposed route is to be adjusted during the detailed engineering design to account for minor geometric alignment.

5.2.4 Alternative Road Design /Minimizing Project Impact and Risks

Alternative project designs have been considered to ensure impacts to people and communities are minimized and risks are avoided and addressed. These include (i) avoiding major earth works and avoidance of existing structures, (ii) address traffic volume,(iii) the situation of the local area,(iv) existing road network, and (v) traffic.

5.2.5 Initial Social Impact Assessment and Inventory

Initial social impact assessment (SIA) was undertaken to determine the potential losses that may be incurred due to the project in terms of physical and economic displacement, translated into loss of assets, land, structures (residential / business/institutional), trees and farm crops, business and livelihood losses.

In undertaking the SIA, google maps were used and rapid appraisal survey was undertaken involving the counting of trees and structures within a 60m ROW, 30m on each side of the alignment from the centre of the road. Coordination with SLTC's Environmental and Safety Manager, LGUs' MPDCs and Municipal Assessor's Office including barangay councils was undertaken during the conduct of social impact assessment. Group discussions with affected communities were also held to further surface APs concerns and issues

The results of the SIA findings will be updated during the final engineering design in consideration of final design changes that may impact along the ROW alignment, particularly, (i) number of persons and structures, (ii) number of potential business losses and (iii) sources of livelihood that will be impacted.

The direct impact area which is within the 60-m ROW alignment traversing 45 barangays, municipalities/cities and covering a length of 56.862 km. Indirect Impact Areas (IIAs) are sites directly outside the 60-meter road-right-of-way alignment, stretching out to 200 meters on both sides of the proposed highway. The lands are primarily residential and agricultural areas. The indirect impact areas may not be adversely affected unlike those assets and structures within the ROW or direct impact areas.

Temporary disturbance may be experienced by residents whose access may be hampered during road project construction activities that may also affect air quality and noise in the area. Impact to economic and livelihood of residents is through re-routing of ways for transportation vehicles may affect time and distance to work place or access to basic services among vulnerable groups such as the elderly, youth and PWDs.

A 100% inventory of assets and losses/census of affected persons is on-going to determine actual land acquisition value, compensation and entitlement, resettlement costs and other related costs of implementing the LARAP.

No Indigenous people or IP communities were identified by the LGUs concerned during the initial impact assessment in the areas to be traversed by the highway or within its vicinity, hence IP Policy (RA8371) does not apply.

5.2.6 Categorization of Impacts based on Initial Social Impact Assessment

The types of losses during construction that have to be mitigated are presented in **Table 5-3.**

Table 5-3: Summary of Social Impacts

Type of Impacts	Number of Units	Remarks
1. Potential number of PAHs to be physically displaced /relocated due to construction	493 PAHs – project affected household	- for updating

Type of Impacts	Number of Units	Remarks
2. No. of potential land owners to be affected	- Agricultural(424) - Residential (542) -Commercial (5) - Industrial (9)	• Project final alignment/ROW width not yet finalized during data gathering to be updated during final engineering phase; • Parcellary maps on the potential ROW has yet to be secured and validated as to current occupant of the land parcel to be affected.
3. Loss of land (potential)	- 247.1 hectares	For updating once ROW alignment is finalized
4. Loss of housing/dwelling units (indicative)	-506 residential structures - 426 secondary structures	For validation and updating as to: - type, floor area, materials used - ownership - severity of impact to be experienced.
5. Loss of trees (potential)	69,341 various tree species	About 10 different fruit trees in various stages of maturity (non-bearing and fruit –bearing) include Kalamansi/citrus, lanzones, rambutan, mangoes, etc. (for validation in terms of number, stage of maturity/age and fruit-bearing/non-fruit bearing)
6. Potential loss of livelihood/income sources	PAFs (to be physically relocated)	For updating - on preference of relocation sites -SES data and skills/type of occupation, and others
7. Loss or temporary disturbance of employment due to relocation of business/institutional structures		For updating -number of employees to be disturbed

The impacts of the project can be classified according to the type of loss which may be (i) structures (residential, commercial and institutional structures), (ii) trees and farm crops, and (iii) land due to acquisition. The range of impacts can be also considered as “minimal” to ”severe” depending on the extent of loss and damage on assets and improvements.

The final LARAP preparation shall consider the extent of loss of all assets and improvements along the ROW and other associated facilities. Inventory of trees shall be done by consultants and the partner agencies (DENR, etc.) whereas land valuation shall be done by an independent appraiser, if required. Roads and creeks/rivers to be affected will be repaired and will be returned to their functional status by the proponent.

Results of the initial impact assessment, which shall be updated during comprehensive LARAP preparation, are as follows:

Impact on Structures

The Project will cause physical displacement of families and economic losses; (i) 506 units of housing structure, 493 of which are residential structures which are generally permanent and 13 structures are stores; (ii) 426 identified secondary structures such as sheds, poultry, farm houses, pavement among others.

Impact on Permanent Trees/Coconut Trees

There are approximately 69,341 various tree species, 27.3% of trees *Cocosnucifera* or coconut tree. Fruit bearing trees include citrus, kalamansi, lanzones, rambutan, mangoes, among others. The loss of coconut trees will be significant, coconut farmers will likely lose their main source of income/or employment as a result of the cutting of coconuts during construction. Economically, this will result in decrease of production in coconut plantations thereby possible impact on supply for processing of cooking oil, copra, and production of biofuel.

Impact on Land

It is also estimated that approximately 247.1 hectares of land shall be required for land acquisition by the project. Classification of ownership status is only indicative. This was based on initial household survey which was the basis in projecting land ownership/tenure. With the availability of the parcellary maps and ongoing parcellary survey, the ownerships of the majority of the affected lots have been established. Final validation are being conducted as to the real owner of the land and the actual occupant. Severity of land impact will be considered for determining extent of loss and valuation.

For land classification and estimated valuation, secondary information has to be obtained from the Department of Finance and Bureau of Internal Revenue to determine the estimated zonal value of land properties and their prevailing market price, through the current market selling price in the specific areas.

The initial masterlist of affected lots is provided in ***Annex R***.

5.2.7 Objectives and Legal Framework

Objectives

The underlying principle of the LARAP Policy Framework is to ensure that all PAFs share in project benefits, and are compensated and rehabilitated to assist them to improve, or at least maintain, their living conditions and income earning capacity at pre-project levels.

Legal Framework

The policy framework within which the Land Acquisition Plan and Resettlement Action Plan (LAPRAP) Framework shall operate is derived from the Philippine Constitution, Republic Act 8974, Environmental and Social Safeguards of the financing institutions and other applicable laws.

This project shall also be governed by the DPWH Department Order 327 Series 2003, on 'Guidelines for Land Acquisition and Resettlement Action Plans (LAPRAPs) for Infrastructure Projects" and LARRIP Policy of 2007, (3rd edition). It provides guidance to those preparing resettlement action plans (RAPs) and safeguards instrument affected by infrastructure projects, whether foreign or locally funded.

The various provisions and prescriptions of laws, policies and guidelines related to operation and implementation of resettlement and land acquisition also forms part of the basic policy and direction of the LARAP preparation. These include the following:

a) Basic National Policy

- Article lll, Section 9: "Private property shall not be taken for public use without just compensation."

b) RA 8974 - An Act to Facilitate the Acquisition of Right-of-Way (ROW), Site or Location for National Government Infrastructure projects (November 2000)

- Implementing Rules and Regulations of RA 8974 provides the different bases for land valuation for the following modes of acquisition, negotiated sale and expropriation.

- The Implementing Rule and Regulations of this law state that the Implementing Agency shall negotiate with the owner for the purchase of the property by offering first the current zonal value issued by the Bureau of Internal Revenue for the area where the private property is located.

- The law also states that valuation of the improvements and/or structures on the land to be acquired shall be based on the replacement cost which is defined as the amount necessary to replace the structure or improvement based on the current market prices for materials, equipment, labor, contractor's profit and overhead, and all other attendant costs associated with the acquisition and installation in place of the affected improvements/installation.

- Method of Negotiation: Under the law, there are different modes of acquiring title to, and ownership, private property particularly real estate property, as well as the modes of acquiring right to use private property for another purpose. RA 8974 specifies the following: Donation, Quit Claim, Exchange or barter. Negotiated Sale or Purchase, Expropriation and any other modes of acquisition authorized by law.

- Zonal value as the first offer. In case the mode of acquisition is through a negotiated sale, the first offer shall be zonal value of the particular land where the property is located, issued by the Bureau of Internal Revenue. In case the owner rejects the first offer, the Department shall negotiate using the values recommended by the Appraisal Committee or Independent Land Appraiser as a guide for negotiation.

- Standards to determine market value. Negotiated sale between DPWH and the PAF based on the following standards to determine the market value:

  - The classification and use for which the property is suited;
  - The development costs for improving the land;
  - The value declared by the owners;
  - The current selling price of similar lands in the vicinity;
  - The reasonable disturbance compensation for the removal and/or demolition of certain improvements on the land and for the value for improvements thereon;
  - The size, shape and location, tax declaration and zonal valuation of the land;
  - The price of the land as manifested in the ocular findings, oral as well as documentary evidence presented;
  - Such facts and events as to enable the affected property owners to have sufficient funds to acquire similarly-situated lands of approximate areas as those required from them by the government, and thereby rehabilitate themselves as early as possible.

- Quit Claim. A quit claim instrument is required to be executed by owners of lands acquired under the Public Land Act because of the reservation made in the issuance of patents or titles thereto. In other words, even if the title or free patent describes the whole area as owned by the patentee or title holders, by operation of the law, a strip of twenty or sixty meters, as the case may be, of that area described is not absolutely owned by him, because it is reserved by the government for public use. Hence, if the government should exercise its right to use the area reserved by it for public use, the owner shall be required to execute a Quit Claim over such area reserved and actually taken by the government for public use.

- This mode can be availed of not only in cases where the lot acquired under the Public land Act is still covered by Free patents but even after the issuance of Certificate of Title or Transfer Certificates of Title because of a series of transactions involving transfer of ownership from one person to another. No payment shall be made for land acquired under the quit claim mode except for damages to improvements, and, if eligible, assistance with income restoration.

- In case PAPs/PAFs are qualified for compensation but with arrears on land tax. To facilitate the processing of payment on land acquired from the PAPs with tax arrears the DPWH will pay the arrears and deduct the amount to the total compensation cost.

- In case the PAPs/PAFs are qualified but already dead and the heirs have not undergone extra-judicial partition, the PAPs/PAFs will be given a grace period to meet the requirement within the validity period of allotment for two (2) years. Beyond two years that the PAPs cannot comply with the requirement they have to settle the case in court.

- In case of Expropriation:

    - **For structures:** In the event that the PAF rejects the compensation for structures at replacement cost offered by the DPWH, the department or the PAF may take the matter to court. When court cases are resorted to either by DPWH through expropriation or by the PAFs through legal complaints, the DPWH will deposit with the court in escrow the whole amount of the replacement cost (100%) it is offering the owner for his/her assets as compensation to allow DPWH to proceed with the works. The PAF will receive the replacement cost of the assets within one (1) month following the receipt of the decision of the court.
    - **For Land:** if the owner contests the Department's second offered value for compensation for land, the PAF or the DPWH may take the matter to court. DPWH shall immediately pay the owner: (a) 100% of the value of the property based on the BIR zonal valuation, and (b) the value of improvements and structures. However, if the owner rejects the full payment, the DPWH will deposit 100% of the BIR zonal in an escrow account. The court shall determine the just compensation within sixty (60 days), taking into account the standards for the assessment of the value of the land. (Sec. 5, RA 8974).

c) Other Applicable laws and policies: Executive Orders, Administrative Orders, and Department Orders

- Commonwealth Act 141, Sec. 112 or Public Land Act- prescribes a twenty (20) meter strip of land reserved by the government for public use, with damages being paid for improvements only.

- Presidential Decree 635 amended Section 112 of CA 141 increasing the width of the reserved strip of twenty (20) meters to sixty (60) meters.

