Environmental Assessment Report

Summary Environmental Impact Assessment
Project Number: 40198
May 2008

Socialist Republic of Viet Nam:
Ho Chi Minh City–Long Thanh–Dau Giay Expressway Construction Project

Prepared by Vietnam Expressway Corporation for the Asian Development Bank (ADB).

CURRENCY EQUIVALENTS
(as of 17 March 2008)

Currency Unit	–	dong (D)
D1.00	=	$0.0000625
$1.00	=	D16,000

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	biological oxygen demand
CEPT	–	Center for Environmental Protection in Transportation
CO	–	carbon monoxide
COD	–	chemical oxygen demand
DONRE	–	department of national resources and environment
EIA	–	environmental impact assessment
EMP	–	environmental management plan
EMU	–	environment management unit
HCMC	–	Ho Chi Minh City
HIV	–	human immunodeficiency virus
HC	–	hydrocarbon
JBIC	–	Japan Bank for International Cooperation
MONRE	–	Ministry of Natural Resources and Environment
NH	–	national highway
NO_2	–	nitrogen dioxide
PAP	–	project-affected person
PPTA	–	project preparatory technical assistance
PSC	–	project supervision consultant
SO_2	–	sulfur dioxide
SAPROF	–	Special Assistance for Project Formation
SS	–	suspended solids
TSP	–	total suspended particulates
VEC	–	Viet Nam Expressway Corporation

WEIGHTS AND MEASURES

$\mu g/m^3$	–	microgram per cubic meter
ºC	–	Celsius
dB	–	decibel
dBA	–	A-weighted sound level in decibels
km	–	kilometer
L_{eq}	–	equivalent continuous noise level
m	–	meter

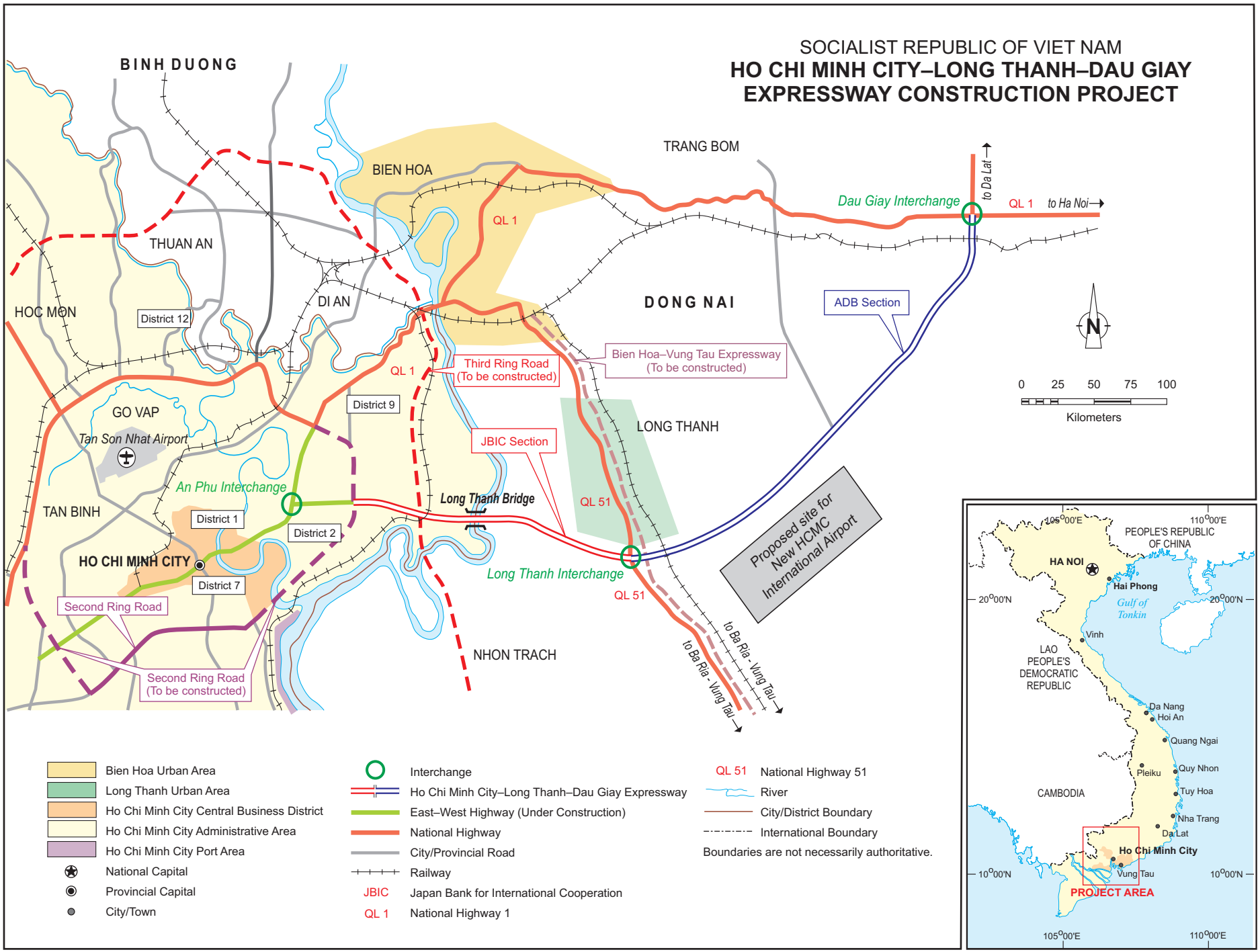
NOTE

In this report, "$" refers to US dollars.