- EO 113 (1995) and EO 621 (1980)
    - National Roads shall have a ROW width of at least 20 meters in rural areas which may be reduced to 15 meters in highly urbanized areas;
    - ROW shall be at least 60 meters in unpatented public land; and
    - ROW shall be at least 120 meters through natural forested areas of aesthetic or scientific value.

- EO 1035
    - Financial assistance to displaced tenants, cultural minorities and settlers equivalent to the average annual gross harvest for the last 3 years and not less than PhP 15,000 per ha;
    - Disturbance compensation to agricultural lessees equivalent to 5 times the average gross harvest during the last 5 years;
    - Compensation for improvements on land acquired under Commonwealth Act 141; and
    - Government has the power to expropriate in case agreement is not reached.

- MO 65, Series of 1983
    - Easement of ROW where the owner is paid the land value for the Government to use the land but the owner still retains ownership over the land; and
    - Quit Claim where the Government has the right to acquire a 20 to 60 m width of the land acquired through CA 141. Only improvements will be compensated.

- Republic Act 6389
    - Provides for disturbance compensation to agricultural lessees equivalent to 5 times the average gross harvest in the last 5 years.

- Article 141, Civil Code
  - Real actions over immovables prescribed after thirty (30) years. The provision is without prejudice to what is established for the acquisition of ownership and other real rights by prescription.

- RA No 7279, Urban Development Housing Act of 1992 (UDHA)
  - The law provides that the local government units, in coordination with the National Housing Authority, shall implement the relocation and resettlement of persons living in danger areas such as esteros, railroad tracks, garbage dumps, riverbanks, shorelines, waterways, and in other public places as sidewalks, roads, parks, and playgrounds. The local government unit, in coordination with the National Housing Authority, shall provide relocation or resettlement sites with basic services and facilities and access to employment and livelihood opportunities sufficient to meet the basic needs of the affected families (Section 29).

5.2.8 Policy on Eligibility, Compensation and other Entitlements

This project will adopt the LARRIP policy (2007) particularly, in terms of determining compensation and entitlement. An entitlement matrix presents the specific basis for compensation for each type of loss, severity of impact and eligibility criteria for each Project Affected Person.

Criteria for Eligibility for Compensation

- Land owners
  - Legal owners (agricultural, residential, commercial and institutional) who have full title, tax declaration, or who are covered by customary law (e.g. possessory rights, usufruct, etc.) or other acceptable proof of ownership.
  - Users of arable land who have no land title or tax declaration
  - Agricultural lessees

- PAFs with Structures
  - Owners of structures who have full title, tax declaration, or who are covered by customary law (e.g. possessory rights, usufruct, etc.);
  - Owners of structures, including shanty dwellers, who have no land title or tax declaration or other acceptable proof of ownership; and
  - Renters

Indicators of Severity of Impact

Properties to be acquired for the project may include the entire area or a portion of it. Hence, compensation for such assets or properties depends on whether the entire property will be affected or just a portion of it.

- Severe- the portion of the property to be affected is more than 20% of the total land area or even less than 20% if the remaining portion is no longer economically viable or it will no longer function as intended. The owner of this property (land or structures, etc.) shall be entitled to full compensation in accordance to RA 8974.
- Marginal- the impact is only partial and the remaining portion of the property or assets is still viable for continued use. Compensation will be on the affected portion only.

Compensation per Category of Assets Affected

The classifications or categories of assets to be compensated include Land, Structures, other Improvements and Crops, Trees and perennials. Described below are the compensation and entitlements provisions for which the PAFs are eligible, per classification of assets affected.

- Compensation for Structures

  - Compensation in cash for the affected portion of the structure, including the cost of restoring the remaining structure, as determined by the concerned Appraisal Committee, with no deduction for salvaged building materials.

- Compensation for other Improvements
  - Compensation in cash at replacement cost for the affected portion of public structures to government or non-government agencies or to the community in case of a donated structure by agencies that constructed the structure.
  - Compensation to cover the cost of reconnecting the facilities, such as water, power, and telephone.

- Compensation for Crops, Trees and Perennials
  - Cash compensation for perennials of commercial value as determined by the DENR or the concerned Appraisal Committee
  - PAFs will be given sufficient time to harvest crops on the subject land
  - Compensation for damaged crops (palay and corn) at market value at the time of the taking. The compensation will be based on the cost of production per ha. pro-rata to the affected area.
  - Entitlement for fruit –bearing trees will be based on the assessment of the provincial or the Municipal Assessor's Office where the project is located.

- Compensation for Land
  - Computation for the replacement cost of the land shall be pursuant to RA 8974. The initial offer to the PAF is the indicated price in the current zonal valuation issued by the Bureau of Internal Revenue (BIR) for the locality where their property is located. If the offered price is not acceptable to the PAF, the second offer will be current market value at the time of the taking, based on the standards prescribed in Sections 5 and 6 of RA 8974.
  - Land swapping if feasible," land for land", will be provided in terms of a new parcel of land of equivalent market value, at avocation acceptable under zoning laws, or a plot of equivalent value, whichever is larger in a nearby resettlement area with adequate physical and social infrastructure. When the affected holding has a higher value than the relocation plot, cash compensation will cover the difference in value.
  - Holders of free patent, homesteads under CA 141, or the Public Lands Act, will be compensated for improvements only.
  - Holders of Certificate of Land Ownership Award (CLOA) granted under the Comprehensive Agrarian Reform Act shall be compensated pursuant to the provisions of RA 8974. However, CLOAs granted under Public Land Act or CA141, land owners shall be compensated for the affected improvements only.

5.2.9 Other Types of PAFs Assistance or Entitlements

- Disturbance Compensation- For agricultural land severely affected the lessees are entitled to disturbance compensation equivalent to five times the average of the gross harvest for the past 3 years but not less than PhP 15,000.
- Income Loss - For loss of business/income, the PAF will be entitled to an income rehabilitation assistance not to exceed PhP 15,000 for severely affected structures, or to be based on the latest copy PAFs tax record for the period corresponding to the stoppage of business activities.
- Inconvenience Allowance in the amount of Php10,000 shall be given to PAFs with severely affected structures, which require relocation and new construction.

- Rehabilitation Assistance (skills training and other development activities) equivalent to PhP 15,000 per family per municipality will be provided in coordination with other government agencies, if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity.
- Rental Subsidy - Will be given to PAFs without sufficient additional land to allow the reconstruction of their lost house under the following circumstances:
  - The concerned properties are for residential use only and are considered as severely affected.
  - The concerned PAFs were physically residing in the affected structure and land at the time of the cut-off date.
  - The amount to be given will be equivalent to the prevailing average monthly rental for a similar structure of equal type and dimension to the house lost.
  - The amount will be given for the period between the delivery of house compensation and the delivery of land compensation.
- Transportation allowance or assistance - If relocating, PAFs to be provided free transportation. Also, informal settlers in urban centers who opt to go back to their place of origin in the province or be shifted to government relocation sites will be provided free transportation.

5.2.10 Entitlement Matrix

The Entitlement Matrix describes the type of loss, application, entitled person and compensation entitlement for the project affected people.

Table 5-4: Entitlement Matrix

Type of Loss	Application	Entitled Person	Compensation/Entitlement
Land (Classified as Agricultural, residential, Commercial or Institutional)	More than 20 % of the total land holding lost or where less than 20% lost but the remaining land holding become economically unviable.	PAF with TCT or tax declaration can be legalized to full title.)	PAF will be entitled to: 1. Cash compensation for loss of land at 100% replacement cost the informed request of PAFs 2. If feasible, land for land will be provided in terms of new parcel of land of equivalent productivity, at a location acceptable to PAFs 3. Holders of free or homesteads patents and CLOA under CA141 - Public Lands Act will be compensated on land improvement only 4. Holders of Certificate of Land Ownership Award (CLOA) granted under the Comprehensive Agrarian Reform Act shall be compensated for land at zonal value 5. Cash compensation for damaged crops at market value at the time of the taking. 6. Rehabilitation assistance in the form of skills training equivalent to the amount of PhP 15,000 per family, if the present means of livelihood is no longer viable and the AF will have to engage in a new income activity.

Type of Loss	Application	Entitled Person	Compensation/Entitlement
		AF without TCT.	1. Cash compensation for damaged crops at market value at the time of the taking. 2. Agricultural lessors are entitled to disturbance compensation equivalent to five times the average of the gross harvest for the past 3 years but not less than PhP 15,000.
	Less than 20% of the total land holdings lost or where less than 20% lost or where remaining viable for use.	AF with ICT or tax declaration (tax declarations that are legalizable to full title.)	PAF will be entitled to: 1. Cash compensation for loss of land at 100% replacement cost at the informed request of PAFs 2. Holders of free or homestead patents and CLOAs under CA 141 - Public Land Act shall be compensated on land improvements only. 3. Holders of Certificates of Land Ownership (CLOA) granted under the Comprehensive Agrarian Reform Act shall be compensated for the land at zonal value. 4. Cash Compensation for damaged crops at market value at the time of taking.
		AF without TCT	1. Cash compensation for damaged crops at market value at the time of taking 2. Agricultural lessor is entitled to disturbance compensation equivalent to five times the average of the gross harvest for the past 3 years but not less than PhP 15,000.
Structures (Classified as Residential/ commercial/ Industrial/ recreational	More than 20% of the total landholding loss or where less than 20% loss but the remaining structures no longer function as intended or no longer viable for continued use.	AF with TCT or tax declaration (tax declaration can be legalized to full title)	AF will be entitled to: 1. Cash compensation for entire structure at 100 % replacement cost 2. Rental subsidy for the time between the submission of completed documents and release of payment on land.
		PAF without TCT	AF will be entitled to: 1. Cash compensation for the entire structure at 100 % replacement cost. 2. Rental Subsidy for the time between the submission of complete documents and the release of payment on land.

Type of Loss	Application	Entitled Person	Compensation/Entitlement
	Less than 20% of the total landholding lost or where the remaining structure can still function and is viable for continued use	PAF with TCT or tax declaration (Tax declarations that are legalizable to full title)	Compensation for affected portion of the structure
		PAF without TCT	Compensation for affected portion of the structure
Improvements	Severely or Marginally Affected	PAF with or without TCT, tax declaration, etc.	PAF will be entitled to cash compensation for the affected improvements at replacement cost
Crops, Trees, perennials		PAF who are owners of crops, trees, and perennials	PAF will be entitled to cash compensation for crops, trees, and perennials at current market value as prescribed by the concerned LGUs and DENR.

5.2.11 Socio-Economic Profile

Updating the PAFs Socio-Economic Profile

During the detailed engineering design (DED), the profile of the PAFs will be updated to serve as basis for designing the resettlement strategy as well as basis for the preparation of the Livelihood and Income Restoration program. Updated information will also serve as benchmark data, disaggregated by gender, which will be used for determining whether there is any improvement in the socio-economic conditions of the PAFs as a result of RAP implementation or to determine changes before and after relocation.

Consultation, Participation and Disclosure

Group discussions (GDs) were conducted in all the 45 barangays with various sectors (women, youth, elderly, farmers, businessmen, landowners. etc.) except for two barangays that deferred consultation until final inventory has been completed to know if there are residents to be affected and the other reason, due to conflict of schedule of activities.

Public consultations were also undertaken with various stakeholders to present the results of the EIA study and at the same time surface further issues and concerns to be mitigated.

Early on the preparation of the study, coordination with the barangays, Municipal LGUs, through their Municipal Development Planning Officers (MPDO) and Engineering office in the affected municipalities was also undertaken for scheduling of EIS preparatory activities. The primary agenda of the meeting was to brief them about proposed project and about the EIA study, their perception of the project benefits, as well as, their concerns.

Generally, various stakeholders were observed to have positive outlook about the project and recommended that the proponent should define mitigation measures for negative impacts such as (i) compensation for assets loss, and (ii) access of PAFs to basic social services and (iii) rehabilitation, in the case families of that will be displaced by the Project.

Since the LARAP will still be prepared during the detailed design study, the project consultant responded to LGU's enquiries that their concerns shall be documented and mitigation measures shall be drawn up during LARAP preparation.

LARAP Consultations/ Planning Workshop

During the preparation of the LARAP, all stakeholders will be informed about the project scope, objectives, benefits and impacts (positive and negatives) including the compensation for affected assets and improvements made on land. Invitations shall be sent and follow-ups shall be done for the affected households to ensure their involvement and participation throughout the process. The consultation meetings shall also pave the way for better understanding and trust between the proponent and the affected people, thus lessening resistance as well as improve acceptance of the project. Consultation shall act as confidence building measure towards more meaningful partnerships between the Implementing Agency and affected people.

Consultation meetings shall be undertaken with the LGU's and partner agencies like DENR, DA, DSWD, PCUP, etc. who shall be involved in the relocation process. Printed pamphlets may be prepared for affected persons to ensure that right information is disseminated. The information shall be short, clear and simple and presented in question and answer type.

LARAP planning workshop will be undertaken to enable the PAFs to evolve their vision and their concept of their new community and basic services that that they envision at the relocation site including their roles and responsibilities. SLTC representative will be invited to join during the planning workshop.

LARAP Disclosure and Endorsement

Before the finalization of the LARAP, it will be presented to the SLTC for its review and approval. After SLTC's approval, it will be disclosed to the LGU and the PAFs for their further comments. If there would be no further comments from the PAFs, the LARAP will be finalized.

5.2.12 Income Restoration and Resettlement Framework

Mechanisms shall be drawn to provide support and income restoration for affected persons who will be relocated and be severely affected in terms of lost assets and sources of income and livelihood. A relocation site shall be identified and developed for people who shall be permanently displaced. The selection of the relocation site shall be crucial in terms of PAF's accessibility to social and economic centers. It shall be imperative to provide various options for relocation site and also organize PAFs' site visits to these locations so that they can assess each option based on their needs and requirements. Relocation shall be coordinated with housing agencies like the NHA and NGOs. The proponent shall be responsible for coordinating with these agencies in identification of potential relocation sites. The PAFs may also want to (i) self-relocate and would just opt for cash compensation for their lost assets and some entitlements or (ii) opt to consider "land only" and choose where they want to resettle and will be given compensation for their lost assets and other entitlements.

The preparation of the LARAP shall be undertaken by the proponent in consultation with the PAFs to ensure ownership of the LARAP during Detailed Engineering Design phase. Basic facilities shall include educational, health and recreational facilities as well as other infrastructure facilities such as roads, drainage, electricity, potable water system, etc. The receiving LGUs shall be involved in the site planning to ensure smooth integration of the PAFs to their new locality and immediate support to them in terms of basic social services and security. The LARAP shall also consider the option of forming an association or cooperative that could take care of PAFs socio-economic needs.

5.2.13 Income Restoration and Livelihood Strategy for Relocatees

PAFs that will be severely affected due to loss of sources of income shall be provided assistance to restore income lost as a result of project implementation. The objective shall be to ensure those severely affected families are be able to restore their economic condition to pre-project conditions or even better. Socio-economic profile will be established as basis for determining the type of mitigation measures and entitlement for the PAFs particularly, (i) livelihood and income strategy,(ii) entitlements including food subsidies, trainings and vocational skills training, (iii) and other types of assistance such as organizing them for referrals needed to enhance basic services at designated relocation sites. Livelihood assistance shall consider the current occupation of affected households and the new skills they want to learn which may include agricultural farming technology, micro-enterprises and micro-finance, marketing, among others. The strategy will either be (i) employment–based and (ii) self-employment-based. For the employment track, aside from technical skills training, job referrals will be provided to those completing the training while entrepreneurial skills and opportunities will be provided to those opting for self –employment, particularly women who are no longer eligible for employment in the formal sector.

Also the PAFs will be prioritized during construction. Potential livelihood activities will benefit the women who may engage in food vending, selling other goods and stuff, etc. at the construction site.

The proponent may list the potential job opportunities during construction and will coordinate with the contractor and the LGUs/barangay councils for potential manpower needs. In addition, there may be potential work needed by the proponent during operations (grass cutting, landscaping, etc.) which will be identified so that members of the PAFs can be trained for these jobs.

The final LARAP shall identify appropriate training intervention as well as assistance to help them set – up new business or start with other productive endeavor. These include capital assistance, business management training and marketing assistance. ”Land for land” or land replacements shall be considered as an option to cash compensation particularly if the affected households are engaged in farming/ agricultural production.

Assistance shall also be given to the vulnerable sectors including single parents, elderly, female - headed households and persons with disabilities (PWDs) focusing on skills and livelihood trainings. During the preparation of the LARAP, the proponent shall draw strategies that will enhance self-reliance among the relocatees such that they do not become too dependent on the government. The host population shall be involved in resettlement planning and improvements and shall also be provided support in improving basic services and livelihood and shall not just be an observer of an on-going development in their community. The profile of the adjacent host communities shall also be established before LARAP planning to determine their own social and economic needs.

5.2.14 Land Acquisition/Compensation Strategy

The proponent shall be guided by RA 8974, EO 1035 and other legal instruments in negotiating with landowners. Based on the provisions of the law, valuation and negotiation procedures shall be undertaken. The DPWH Infrastructure Right-of-Way Manual shall be used to facilitate the purchase of the land needed for the ROW and other facilities of the project in a manner that shall not put the PAFs in a disadvantageous position.

The manual provides the guidelines for establishing the appropriate documentation and data about the land and its legitimate claimant/owner to effectively begin negotiating with land owners. The detailed parcellary and topographic maps are also needed to establish affected properties. It is also necessary to classify the type of claimants. Based on the segregation of claimants the proponent shall be able determine the proper land acquisition procedures to follow.

Public consultation on compensation and ROW procedures shall be conducted to discuss, (i) compensation and entitlements, (ii) ROW procedures, (iii) documents to establish ownership, payment of taxes, identity, court procedures, among others. The consultation shall provide claimants/land owners the opportunity to ask the appropriate questions related to their status and concerns and also assist them in preparation of requisite documents. It will also facilitate the negotiation process as well as the payment for compensation. The master list of legitimate land owners/claimants and compensation and entitlement due to each claimant shall be prepared before negotiation process begins.

Based on the prepared Compensation and Entitlement vis-à-vis the classification of each claimant/affected person, the DPWH will send a Notice with a First Letter Offer which shall formally inform the claimant of the Government’s intent to buy/take the property and make an offer for compensation based on zonal value. A Second Offer may be made by the DPWH pursuant to R.A. 8974 for claimants who would refuse the First Offer. Expropriation is used as the last option if negotiation fails.

In cases where claimants have completed the necessary documents, the ownership of land and improvements have been verified to the satisfaction of all concerned and all documents convincingly show that there are no more impediments to effecting payment, the proponent SLTC shall advance the payment of compensation which will be later requested for reimbursement from the Department of Public Works and Highways. With this procedure, the claimants can be paid compensation faster than usual.

5.2.15 Grievance Redress Mechanism

The implementation of the LARAP may be faced with potential complaints or problems on compensation, project benefits and relocation and rehabilitation issues from Project Affected Families (PAFs). To ensure the resolution of complaints and issues, a Grievance Committee or a Municipal Resettlement Implementation Committee (MRIC) shall be organized to review and assess the subject of complaints and make decisions on the said complaints.

Social safeguards require that mechanisms to receive and facilitate the resolution of displaced persons' concerns and grievances shall be established and that access to and procedures of such mechanisms should be gender sensitive. The PAFs shall be informed during consultation meetings that channels of information for complaints and grievances and related procedures are available for them.

In this respect, grievances with regards to RAP implementation or any aspects of the project shall be handled through negotiations and are aimed at achieving consensus. The procedures to be followed are the following:

- The PAFs lodge their grievances by writing (or written when received verbally) to the MRICs for immediate resolution. Assistance shall be given to persons who are not able to write their complaints.
- If the complaint is not satisfactorily resolved in 15 days or the PAF does not receive any response from the MRIC, the PAF can forward the complaint or file an appeal at DPWH Regional Office (RO).
- If the complaint is not satisfactorily resolved in 15 days or the PAF does not receive any response from the DPWH RO, the PAF can file a legal complaint in any appropriate court of law.

The actual proceedings must also be documented for purposes of future litigations, if any. Information on the grievance procedure shall be simple and clear to ensure PAFs understanding of the process. PAFs shall be paid all administrative and legal fees incurred pursuant to the grievance redress procedures, if AP wins the case. This grievance mechanism option will be disseminated to the PAFs as their right as early as during the consultations during LARAP preparation.

5.2.16 Institutional Arrangements and Implementation

The institutional and implementation arrangement of the LARAP will be finalized during the Detailed Engineering Design Phase. A Project Management Office (PMO) will be set up under the supervision of the SLTC Board to be responsible for overseeing project planning and implementation. Under the PMO set up, the proponent's Environmental Safety and Health Unit, will be responsible for the LARAP planning and implementation of social safeguards (involuntary resettlement and environment) compliance. The DPWH-IROW and Resettlement Project Management Office, a government unit responsible for the development of roads and highways will be involved in land acquisition and expropriation, if necessary.

The planning and implementation of the LARAP, shall also involve the LGUs and key agencies from project preparation to monitoring. The LARAP shall clearly specify the roles and responsibilities and specific tasks of the agencies that will be involved, particularly in the process of social preparation, project implementation and monitoring the progress of the LARAP and evaluating the impact of LARAP implementation.

Some government agencies such as the Housing and Urban Development Coordinating Council (HUDCC), Presidential Commission for the Urban Poor (PCUP) and the Commission on Human Rights (CHR) will ensure national policies are implemented and the relocation as well as eviction of informal settlers is undertaken based on the UDHA law. Specifically, the PCUP is responsible for (i) facilitating the processing and issuance of Demolition and Eviction Compliance Certificate pursuant to EO 152 and (ii) monitoring the demolition of structures during relocation.

The CHR, on the other hand, shall be responsible for ensuring that relocation is undertaken based on existing laws. It shall see to it that relocation of the project affected families (PAFs) is conducted in a humane manner and the rights of all PAFs are protected as provided in the UDHA Law. It shall observe the actual dismantling and relocation activities to monitor the proponents' compliance to the legal requirements of demolition. It shall also investigate complaints involving violations of human rights.

In coordination with the PMO, the Local government units (LGUs) through its Urban Poor Affairs Office (UPAO) shall assist in the identification of potential relocation sites or lands that can be possibly used for housing by PAFs, particularly for those opting for land only or those who can afford to relocate on their own after receiving their compensation for losses. Specifically, receiving LGU shall see to it that the relocatees are integrated into the socio-economic mainstream for them to have more access to social services and LGU support. LGUs/UPAO office shall also be responsible for the design and planning of needed resettlement sites in coordination with the PMO- Environmental and Health safety Unit and government agencies such as the National Housing Authority (NHA).

The receiving LGU will orchestrate the delivery of social services through its local agencies; (i) the DSWD for livelihood and vocational skills training and other assistance for relocatees', (ii) the Department of Education (Dep Ed) for ensuring the relocatees' children are accommodated and enrolled in receiving school and for facilitating the transfer of documents from sending to receiving school and (iii) the local health department for ensuring appropriate health and emergency response during and after relocation. The barangay units will also be responsible for security and peace and order situation at the relocation site through monitoring and mobilization of barangay police force.

The role of NGOs operating in the project area is necessary as they usually work with informal settlers and poor communities. They are supposed to have established partnership with affected communities. In this light, they will be working with the agencies during census and inventory and primarily, in the conduct of social preparation activities. The social preparation activities will entail in depth consultations with affected communities, win their trust and listen to their concerns and issues including their needs at the relocation sites. During this phase, affected communities will be ready to decide on their options: (i) to opt for cash compensation, (ii) to relocate on their own,)(iii) live in a developed resettlement site or (iv) just settle for land and will just be provided with building assistance. The project affected families (PAFs) shall be prepared psychologically before relocation and should be able to set their goal and direction based on the options they are to take.

Selected NGOs shall be working with the resettled families beyond relocation to provide support in the planning and implementation of income and livelihood projects based on their needs and capabilities. They shall also help in the organization of a community association or cooperatives to help the PAFs in their capital formation and savings. The NGOs will also assist in mobilizing resources and inking PAFs with other organizations within and outside their communities.