CONTENTS

SOCIALIST REPUBLIC OF VIET NAM

HO CHI MINH CITY–LONG THANH–DAU GIAY EXPRESSWAY CONSTRUCTION PROJECT



- Bien Hoa Urban Area
- Long Thanh Urban Area
- Ho Chi Minh City Central Business District
- Ho Chi Minh City Administrative Area
- Ho Chi Minh City Port Area
- National Capital
- Provincial Capital
- City/Town
- Interchange
- Ho Chi Minh City–Long Thanh–Dau Giay Expressway
- East–West Highway (Under Construction)
- National Highway
- City/Provincial Road
- Railway
- JBIC Japan Bank for International Cooperation
- QL 1 National Highway 1
- QL 51 National Highway 51
- River
- City/District Boundary
- International Boundary

Boundaries are not necessarily authoritative.

08-1351 EG

I. INTRODUCTION

1. The proposed Ho Chi Minh City (HCMC)–Long Thanh–Dau Giay Expressway Construction (the Project) will receive funding from the Japan Bank for International Cooperation (JBIC) for the first 20 kilometers (km); the Asian Development Bank (ADB) will finance the remaining 31 km. As part of the ADB project preparation technical assistance (PPTA), Finnroad (the consultant) prepared an environmental impact assessment (EIA) for the entire expressway consistent with ADB's *Environment Policy* (2002) and *Environmental Assessment Guidelines* (2003). Sources of information for the EIA include the Government's EIA prepared by the Center for Environmental Protection in Transportation (CEPT), the Special Assistance for Project Formation (SAPROF) study prepared by JBIC in 2007, and additional environmental baseline data collected by the consultants. The Government's EIA is available in English and was used as reference in the preparing the EIA for the PPTA. The Project's covenants will specify that the Government of Vietnam (GOV) will implement the provisions of the PPTA EIA and environmental management plan (EMP). The consultants held two series of public consultations during the assessment.

2. Vietnam Expressway Corporation (VEC), the Executing Agency for the Project, commissioned CEPT to undertake the environmental assessment. The Government's EIA was submitted to the Ministry of Natural Resources and Environment on 18 July 2007 and approved on 31 October 2007.

3. This summary EIA briefly describes the Project, existing environmental conditions in the project area, anticipated environmental impacts and corresponding mitigation measures, public consultation process, and environmental management and monitoring plan.

II. DESCRIPTION OF THE PROJECT

4. The approximately 50.9 km project expressway is located in the country's major southern economic area. The Project will contribute to improving transportation systems and supporting economic development in the area. It will help businesses in three large economic centers in the south: HCMC, and Ba Ria Vung Tau and Dong Nai provinces. The Project will shorten the current journey from HCMC and Mekong Delta provinces to Vung Tau. It supports the establishment of Long Thanh International Airport, which will serve expanded international and national traffic.

5. The JBIC section starts at km 4+000 (at the intersection with Ring Road 2) up to km 23+900 at the intersection with National Highway 51 (NH51) located at the southern end of Long Thanh town. The ADB section starts at the NH51 intersection (km 23+900) and ends at Dau Giay interchange (km 54 +983), where it meets NH1.

6. The Project involves construction of 21 bridges, of which 20 are small or medium size. The large Long Thanh bridge in the JBIC section will be 1,721.44 meters (m) long and 19.75 m wide; its base will be 110 m long and 30.5 m high. For the purpose of this study, the bridge is assumed to be a reinforced concrete box girder, although other options may be considered during detailed design. An approximately 6.4 km long viaduct will be constructed along the JBIC alignment.

7. The expressway will be a four-lanes toll road, with access initially restricted to three locations: the intersection with Ring Road 2, the intersection with NH51 at the southern end of Long Thanh town, and at Dau Giay. Toll plazas will be provided at all three interchanges; the

interchange with NH51 will have toll booths on the approach ramps, not on the expressway itself. While the locations of the interchanges have already been identified, details pertaining to layout and corresponding land acquisition requirements will be determined during the detailed design. Further intersections may be provided, particularly with the planned ring road 3 and expressway from Bien Hoa to Vung Tau. In addition, two service areas are planned.