5.2.17 Institutional Involvement in Pre- Relocation to Post-Relocation Phases

The pre-relocation phase will focus on the plans for the resettlement while the actual relocation phase will mobilize the affected families to the relocation site. The post relocation phase will implement the LARAP assistance program and will monitor progress and assess impact of the assistance on the socio-economic conditions of the PAFs/relocatees.

The specific tasks and responsibilities under each phase including LGUs and partner agencies are presented below:

a) **Pre- relocation Phase**

TASKS/ACTIVITIES	OFFICE/AGENCY
Project orientation / Social Preparation	PMO-SLTC TR 4 Project / DPWH and other Government Agencies / LGU / NGOs / Project Consultants
Conduct of census survey and verification	PMO-SLTC TR 4 Project / DPWH and other Government Agencies / LGU / NGOs / Project Consultants

Conduct of structural inventory / tagging and mapping / parcellary maps/ zonal / market valuations	PMO-SLTC TR 4 Project / DPWH and other Government Agencies(DA,DAR,DENR, Land Bank / LGU / NGOs / Project Consultants (RAP and legal consultants)
Evaluation of data and preparation of master list	PMO-SLTC TR 4 Project / DPWH and other Government Agencies / LGU / NGOs / Project Consultants / LGU / NGOs / Project Consultants
Conduct of Census/socio- economic survey	PMO-SLTC TR 4 Project / DPWH and other Government Agencies / LGU / Project Consultants
Analyze and prepare socio-economic report	Project Consultants
Formulation of relocation options and assistance entitlement package	PMO-SLTC TR 4 Project / Project Consultants
Formulation of beneficiary selection policies	PMO-SLTC TR 4 Project / Project Consultants / LGU, PCUP, UPAO, NGO - (Municipal Interagency Committee)
Organization of beneficiary / Grievance committee	PMO-SLTC TR 4 Project / Project Consultants /LGU, PCUP, UPAO, NGO - (Municipal Interagency Committee
Preparation and issue notice for qualifications and disqualifications	PMO-SLTC TR 4 Project / Project Consultants / LGU / Municipal Interagency Committee
Secure relocation clearance certificate from PCUP	PMO / ESCRU / LGU / UPAO / PCUP

b) Actual Relocation

TASKS AND ACTIVITIES	AGENCY
Conduct of orientation as to relocation requirements as well as compensation scheme	PMO-SLTC TR 4 Project/ Project Consultants / LGU, PCUP, UPAO, NGO - (Municipal Interagency Committee
Preparation of documents for application	PMO-SLTC TR 4 Project/ Project Consultants /LGU, PCUP, UPAO, NGO - (Municipal Interagency Committee)
Organization of dismantling team and transport assistance	PMO-SLTC TR 4 Project / PCUP, CHR, LGU / UPAO, DSWD, POs / NGOs
Conduct of consultation meetings with project affected families (PAFs)	PMO-SLTC TR 4 Project /PCUP, CHR, LGU / UPAO, DSWD
Facilitating actual transfer to the site	PMO-SLTC TR 4 Project / PCUP, CHR, LGU / UPAO, DSWD
Facilitate provision of food for affected families to the site and other support assistance	PMO-SLTC TR 4 Project / PCUP, CHR, LGU/ UPAO, DSWD

c) Post- relocation Phase

TASKS/ACTIVITIES	AGENCY
Implementation of RAP Assistance	PMO-SLTC TR 4 Project / DSWD, Pos / NGOS, LGUs, TESDA, DA, CDA, other Agencies
Implementation of Grievance Mechanism, if issues occur	PMO-SLTC TR 4 Project / LGUs / Grievance Redress Committee
Conduct of formal turn-over of cleared areas and final documentation	PMO-SLTC TR 4 Project / LGUs / UPAO
Livelihood Training Assistance/restoration and other support (capital and marketing assistance)	PMO-SLTC TR 4 Project / DSWD, DOH, TESDA, DA, CDA, and other government agencies
Organizing, Capability Building and Institutional Development	PMO-SLTC TR 4 Project / DSWD, TESDA, other agencies / NGOs
Monitoring and evaluation of the project entitlement, benefits and impact to relocated families	PMO-SLTC TR 4 Project / External Monitoring agency

5.2.18 Budget and Financing

5.2.18.1 Funds for LARAP Implementation

Funds for the implementation of LARAP shall be the responsibility of the proponent. This will include (i) land acquisition; (ii) cost for resettlement; (iii) compensation costs for affected structures, improvements and trees; and, (iv) other benefits and entitlements. Cost for re-constructing community/institutional infrastructures affected during construction to its functional state (barangay hall, power lines, water system, etc.) will also be borne by the proponent.

5.2.18.2 Basis for Cost Estimation for LARAP Budget

All related budget items for LARAP (compensation for land, structures, benefits and entitlement to relocates) is based on current land acquisition and compensation policies, regulations, executive orders and other laws in the Philippines and consistent with international standards.

Compensation for loss of structures shall be at replacement cost without depreciation and deduction for salvageable materials. The replacement cost of construction materials and labor for each structure shall be in reference to the actual dimension of the affected area. The costs of materials shall be based on the prevailing market price of the locality.

5.2.19 Monitoring and Reporting

The LARAP shall specify steps to establish internal and external monitoring and evaluation of resettlement including indicators related to progress of RAP implementation, delivery of assistance and benefits and problems and issues during RAP implementation. With respect to impact and changes of the lives of the PAFs, evaluation shall be undertaken by an external party to ascertain whether due project assistance, the socio-economic conditions of the affected persons have improved or not.

Internal monitoring indicators shall be drawn as basis in measuring (i) project outputs against targets, budget and time frame and (ii) progress and status of the delivery of compensation and entitlements.

External monitoring indicators include the following parameters: (i) basic information on AP households, (ii) restoration of living standards, (iii) Restoration of livelihoods, (iv) levels of PAF satisfaction, (v) effectiveness of resettlement planning and (vi) other impacts.

Appropriate monitoring tools and instruments shall be prepared for monitoring and evaluation purposes. This will include requirements for (i) compliance monitoring to determine whether LARP is implemented as planned, (ii) annual monitoring, to track additional PAFs that will be identified including milestones and progress and (iii) post evaluation monitoring, to determine whether conditions of the PAFs have improved or not and including unintended impacts, if any. The Environment, Health and Safety Unit of the SLEX-TR 4 project shall undertake internal monitoring and reporting based on project requirements.

5.3 Information, Education and Communication (IEC) Plan Framework

5.3.1 Background/Rationale

The Information, Educational Communication (IEC) Plan Framework for the SLEX TR 4 Project is an important tool in establishing harmonious relationship between the proponent and project stakeholders. It opens the line of communication that will critically identify project stakeholders' issues and concerns and possible mitigation measures. The IEC plan goes beyond the objective of providing information or conducting dissemination activities. It focuses on providing on-going interaction between the proponent and stakeholders before and during construction and project operations. It provides information on the milestones and progress of development and issues during implementation stages. More meaningfully, IEC program will inculcate value formation by making the community and residents aware of their roles as project stakeholders. When the IEC program is conducted effectively, it is a significant confidence and trust-building tool for both the project stakeholders and the project proponent.

This IEC Plan is based from the previously submitted EIS. This current document is an enhanced version to suit project developments to date.

5.3.2 Goals and Objectives

The IEC plan will seek to reach a broad-based population of various project stakeholders and sectoral groups that will be directly or indirectly affected by the project. It promotes a better understanding of the issues and concerns of the project stakeholders and the proponent, for the resolution of the issues and concerns through acceptable planned mitigation measures.

The specific objectives are as follows:

1. To provide better appreciation of the project goals and objectives, project description and components, identified impacts and corresponding social concerns and issues on the part of the project stakeholders;
2. To clarify misinformation and vague ideas about the project to reduce negative reactions, threat, as well as informed-decision among project stakeholders;
3. To inform the project stakeholders on the contribution of the SLEX- TR4 project to economic growth and employment, the tollway express project and its components , benefits and gains, potential risks and mitigation measures; and
4. To initially set trust and confidence building initiatives between stakeholders and the project proponent to pursue pro-active approaches and strategies to mitigate potential impacts and to enjoy an equitable distribution of the benefits as a result of project operations.

5.3.3 Approaches and Strategies

The following steps will be used to develop a full IEC Plan Framework:

(i) Stakeholders Identification and Analysis

Identification of the various stakeholders and what they represent, their interest in the project and how it affects their lives, business or group interest. The stakeholders may be represented by government institutions/holders, NGOs, sectoral groups (farmers, land owners, tenants, traders, business establishments, youth, elderly/vulnerable, women, etc.), advocacy and human rights groups, among others. They compose those who will be directly or indirectly affected by the SLEX-TR 4 project.

Various stakes or interests of affected groups are to be considered by assessing their possible benefits and losses, as well as differences in background and culture.

(ii) Assessment of their influence and extent of interest on the project

Assessment will be made to evaluate the extent of interest or the seriousness of the threat or project impact to the various stakeholders. The FGD's conducted as part of the EIS will provide assessment insights.

(iii) Define specific issues and concerns

Identify and define specific issues and concerns expressed in public orientation meetings and/or focused group discussions. Based on the interest and influence of the project stakeholders, their issues and concerns could be identified and analyzed as basis for the type of content and methodology that would be appropriately used. (Refer to Table 5-5: Assessment of Project Stakeholders Concern and focal areas for IEC)

(iv) Selection of appropriate IEC methodology

Project stakeholders' background and profile will be assessed before deciding on most appropriate IEC methodology to be used.

(v) Implement planned IEC approaches and strategies

The proponent will implement planned IEC activities through its Environment, Health and Safety Division targeting various stakeholders all throughout the project phases. On the other hand, EIA social study team will conduct the IEC during the study period. (Note: The EIA Social Study Team conducted FGDs covering all barangays)

A meeting will be held with stakeholders in each of the affected barangays prior to project implementation to discuss details of the project including salient portions of the RAP.

(vi) Evaluation of IEC Plan Implementation

IEC effects and results will be periodically assessed by the proponent to determine its impact and to define improvements on IEC approaches and strategies.

An assessment of the interest or stake, project concerns and issues of project stakeholders including proposed IEC content are presented in **Table 5-5** and **Table 5-6**, respectively.

Table 5-5: Matrix: Assessment of Stakeholders Concerns and Focal Areas for IEC

Project Stakeholders	Level of Stake or Interest/Project Impact	Project Concerns/Issues	Proposed/IEC Approaches/ Content
A. Pre-Construction Phase			
Land owners	High - May experience potential losses and economic displacement - Loss of livelihood and farm incomes	• Fair valuation/ compensation for loss of assets(farm land /crops) • Delayed compensation payments	• Provide information on the project, project phases and mitigation/compensation measures for potential threats and risks
Tenants	High - Loss of livelihood and income from farming - Will affect access to social services such as education, health, etc.	• Availability of Livelihood opportunities and employment • Adequacy of compensation/ benefits	• Information meetings to discuss project objectives, activities, technology to be used, benefits and advantages, potential threats and mitigation measures
		• Anxiety that planned mitigation measures may not be adequate	• Establish working relationship through programs and services. Also employ participatory approach in dealing with their identified problems

Project Stakeholders	Level of Stake or Interest/Project Impact	Project Concerns/Issues	Proposed/IEC Approaches/ Content
			and issues and enable them to tackle such issues through various on-the job-coaching and trainings and seminars. • The empowerment process will enable the directly affected persons to experience positive working relationship with the proponent and will eventually build trust.
Barangay officials and representatives	High - The project site is under their political jurisdiction; represent the interest and welfare of their constituents to be affected. Expects their constituents and the barangay to benefit from the project.	• Unresolved issues of previous project experiences/stories of unpaid compensation payments and inadequate mitigation measures	• Consultation/Information meetings to discuss project objectives, activities, technology to be used, project benefits and advantages, potential threats and mitigation measures
Sectoral groups (women, youth, traders/ businessmen, elderly/PWDs, other vulnerable groups)	High - They may be directly affected in case loss of land and decrease of their agricultural productivity and income	• Anxiety over possible negative impact of the project on environment, their farm production, and income.	• Present mitigation measures including benefits that will be gained from the project (employment and enterprise development assistance)
Church/NGO advocacy groups/Institutions	Medium. - Determined to undertake their mission to advocate against project	• Fear of the future of their children • Concerns and issues on possible impact if Buffer Zone of Mt	• Discuss impacts and mitigation measures if proposed highway traverses the Buffer Zone of Mt Makiling

Project Stakeholders	Level of Stake or Interest/Project Impact	Project Concerns/Issues	Proposed/IEC Approaches/ Content
	that they believe will destroy the environment. - Have high influence on residents specially their parishioners and usually conduct advocacy activities during church services.	Makiling is traversed by the highway .	
Provincial and Municipal Government	High - The project site is under their political jurisdiction; represent the interest and welfare of their constituents to be affected. - Expect their barangay/ constituents to benefit from the project. - Have limited funds to pursue their development plans due to lack of financial resources caused by limited revenues from taxes and other sources.	• Issues on possible threat to agriculture, farming and livelihood activities of their constituents	• Provide information on the project, project phases and mitigation measures for potential threats and risks • Information meetings to discuss project objectives, activities, technology to be used, benefits and advantages, potential threats and mitigation measures • Present/discuss Mitigation Plan for adverse impacts/ for identified losses including the SDP and LARP
B. Project Implementation/ Project Construction			
Primary Stakeholders	High Stake and Interest	• Fear of the inability of the proponent to implement planned	• Discuss role of monitoring committee to oversee the implementation of

Project Stakeholders	Level of Stake or Interest/Project Impact	Project Concerns/Issues	Proposed/IEC Approaches/ Content
		mitigation measures such as benefits, compensation, employment, environmental protection and rehabilitation	construction and operations activities
Secondary Stakeholders a. Barangay Officials b. Sectoral groups (fishermen, farmers, traders, businessmen, sari-sari store owners, etc.) c. Church/NGO advocacy group / Provincial and Municipal Government	High Stake and Interest	• Equitable distribution of benefits and taxes and how each one will benefit from the project	• Discuss how primary and secondary stakeholders will benefit from projects and programs /and the implementation of the provision of benefits, compensation, employment and livelihood activities • Inform the public of ongoing social development activities and employment available to residents as well as other opportunities • Solicit suggestions and feedback in project implementation mechanism status and issues.
C. After Construction /during Operations			
Primary Stakeholders	• High Stake and Interest	• Unfinished task of rehabilitation particularly for APs at the relocation site	• Inform stakeholders of the plan during operations and corresponding responsibilities of stakeholders
Secondary Stakeholders	• High Stake and Interest	• Sustainability of development interventions conducted	• Conduct evaluation of project intervention activities and impact • Conduct/sustain interest of community- base MMT to undertake monitoring even during operations and activate gate keepers from affected communities to provide continuing information and get feedback on their satisfaction of the project benefits and gains.

Table 5-6: Information, Education, and Communication (IEC) Plan/Framework

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy / Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
Primary Stakeholder					
1. Landowners	• Project description and status	Group methods	Invitation letters	Pre-construction	Project expected number of attendees
	• Objective of EIA study/EIA findings • Issues and concerns about the project	Group workshop Group discussions	Individual presentation/Group Discussion	Project Feasibility Phase During the Conduct of EIA Study	Cost of meals Cost of Transportation
	• Building Trust and Confidence	Interpersonal/CO approach	Primer about the project and EIA study / Flip chart		
	• Rights and responsibilities of stakeholders/pro-active response to toll road operations	Deployment of SLEX-TR 4 ESH Staff for continuing dissemination of information / organization of information / gatekeepers and peer facilitators	Audio-visual Home Visits	After EIA Study	Cost of Venue Cost IEC materials
	• Monitoring/creation of MMTs	Group workshop / discussion	Hand-outs on MMT creation, task and responsibilities		
2. Farmers / Tenants	1. Project description and status	Group methods	Invitation letters	Pre-Construction	Project expected number of attendees
	2. Objective of EIA study/EIA Findings	Group workshop	Individual presentation / Group Discussion	Project Feasibility Phase	Cost of meals

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy / Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	3. Issues and concerns about the project	Group discussions Interpersonal / CO approach	Primer about the project and EIA study / Flip chart	During the Conduct of EIA Study	Cost of Transportation Cost of Venue
	4. Building Trust and Confidence	Deployment of SLEX-TR4 Staff for continuing dissemination of information / organization of information / gatekeepers and peer facilitators	Home Visits	After EIA Study	Cost IEC materials
	5. Rights and responsibilities of stakeholders / pro-active response to project operations: Monitoring / creation of MMTs	Group workshop / discussion	Hand-outs on MMT creation, task and responsibilities		
3. Informal settlers / Tenants	• Project description and status	Group methods	Invitation letters	Pre-construction	Project expected number of attendees • Cost of meals • Cost of Transportation • Cost of Venue Cost IEC materials
	2. Objective of EIA study/EIA Findings	Group workshop	Individual presentation/Group Discussion	Project Feasibility Phase	
	3. Issues and concerns about the project	Group discussions	Primer about the project and EIA study / Flip chart	During the Conduct of EIA Study	
	4. Building Trust and Confidence	Interpersonal / CO approach	Home Visits	After EIA Study	

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy / Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	5. Rights and responsibilities of stakeholders	Deployment of SLEX-TR4 Staff for continuing dissemination of information / organization of information / gatekeepers and peer facilitators	Study tours to sites with good practice		
	6. Monitoring / creation of MMTs	Group workshop / discussion	Hand-outs on MMT creation, task and responsibilities		
4.Sectoral Groups (women, youth, elderly/PWDs, other vulnerable groups)	1. Project description and status	Group methods	Invitation Letters	Pre-construction	Project expected number of attendees
	2. Project Impact		One-on-one meetings	During and after EIA Study	Cost of meals
	3. Objective of EIA Study		Primer about the project and EIA study		Cost of Transportation
	4. EIA Findings 5. Issues and concerns about the project (unresolved fear and anxiety over possible negative impact of the project such as loss of land and livelihood, compensation and relocation	Group workshop Group Discussion	Audio-visual presentation	After Conduct of EIA Study	Cost of Venue Cost IEC materials

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy / Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	6. Mitigation measures (benefits from project operations 7. Rights and responsibilities of stakeholders / pro-active response 8. Monitoring / creation of MMTs		Hand-outs on MMT creation, task and responsibilities		
5. LGU: Provincial , Municipal and Barangay Units	1. Project description and status 2. Project Impact 3. Objective of EIA Study/EIA Findings 4. Issues and concerns about the project 5. Mitigation measures/Benefits	Group methods Group workshops Group discussion	Invitation Letters One-on-one meetings Primer about the project and EIA study Audio-visual presentation	Pre-construction During and after EIA Study	• Project expected number of attendees • Cost of meals • Cost of Transportation • Cost of Venue Cost IEC materials
	6. Building Trust and Confidence that mitigation measures will be undertaken	Interpersonal/ CO approach one-on-one meetings			
	7. Rights and responsibilities of stakeholders/pro-active response	group workshop/ discussion	Hand-outs on MMT creation, task and responsibilities		

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy / Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	8. Monitoring/creation of MMTs				
a. Church/NGO advocacy groups	1. Project description and Status 2. Project Impact 3. Objectives of EIA Study/EIA Study Findings 4. Issues and concerns about the project 5. Mitigation measures (benefits livelihood/ employment) 6. Building Trust and Confidence that mitigation measures will be undertaken 7. Rights and responsibilities of stakeholders/pro-active response to project operations: Monitoring/creation of MMTs	Group workshop Group workshop/ discussion Continuing one-on-one meetings with key officers/CO approach	• Invitation letters • One-on-one meetings • Audio-visual presentation • Group workshop/discussion • Audio-visual presentations: Project description/ROW alignment • Hand-out on MMT creation, task and responsibilities	• Pre-construction/ During Feasibility Study • Before and after EIA Study • After EIA Study • After EIA Study and continuing • After Conduct of EIA Study	• Project expected number of attendees • Cost of meals • Cost of Transportation • Cost of Venue • Cost IEC materials
b. Concerned agencies (DENR, DAR, DA, DSWD, DepEd, etc.)	1. Project Description and Status 2. Project Impact	• Group workshop / discussion • Group workshop/ discussion	• One-on-one meetings	• Pre-construction	• Project expected number of attendees • Cost of meals

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy / Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	3. Objectives of EIA Study/EIA findings 4. Issues and Concerns about the project 5. Mitigation Measures/Compensation and Benefits 6. Rights and responsibilities of stakeholders: proactive response to project operations : 7. Monitoring/creation of MMTs	• Group workshop/ discussion • Group workshop/ discussion • Group workshop/ discussion • Group workshop/ discussion	• Primer about the project and objectives of EIA • Group discussion • RAP presentation/ workshop • Audio-visual presentation • One-on-one meetings • Hand-outs on project description , impacts and mitigation measures • MMT creation, task and responsibilities	• During and after conduct of EIA Study • After Conduct of EIA Study • After Conduct of EIA Study • After Conduct of EIA Study	• Cost of Transportation • Cost of Venue • Cost IEC materials

[1] *Alert or Red Flag : early warning*
[2] *Action Level : point where management measures must be employed so as not to reach the regulated threshold or limit level, or to Reduce deterioration of affected environmental component to pre-impact or optimum environmental quality*
[3] *Limit Level : regulated threshold of pollutant (standard that must not be exceeded); point where emergency response measures Must be employed to reduce pollutants to lower than standard limit.*

5.3.4 Guidelines on the Conduct of Information, Education and Communication (IEC)

1) The objective of conducting IEC is to inform through the process of education using the communication mediums. The communication processes shall provide feedbacks to the preparer and the proponent about the stakeholders' understanding of the EIA process and project, the issues and concerns about the project, a well as their suggestions and other inputs.
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2) IEC methods may include the following:
   a) Individual methods, e.g. home visits, personal letters, focus interviews
   b) Group methods, e.g. meetings, study tours, group workshops, Focus Group Discussions
   c) Multi- media, e.g. newspaper publication, radio broadcast, web posting

3) The proponent or preparer may use any or all kinds of information materials in conducting IEC campaigns. These may be in print (e.g. flyers, pamphlets, comics, posters, newspapers, banners) or in other forms, such as video, film, and sound slides.

4) These materials should be:
   a) Prepared in a manner and language that can be easily understood by everybody and should contain balanced and complete information. The information material on EIA should, as much as practical, be in the local language or dialect.
   b) Contain sufficient information including a description of the proposed project, the proponent, the EIA process, and the expected outputs. It shall also include such appropriate studies as evaluation of public health, environment, population, gender, socio-economic, and cultural impacts of the project or undertaking and the appropriate mitigation and enhancement measures.

5) The information drive should at the same time inculcate value formation by making the members of the community aware of their responsibilities as stakeholders.

In the conduct of IEC, it is beneficial to the proponent to engage the services of locally-based Communication or Language Teachers or Community Organizers in planning, implementing, assessing and documenting the conduct of IEC.

6.0 ENVIRONMENTAL COMPLIANCE MONITORING

This section discusses the environmental compliance monitoring, validation and evaluation/audit procedures as per DAO 2003-30. It defines the environmental management to be implemented by SLTC in its area of operation or along TR4 alignment. It aims to ensure the following:

a) Project compliance with the conditions set in the ECC;

b) Project compliance with the Environmental Management Plan (EMP);

c) Effectiveness of environmental measures on prevention or mitigation of actual project impacts vis-a-vis the predicted impacts; and

d) Continual updating of the EMP for sustained responsiveness to project operation and its subsequent impacts.

An Environmental Compliance Certificate (ECC) was issued to the project on July 11, 2014. From the date of ECC issuance up to the present, the commencement of the project has not yet conducted due to the proposed TR4 re-alignment. The re-alignment is being pursued based on the issues and concerns of the stakeholders on the initial TR4 alignment, and from the results of ongoing parcellary survey as input in the final design of the road alignment. The actual commencement of the project will be pursued upon issuance of the revised ECC for the TR4 re-alignment.

The present condition seems not to warrant the submission of Compliance Monitoring Report (CMR) and Self-Monitoring Report (SMR) since most of the ECC provisions are applicable when the project is already being implemented. Besides, some of the ECC provisions are included in the present environmental study that will be submitted as requirement in the ECC revision for the proposed re-alignment. However, the ECC provisions that could be conducted prior to start-up of the project such as the submission of Air Dispersion Modeling Report (ECC Condition #8) and Noise Modeling Report (ECC Condition #9) were already complied. The status of ECC compliance is presented in **Table 6-1**.

Table 6-1: Status of ECC Compliance

No.	Particulars / Conditions	Status	Remarks
	Project Description		
	a) List of Barangays along the TR4 Alignment	For revision based on the re-alignment	Included in the current EIS. *See **Table 1** below*
	b) Project Components	For revision based on the re-alignment	Included in the current EIS. *See **Table 2** below*
I	**Conditions**		
	Environmental Management		
1	Conduct an IEC about the mitigating measures, and the environmental & human safety features of the project. Submission of annual report to EMB Central Office & EMB Regional Office No. IV-A.	For implementation awaiting issuance of revised ECC	No project-related activity in the area to date.
2	Implement a Comprehensive Social Development (SDP) and submission of semi-annual report	For implementation awaiting issuance of revised ECC	No project-related activity in the area to date.

No.	Particulars / Conditions	Status	Remarks
	together with the Compliance Monitoring Report (CMR) to the EMB Central Office, copy furnished the EMB Regional Office No. IV-A.		
3	Implement a reforestation and carbon sink program to mitigate greenhouse gas (GHG) emissions from the project.	For implementation awaiting issuance of revised ECC	No project-related activity (e.g., land clearing, tree cutting, etc.) in the area to date.
	General Conditions		
4	The proponent shall conform to the provisions of RA 6969, RA 8749, RA 9003and RA 9275, and other relevant policies, rules and regulations	For implementation awaiting issuance of revised ECC	No project activity to date.
5.a	A readily available and replenishable Environmental Guarantee fund (EGF)	For implementation awaiting issuance of revised ECC	No project activity to date.
5.b	Multipartite Monitoring Teams (MMT) per segment composed of representative(s) from the local environmental NGO, barangays in the primary impact area, LGUs, and other government agencies and stakeholders concerned.	For implementation awaiting issuance of revised ECC	No project activity to date.
5.c	A replenishable Environmental Monitoring Fund (EMF) to cover all costs attendant to the operation and monitoring activities of the MMTs.	For implementation awaiting issuance of revised ECC	No project activity to date.
5,d	An Environmental Unit (EU) to competently handle the environment related aspects of the project	For implementation awaiting issuance of revised ECC	No project activity to date.
6	The proponent shall ensure that its contractors and sub-contractors strictly comply with the relevant condition of the ECC	For implementation awaiting issuance of revised ECC	No project activity to date.
7	The proponent shall submit to EMB Central Office a Resettlement and Compensation Action Plan prior to project implementation.	Ongoing preparation of Resettlement and Compensation Action Plan	
8	The proponent shall submit to the EMB Central Office an Air Dispersion Modeling Report covering the construction and operation phases within sixty (60) days from receipt hereof.	Air Dispersion Modeling Report submitted on November 12, 2014	
9	The proponent shall submit to the EMB Central Office the revised Noise Modeling Report covering the construction and operation phases	Noise Modeling Report submitted on November 12, 2014	

No.	Particulars / Conditions	Status	Remarks
	within sixty (60) days from receipt hereof.		
10	The proponent shall submit to the EMB Central Office the Environmental Impact Study for the areas covered by the realignment (500 m farther from the original alignment) requested by PGPC and APRI to ensure safety in MakBan Geothermal Steam Field and Power Plant operation, within 60 days from issuance of this certificate.	Included in the current EIS.	
11	The proponent shall submit to the EMB Central Office a Traffic Impact Assessment (TIA) Study within thirty (30) days prior to construction.	For implementation awaiting issuance of revised ECC	No project activity to date.
12	The proponent shall ensure that any activities relevant to the proposed project shall not affect or disrupt the operation of MakBan Geothermal Power Plant and Steam Fields. Therefore, the proponent shall maintain regular coordination with PGPC and APRI towards the formulation of the detailed engineering design, construction, and operation of the project	At this stage, the proponent is coordinating with PGPC and APRI regarding the detailed engineering design of the project	
II	**Restrictions**		
13	No activities shall be undertaken other than what were stipulated in the final EIS. Should there be any expansion of the project beyond the project description or any change in the activity or transfer of location, or realignment , the same shall be subject to a new Environmental Impact Assessment; and	The proposed realignment is the subject of the current EIS.	
14	In case of transfer of ownership of this project, these same conditions and restrictions shall apply, and the transferee shall be required to notify the EMB central Office within fifteen (15) days from the transfer of ownership to allow the necessary changes brought about by such transfer.	Not applicable.	-

6.1 Self-Monitoring Plan

Table 6-2 shows the Environmental Monitoring Plan (EMOP) with Environmental Quality Performance Levels (EQPLS) following the pro-forma provided by DAO 2003-30.

The information shown in **Table 6-2** is the initial monitoring plan based on the result of the conducted environmental impact assessment. As necessary, modification will be incorporated upon the commencement of the project and the formation of the Multi-Partite Monitoring Team (MMT). In addition, regular updates will be done as mutually agreed upon by SLTC, MMT and EMB.

6.2 Multi-Partite Monitoring Framework

South Luzon Tollway Corporation as the proponent of this project will initiate the creation of the Multi-Partite Monitoring Team (MMT) after the issuance of the Environmental Compliance Certificate (ECC). The MMT will consist of members from various sectors to encourage public participation, promote greater stakeholders' vigilance, and to provide appropriate check and balance mechanism in the monitoring of project implementation. **Table 6-3** shows the list of the proposed members of the MMT, the basis of selection, and scope of MMT responsibilities and activities. A Memorandum of Agreement (MOA) between EMB Central Office (EMB-CO) and SLTC based on a pro-forma to be provided by EMB will be executed with conformity of members of the MMT. The MOA signed by the SLTC and the MMT members will be submitted to EMB-CO for final approval within the deadline specified in the ECC.

A MMT Manual of Operation (MOO) shall be formulated by the MMT and should be revised based on applicable policy updates. The MOO shall guide the MMT in planning its activities, operationalizing its functions and managing its performance. It should contain at least the following:

- Membership: selection process, code of ethics, suspension/removal, resignation/replacement process
- Organization: structure, leadership, roles & responsibilities
- Fund Administration and Management
- Activities: meetings, monitoring activities, records keeping, public disclosure, operation and performance enhancement

Considering the extent of the project which will cover the 56.862 km road alignment, the MMT will only consist of representatives with legitimate and significant concerns during the construction phase of the project. During the operations phase, SLTC will establish a Public Information Office – Community Relations Office under the TR4-Quality Environment, Safety and Health (QESH) Office which will address the public concerns. The composition of the MMT will be modified to suit the less complex activities of the project during the operation stage.

Table 6-2: Self-monitoring Plan

Key Environ-mental Aspects per Project Phase	Potential Impacts	Parameters to be Monitored	Sampling & Measurement Plan			Lead Entity	Annual Estimated Cost (PhP)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE													
LAND	1. Siltation of depressed areas	Volume of silt deposited	Site inspection	Once before construction and after heavy rains.	Vicinity of Project Site	Company Environmental Officer and Project Engineer and/or MMT or third party expert (Geologist)	50,000/ sampling activity	Noticeable increase in sediment deposition in the depressed area	TSS ≥ 20 mg/l increase in the adjacent waterbody	TSS ≥ 25 mg/l increase in the adjacent waterbody	Inspection and control of possible source of sediments	Check effectivity of silt containment facility	Removal and proper disposal of sediments from the silt containment facility
WATER	1. Flooding Hazard	Water level/ localized ponding/ flooding; Rain gauge measure-ments	Research on hydrologic related hazards; Flood study	Once before project implementation	Critical water bodies traversing project alignment	Hydrologist; Company Environmental Officer and/or MMT	200,000 (study); 25,000 / monitoring activity	Noticeable presence of water ponds/local floods	Continuous presence of water ponds and local flooding	Long term (more than one week) occurrence of local flooding	Increase frequency (e.g. weekly during rainy season) of monitoring for local flooding and ponding	Conduct of regular monitoring with more frequent monitoring during rainy season	Construction of appropriate drainage system
	2. Siltation of nearby waterbodies	TSS	Water sampling and laboratory analysis by accredited laboratory.	Quarterly or as necessary	Critical water bodies traversing or adjacent to the construction sites	Company Environmental Officer and/or MMT.	10,000 per station	TSS ≥ 15 mg/l increase	TSS ≥ 20 mg/l increase	TSS ≥ 25 mg/l increase	Inspection and control of possible source of sediments	Check effectivity of silt containment facility	Removal and proper disposal of sediments from the silt containment facility

	3. Degradation of the water quality of waterbodies	Oil & Grease, DO, BOD,	Water sampling and laboratory analysis by accredited laboratory.	Quarterly or as necessary	Critical water bodies adjacent or traversing the construction sites	Company Environmental Officer and/ or MMT.	40,000 per station	Oil & Grease ≥ 0.5 mg/l DO ≤ 6.5 mg/l BOD ≥ 4.0 mg/l	Oil & Grease ≥ 1.0 mg/l DO ≤ 6.0 mg/l BOD ≥ 5.0 mg/l	Oil & Grease ≥ 1.5 mg/l DO ≤ 5.5 mg/l BOD ≥ 6.0 mg/l	Inspection and clean-up of oil-water separators Checking of solid waste management and drainage system	Re-orientation on solid wastes and wastewater management. Regular monitoring of in-placed solid wastes management and drainage system	Preventive maintenance and review/ update design of drainage system and strict implementation of solid waste management
AIR	1. Increase in fugitive dust emission;	TSP, PM_{10}	1-Hr air quality monitoring	Once prior to project construction activity and quarterly afterwards; or increased as necessary	Area Sensitive Receptors along project alignment	Company Environmental Officer and/or third party expert (Environmental Specialist) and/ or MMT.	50,000 per sampling station	TSP ≥ 150 µg/NCM PM_{10} ≥ 120 µg/NCM NO_2 ≥ 150 µg/NCM SO_2 ≥ 200 µg/NCM	TSP ≥ 200 µg/NCM PM_{10} ≥ 150 µg/NCM NO_2 ≥ 200 µg/NCM SO_2 ≥ 250 µg/NCM	TSP ≥ 250 µg/NCM PM_{10} ≥ 180 µg/NCM NO_2 ≥ 230 µg/NCM SO_2 ≥ 300 µg/NCM	Continued regular quarterly monitoring; regular maintenance of vehicle and equipment	Dust suppression thru sprinkling of open area;	Management to investigate and implement measures to minimize air pollutant emissions
	2. Increase in air pollutants due to concentration of vehicles and equipment	SOx, NOx											
	3. Increase in ambient noise level	Noise Level	Noise monitoring	Once prior to project construction and quarterly	Outside perimeter of construction sites and Sensitive	Company Environmental Officer and/or third party	10,000/ sampling station	Exceedance over standards within the perimeter	Complaint by nearest community/ receptors	Multiple complaints	Regular maintenance of noise producing	Management to investigate and	Management to investigate and address complaints;

				afterwards; or increased as necessary	Receptor Areas	expert (Environmental Specialist) and/ or MMT.		of the project site			equipment and vehicles	address complaints	Regular maintenance or repair of noise producing vehicles
PEOPLE	1. Physical displacement and relocation of affected households	- Access to amenities and social services at relocation site	- Benefit monitoring	- Quarterly	Relocation sites where affected households are relocated	SLTC TR4 External Monitoring Team	Php 6,000,000 (lump sum budget for monitoring for 3 years)	Number of submitted complaints and grievances	Grievance committee to act on complaints and issues within 15 days from submission of complaints, if valid	Immediate action on unresolved issues	Number of complaints and grievance not acted upon or resolved	SLTC PMO to look into unresolved / types of complaints and grievance	Immediate action on unresolved cases/issues
		- Sources of livelihood and employment at relocation site	- Monitor progress and milestones including issues and problems at relocation site	- Annually									
	2. Losses in residential houses, farm land/ residential land , business/ institutional infrastructure, trees & perennial crops of affected households	Adequacy and timeliness of the payment of compensation for losses at replacement cost	Monitor payment of compen-sation and when received	- Before construction and before relocation	-Relocation site where affected households are relocated	SLTC TR4 External Monitoring Team	Included in monitoring budget	Number of submitted complaints and grievances	Grievance committee to act on complaints and issues within 15 days form submission of complaints, if valid	Immediate action on unresolved issues	Number of complaints and grievance not acted upon or resolved	SLTC PMO to look into unresolved / types of complaints and grievance	Immediate action on unresolved cases/issues
				- Quarterly	-Listing of affected households paid								

	3.Potential exclusion of local labour for employment during construction	Number of local labor hired during construction	- Monitor number of hired laborers	- Monthly	Contractor's listing of laborers from local communities based on MOA signed	SLTC TR4 External Monitoring Team	Included in monitoring budget	Number of submitted complaints and grievances	Grievance committee to act on complaints and issues w/in 15 days from receipt of complaints, if valid	Immediate action on unresolved issues	Number of complaints and grievance not acted upon or resolved	SLTC PMO to look into unresolved / types of complaints and grievance	Immediate action on unresolved cases/issues
	4. Incidence of respiratory ailments near construction site(asthma, coughs,) due to dust and pollution and other communicable diseases (HIV, AIDs STDs)	Number of aliments related to respiratory diseases in nearby communities	Monitor cases of respiratory ailments thru primary and secondary data from health unit	-Monthly	Indirect impact communities near construction sites	SLTC TR4 External Monitoring Team and Municipal Health Unit	Included in monitoring budget	Increase number of respiratory ailments	-MHO to conduct surveillance activities to determine cause of aliments -Contractor to enhance mitigation measure on dust and air as a result diggings -Timing of construction activities	Medical treatment	Set number of health/ incidence of aliments for response action	SLTC monitor contractor for measures of ensuring health safety standards during construction	Continuing monitoring of SLTC-Health and Safety Division and MMT for compliance of health and safety standards during construction
	5. Traffic accidents	Number of traffic accidents during construction	Secondary data	-Quarterly	Construction sites and stretch of the ROW alignment	- SLTC TR4 External Monitoring Team - Brgy. Tanod	Included in monitoring budget	Increase number of traffic accidents	Contractor to ensure proper signage and traffic and construction safety in	Safety mechanisms in place	Immediate checking of safety mechanism in place	SLTC monitor measures implemented by contractor	Continuing monitoring of SLTC-Health and Safety Division and MMT

						- SLTC Highway Traffic Group			place				for compliance of health and safety standards during constructio n
OPERATION PHASE													
LAND -	1. Removal of vegetation and disturbance to wildlife	Survival rates; Growth and development; Species richness	Flora and fauna survey on final road alignment and at the rain forestation sites	Semi-annual during initial two years of operation; Annual afterwards	Rain forestation sites and along the road alignment	Company Environ-mental Officer and/or MMT or third party expert (Ecologist/ Botanist)	150,000 / sampling activity	High mortality of planted seedlings (mortality greater than 30%)	Noticeable reduction in survival/ success rate of out planted seedlings (mortality greater than 50%); and Noticeable decline in plant health and/or presence of pest/disease	Less than 50% survival rate, and/or pest/disease infestation	Implement biodiversity manageme nt plan; Replaceme nt of unsuccessf ul out planted seedlings; and, Introductio n of enhance-ment measures such as removal of weeds, application of fertilizers to improve growth rate and plant health	Increase in monitoring frequency to monthly; Collaborate with experts (UPLB) on rehabilitatio n design & implementat ion of biodiversity managemen t plan	Coordinate with local environme nt offices such as the CENRO, PG-ENRO and DENR 4A and experts to identify causes of pests/ diseases deteriorati on of plant health.

WATER	Flooding / Surface run-off	Water level	Site Inspection	During and/or after heavy rain	Along the alignment and at the outlet of drainage system	Company Environme nt-al Officer/ Project Engineer	Part of project operation	Constricted flow at the drainage outlet	Flooding immediately downstream of the drainage outlet	Flooding along the road alignment	Inspection and maintenan ce of the drainage system	Maintenanc e of the drainage system and implement possible measures to prevent flooding	Review and upgrading the design of the drainage system
AIR	1. Deteriorat ion of air quality due to emission from vehicles	TSP, PM_{10}, NO_2 and SO_2	1-Hr Air quality monitoring	Monthly during the 1st year of operation and reduce monitoring afterwards based on results of monitoring	Sensitive Receptor Areas along project alignment	Company Environ-mental Officer/Proj ect Engineer and/or MMT	50,000 per sampling station	TSP ≥ 150 µg/NCM PM_{10} ≥ 120 µg/NCM NO_2 ≥ 150 µg/NCM SO_2 ≥ 200 µg/NCM	TSP ≥ 200 µg/NCM PM_{10} ≥ 150 µg/NCM NO_2 ≥ 200 µg/NCM SO_2 ≥ 250 µg/NCM	TSP ≥ 250 µg/NCM PM_{10} ≥ 180 µg/NCM NO_2 ≥ 230 µg/NCM SO_2 ≥ 300 µg/NCM	Continued frequency of monitoring; regular maintenan ce of vehicle and equipment	Check and/or supplement revegetation along the alignment	Manageme nt to investigate and implement measures to comply with NAAQS
	2. Increase noise levels	Noise levels	Noise monitoring	Quarterly	Sensitive Receptor Areas along project alignment	Company Environ-mental Officer/ Project Engineer and/or MMT	10,000 per sampling station	Exceedance of NPCC limit within the perimeter of the project site	Complaints by nearest community/ receptors	Multiple complaints	Increase frequency of monitoring, as necessary	Check effectivenes s of installed noise barriers	Manageme nt to investigate and address complaints
PEOPLE	1.Limited access to social services at relocation site/ absence physical amenities at relocation	Water sources; - educational, health and recreational facilities; and lighting facilities	- actual visit at relocation sites	-Quarterly	Relocation sites	SLTC TR4 External Monitoring Team	Included in monitoring budget	Increase number of social problems/ complaints, health issues, school drop-outs, and robbery	- Grievance committee to act on complaints and issues within 15 days form submission of complaints,	-immediate action on unresolved issues	Number of complaints and grievance not acted upon or resolved on basic facilities	SLTC PMO to look into unresolved/ types of complaints and grievance on basic facilities	Immediate action on unresolved cases/issue s

	site							and theft	if valid				
	2. Lack of sustainable alternative source of livelihood and employment	-Number of relocatees have no livelihood /not employed	actual visit at relocation sites	-Quarterly	Relocation sites	SLTC TR4 External Monitoring Team	Included in monitoring budget	Increase number of complaints on unemploym ent / lack of economic opportuniti es	Grievance committee to act on complaints and issues within 15 days from receipt of complaints, if valid	Immediate action on how to increase livelihood opportunitie s for the relocatees	Number of complaints and grievance not acted upon or resolved on unemploy ment	SLTC PMO to look into unresolved/ types of complaints and grievance on lack of employment at the relocation site and develop measures to develop sustainable source of income	Immediate action on developing alternative sources of income
		-Type of livelihood activity undertaken	-list of referrals for job employment										
		-Number of livelihood and skills training undertaken and number of relocatees participating											
		-Utilization of skills learned from training	-list of graduates in skills training										
		-Number of persons receiving capital assistance for chosen livelihood activity											
		-Number of jobs created form skills											

		training/ business enterprise											
	3. Safety of motorists and riding public	-Number of accidents along the highway	Secondary data from SLTC	-Monthly	Along the full stretch of the TR4 alignment	SLTC TR4 External Monitoring Team	Included in monitoring budget	Number of complaints from accidents (poor lighting, signage not in place, etc.	SLTC to look at seriousness of incidents ,and causes	Immediate action to mitigate impacts of incidents	Increase in incidence of traffic accidents and safety including robbery/theft	Cause of complaints addressed by SLTC	Continuing monitoring of safety of commuters and riding public by SLTC
		-Number of theft and robberies faced by riding public											

[1] *Alert or Red Flag : early warning*
[2] *Action Level : point where management measures must be employed so as not to reach the regulated threshold or limit level, or to Reduce deterioration of affected environmental component to pre-impact or optimum environmental quality*
[3] *Limit Level : regulated threshold of pollutant (standard that must not be exceeded); point where emergency response measures Must be employed to reduce pollutants to lower than standard limit.*

Table 6-3: List of Proposed Members of the MMT and their Proposed Role and Responsibilities

<table>
<tr><th>Stakeholder-Members</th><th>Basis of Selection</th><th>Proposed role</th><th>Scope of Responsibilities and Activities</th></tr>
<tr><td>A representative from the following government agencies:

• Provincial Government Environment and Natural Resources Office (PG ENRO of Laguna and Quezon);
• Municipal/City Environment and Natural Resources Office (MENRO/City ENRO-Laguna, Batangas and Quezon);
• Rural Health Unit (RHU) Chief (Batangas, Laguna and Quezon);
• Concerned Barangay Captains</td><td>Government local representatives that are implementing and monitoring the environmental conditions and programs in the project area</td><td>Monitor</td><td rowspan="5">• Conduct quarterly ocular site visit to validate the proponent’s compliance with the ECC conditions and the Environmental Management and Monitoring Plan
• Prepare and submit its report to EMB-CO using EMB-prescribed format at least semi-annually
• Institute an environmental emergency and complaints receiving and management mechanisms</td></tr>
<tr><td>Maximum of 2 representatives from locally-recognized community leaders</td><td>Interested representatives of significantly affected communities from primary impact areas</td><td>Represent concerns from affected communities</td></tr>
<tr><td>A representative from the Makban Geothermal Power Plant</td><td>For coordination purposes</td><td>Represent concern/s regarding affected operations of Makban Geothermal Power Plant</td></tr>
<tr><td>A representative from the University of the Philippines at Los Baños (UPLB)</td><td>For coordination purposes</td><td>Represent concern/s regarding affected operation of Makiling Forest Reserve</td></tr>
<tr><td>A representative from the LGU-accreditedlocal Non-Government Organizations (NGOs).</td><td>Interested representatives of significantly affected sector from primary impact areas</td><td>Represent concern from affected sector</td></tr>
</table>

6.3 Environmental Guarantee and Monitoring Fund Commitment

6.3.1 Environmental Monitoring Fund

The SLTC shall provide funds for the Environmental monitoring Fund (EMF), the amount of which shall be based on the annual work and financial plan (AWFP) to be approved by the EMB-CO. The EMF administration and management shall be prescribed in the MOO and should contain the following provisions:

- Eligible Expenses and Standards
- Preparation and Approval of Work and Financial Plan for the establishment of the amount of EMF
- Management of Fund
- Disbursement and Auditing Procedures

The SLTC shall release the funds based on the EMB-approved AWFP. Initially, the relase of funds should be equivalent to the projected expenses for the first three (3) quarters and succeeding releases shall be done semi-annually upon liquidating the expenses and validating submission of the MMT Report to EMB for the previous reporting period. The SLTC shall conduct regular audit of the EMF and apprise EMB on irregularities, if any.

6.3.2 Environmental Guarantee Fund

As per DAO 2003-30, an Environmental Guarantee Fund (EGF) is required to be set- up by the Proponent and it should be readily accessible and disbursable. The EGF will be used for the immediate clean-up or rehabilitation of areas affected by damages in the environment, and the resulting deterioration of environmental quality as a direct consequence of a project's construction, operation or abandonment. It shall likewise be used to compensate parties and communities affected by the negative impacts of the project. Lastly, the EGF could be utilized to fund community-based environment related projects including, but not limited to, information and education and emergency preparedness programs.

The proponent commits to establish an EGF amounting to **One Million Pesos (PhP 1,000,000.00)** in accordance with the EGF Administration and Management Guidelines outlined in the DAO 2003-30. The abovementioned amount is established considering the following:

- Committed programs in the Environmental Impact Statement;
- Degree of environmental risk involved (based on number and extent of potential damage);
- Valuation of resources most likely to be affected; and,
- The proponent's ability to provide funds for the EGF.

If the EFG will not be sufficient to pay for compensable claims, it will be provided with additional funds to cover the cost of the activities covered by the EGF. Similarly, the Proponent will replenish the EGF should it falls below PhP 500,000.00.

As per DAO 2003-30, the Proponent will ensure that the amount of the EGF will cover the following:

- At the end of the project life, a sufficient amount should be left from the EGF to ensure that rehabilitation, restoration, decommissioning, or abandonment shall be adequately financed.
- The EGF may be increased during the project life span to ensure that the balance shall be sufficient for the abandonment phase.
- The EGF will be adjusted to cover inflation and other factors.
- The required submission to the DENR-EMB of the project's Abandonment Plan shall have a corresponding fund commitment subject to the approval of the DENR or the lead government agency with direct approving authority on the Abandonment/ Decommissioning Plan of the project (i.e., Department of Transportation).

In general, the EGF shall have two (2) major components as follows:

Trust Fund

The trust fund is a form of guarantee instrument, which will be used to compensate aggrieved parties for any damages to life or property; undertake community-based environmental programs; conduct environmental research aimed at strengthening measures to prevent environmental damage; and, to finance restoration and rehabilitation of environmental quality as caused by the project. This could be in the form of insurance, letters of credit, trust fund, and other financial instruments or similar guarantee instruments. Unless extreme circumstances warrant, surety or performance bonds are not acceptable forms of EGF trust fund.

Environmental Guarantee Cash Fund

This component of the EGF shall be earmarked for immediate rehabilitation and compensation of affected communities in case of damage or accidents. It also covers the administrative costs of managing the fund by the MMT-authorized fund manager. The part of the fund for emergency response may be placed in a government bank guarantee, withdrawable within a 24-hour or other short-term notice by the proponent or the MMT. The rest of the Cash Fund may be placed in an interest-bearing account. The interest shall accrue to the Cash Fund. The funds shall be replenished when it reaches a certain level agreed upon by the MMT, which should not be lower than 50%.

A MOA will be established by the Proponent and DENR in consultation with the LGUs and stakeholders' representatives. The MOA will include the formation of an EGF Committee that will manage the fund. The committee will be composed of the proponent, representatives from the EMB Central Office, EMB Regional Office, affected communities, concerned local government units (LGUs), and relevant government agencies identified by EMB.

Aside from the EGF, the proponent will also establish an insurance coverage for the project's assets in accordance with international industry practice.

7.0 ABANDONMENT, DECOMMISSIONING, REHABILITATION POLICIES AND GENERIC GUIDELINES

Abandonment in this context means either of the following: a) termination of operations when the Project reaches the end of its economic life; and b) premature cessation due to *force majeure*.

Transfer of ownership means that SLTC will no longer be the franchise holder of the Project. All responsibilities regarding environmental compliance will be transferred to the new franchisee with the proper document revisions and arrangements with the EMB, MMT, and stakeholders.

The formulation of the detailed Abandonment Plan (AP) will be done and submitted to the MMT and EMB Central Office one year before the actual decommissioning activities. Initial discussion of components and inputs to the SLTC AP are presented below.

The final AP will include a) land or soil restoration, decontamination and remediation if warranted; b) strategies and methods for final rehabilitation of the environment disturbed by the project; and, c) land use suitability of the various land disturbances. The initial components and inputs to the AP in the event of abandonment are:

1. <u>Procedures for the decommissioning of the project components:</u>

   - Personnel Decommissioning Program
     a. Livelihood training
     b. Career development plan for non-retirable personnel
     c. Insurance and Retirement Plans
     d. Dependents Educational Support Program
   - Onsite inspections
     a. Project site
     b. Buildings
     c. Roads
     d. Equipment
     e. Septic vaults
   - Securing of Necessary Permits and Clearances
     a. Safety Permits
     b. DENR-EMB Permits
     c. LGU Permits
     d. Other governmental permits
   - Disassembly and crating
     a. Disassembly and disposal of mechanical and electrical systems
     b. Dismantling of buildings and roads
     c. Disposal of demolished materials
   - Loading supervision for the shipment of the following:
     a. Unused fuel and consumables
     b. Scrap materials, spare parts and equipment
   - Clearing, leveling and vegetation layering

2. <u>Transport/disposal of equipment and other materials used</u>
3. <u>If required, remediation of contaminated soil and/or waterbody</u>
4. <u>Alternatives for the future use of abandoned alignment.</u>

The following is a summary of the wastes to be expected as a result of abandonment:

<u>Building and Road Demolition Wastes</u>: The waste building materials, packaging and rubble resulting from renovation, repair and demolition of pavements, buildings and structures.

Bulky Wastes: Solid wastes such as appliances, furniture and other oversized wastes which due to their large size preclude or complicate their handling thru normal solid waste collection, processing or disposal methods.

Special Wastes: Wastes that may have particular health, safety and environmental concerns. These include lighting wastes, electrical components (e.g., oil containing switches and transformers), appliances and other equipment (e.g., refrigerators and air conditioning compressors containing refrigerants and oils), waste lubricants, and other fluids. The following will be completed before and during the demolition activities:

- Ensure that the contractor(s) have developed a Waste and Recycling Plans for the demolition activity.
- Consider manual deconstruction and salvage techniques to recover valuable materials.
- Verify that special wastes with particular health and safety, handling and disposal concerns have been identified prior to any renovation or demolition activities and that these materials have been addressed in the health and safety plans.
- Segregate demolition wastes to facilitate on-site, off-site reuse or recycling.
- Proper accumulation and storage of demolition wastes to minimize run-on and runoff. Provide appropriate sediment and vector controls to minimize water infiltration and other weather damage to waste materials.
- Use of appropriate procedures for the management of special wastes.
- Transport wastes in vehicles that meet regulatory requirements and ensure that the materials are covered and/or bundled so as to prevent spillage during transport.
- Proper disposal of wastes that cannot be reused, recycled or composted.

Proper recording of demolition debris during transport and disposal.

8.0 INSTITUTIONAL PLAN

The main thrust of the Institutional Plan is to establish essential organizational components that will implement the proposed Environmental Management and Monitoring Plan as well as provide the necessary mechanism that will strengthen organizational relationship of the proponent with stakeholders and government agencies.

8.1 Safety, Health and Environment Division

The existing organization set-up of SLTC has a Safety, Health and Environment Manager (SHE Manager) who is responsible for its projects' compliance with the safety, health and environment rules and regulations. The TR4 will be included among the SLTC projects that will be managed by the SHE Manager relative to its compliance with the safety, health and environment rules and regulations. The SHE Manager will also manage the implementation of Environmental Management and Monitoring Plan for the project and in the coordination with EMB-DENR, MMT, other concerned agencies, and stakeholders. She will be assisted by the SLTC support personnel in coordinating with the project contractors for the plan implementation. The contractors will be responsible in the actual implementation of the Environmental Management and Monitoring Plan while the SHE Manager will oversee, guide and assist them to ensure the compliance.

Figure 8-1 shows the recommended organization setup for the project.

8.2 Environmental Management and Monitoring

The Environmental Management and Monitoring Plan will be included in the Contractor's Agreement to explicitly define the contractor's responsibility in its implementation. The contractor will designate environment personnel who will spearhead the monitoring and implementation of the environmental plan. Orientation of the personnel and workers to the applicable provisions of the environmental plan and/or their formulated environment regulations will be conducted to get the former support in the implementation. The contractor will be reporting regularly to the SHE Manager on the status of the plan implementation and compliance with environmental rules and regulations. The SHE Manager or her designated personnel could conduct inspection to check the contractor's implementation of the Environmental Management and Monitoring Plan vis-à-vis its compliance with the environmental rules and regulations

8.3 Health and Safety

The contractors will designate its Health and Safety Officer (HSO). Comprehensive health and safety programs and guidelines will be formulated by the HSO in coordination with other key personnel of the SLTC (e.g., SHE Manager, Technical Manager, and HR Manager). The applicable guidelines will be made clear to the contractor's personnel during the construction phase and to the operation personnel if the TR4 operation will also be contracted.

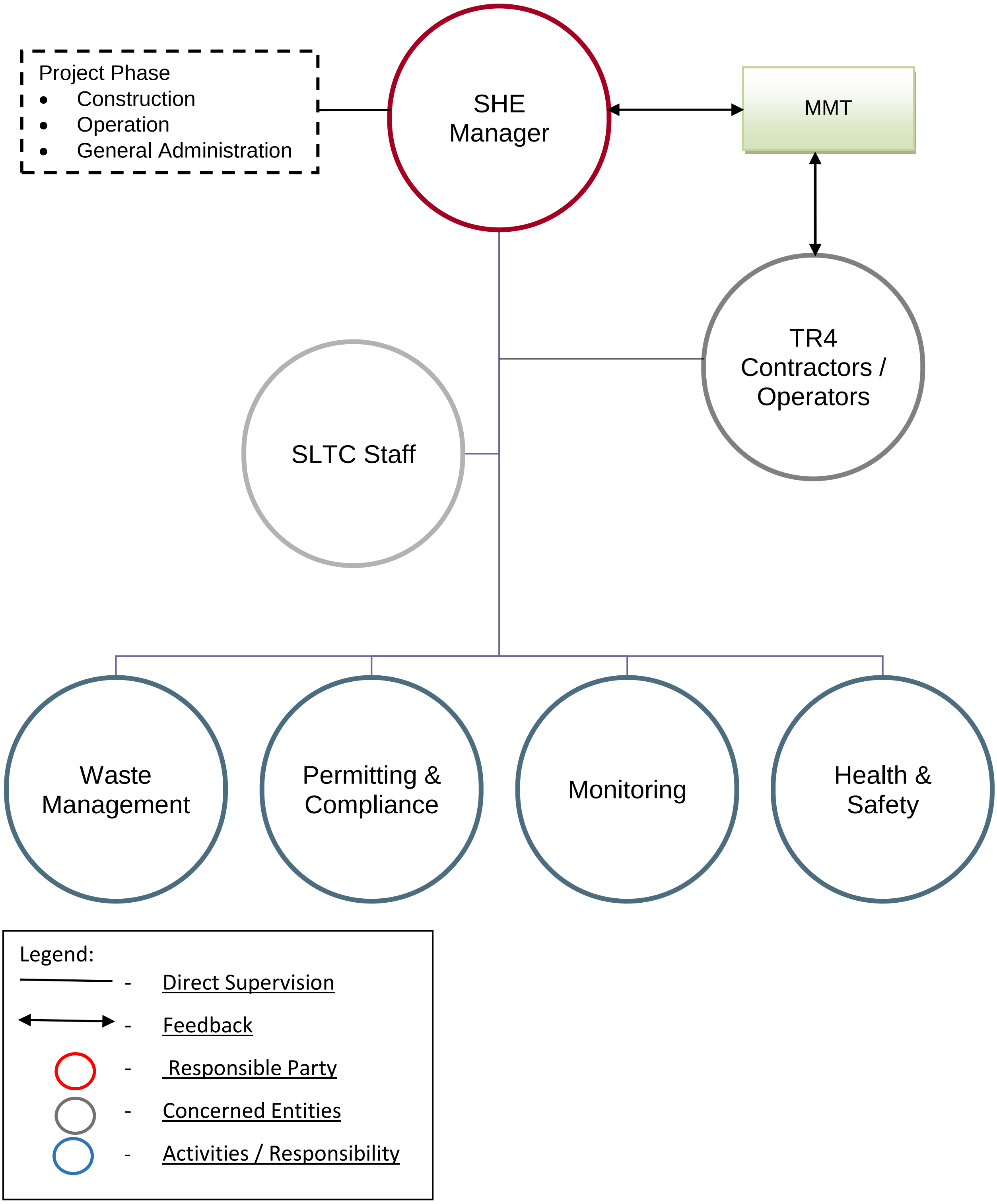

Figure 8-1: Proposed Organizational Set-up

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