8. The Project is intended to be completed by the end of 2011. VEC has established the Southern Expressways Management Unit in HCMC to be responsible for managing the detailed design and construction of the expressway. VEC will manage operation of the expressway.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

1. Climate

9. The project area has a monsoon tropical climate with two seasons: dry and rainy. The climate conditions are rather stable. Annual average temperature is approximately 27º Celsius (C). The temperature varies only slightly; the difference between the hottest and coldest months is between 3ºC and 4ºC. Temperature fluctuations between day and night times are rather high, approximately from 7ºC to 8ºC. The rainy season is from May to November (with 90%–95% of total annual rainfall), coinciding with the dominance of the southwest wind. The dry season runs from December to April (with 5%–10% of total annual rainfall), coinciding with the dominance of southeastern winds. Annual average rainfall is from 1,347 to 1,896 millimeters/year, with 103–159 rainy days per year.

2. Topography, Geology, and Soils

10. The project area can be divided in two sections according to topographical conditions: An Phu–Long Thanh section and Long Than–Dau Giay section. The first section (JBIC section) starts from HCMC at the intersection with Ring Road 2, which is currently under construction. The project section between Ring Road 2 and Long Thanh is sunken: altitude varies from 0.0 m to 1.0 m. In this section the expressway goes through rice fields with rivers and ditches. The topsoil layer consists of soft or very soft clayey mud, with the thickness of the very soft soil layer varying from about 4 m to 20 m with high void ratio and settlement compression.

11. The second road section (ADB section) from Long Thanh is in the transitional area between the plain of Dong Nai River and the Xuan Loc Highlands. The topography is mostly gently sloping with the end section being strongly divided by high hills and big rivers. The altitude of the section varies from 1.5 m in Long Thanh town to 150 m in the Dau Giay area. The average slope is 1%. The foundation of Long Thanh–Dau Giay section consists mainly of stiff or very stiff clay; clayey sand with laterite nodules; medium dense, fine, and coarse sand; and sand with gravel.

12. Erosion problems, particularly in the JBIC section, mainly concern Dong Nai River, which is affected by the tide regime and activities along the river, including the excavation of sand. In addition, a landslide- and erosion-prone site was identified in Binh Sonh commune (km 30+200), where the ADB section of the expressway crosses a small stream with a very steep and unstable embankment.

3. Hydrology

13. The JBIC section of the road in the An Phu–Long Thanh area is located downstream of Dong Nai and Sai Gon rivers, and is accordingly affected by floods on Dong Nai. The area is influenced by the semitide regime of the East Sea with water level fluctuations from 3.5 to 4 m. This section has many rivers and channels, including the Dong Nai, Ong Nhieu, Tac, and Kinh rivers; and Dong Ngoai, Ong Cai, and Ba Hien channels, which all converge at the main rivers of Dong Nai and Saigon.

14. Along the ADB section from Long Thanh to Dau Giay are some small rivers or streams such as Nhan, Bung Mon, Trau, Cau Mon, and Ram. Particularly near the end of the section at the Thong Nhat district, the project area is partitioned by high hills and big streams. This area is affected by the Dong Nai river flood regime. The flood season on Dong Nai River usually lasts from July to October or November with a water volume up to 80%–85% of the total water mass in a year.

4. Surface and Groundwater Quality

15. Surface water quality analyses show that except for the sampling location near Ring Road No. 2 along the JBIC section, the other three locations (one of which is along the ADB section) exceeded allowed levels for domestic use for biological oxygen demand, chemical oxygen demand, dissolved oxygen, and suspended solids. This is probably due to run-off from surrounding areas during the rainy season. Coliform in a sample collected in Dong Nai River at the JBIC section exceeded the allowed limit. Other measured parameters, like nitrate, heavy metals, sulfur, and oil are within the Vietnamese standards for surface water quality.

16. Groundwater monitoring shows that the water quality is generally good, except for coliform, which exceeded the standard in all four stations established along the JBIC and ADB sections. This is caused by contamination from domestic activities and drilled wells, which over 95% of households use as a water source. All other measured parameters are below the prescribed limits.

5. Air Quality

17. The project area is mostly agricultural land with fairly good background air quality. However, air quality is adversely affected by traffic on the highways intersecting the Project. At the Long Thanh interchange with NH51 (where the JBIC and ADB sections meet), the concentration of total suspended particulates exceeds the permitted level. Also other pollution parameters, such as carbon monoxide, sulfur dioxide, nitrogen dioxide, and hydrocarbons in the Long Thanh interchange are higher than in other locations, but within the permitted limits.

Table 1: Air Quality
(hourly average)

Location	Concentration (mg/m^3)				
	SO_2	NO_2	CO	TSP	HC
Intersection with the Ring Road No. 2	0.047	0.032	2.15	0.08	1.55
Dong Nai River	0.073	0.051	2.73	0.07	1.90
Intersection with the NH51	0.109	0.099	7.10	0.36	3.00
Intersection with the NH1	0.079	0.081	5.33	0.14	1.62
TCVN 5937:2005	0.35	0.2	30	0.30	—

— = not available, CO = carbon monoxide, HC = hydrocarbon, mg/m^3 = milligram per cubic meter, NH1 = National Highway 1, NH51 = National Highway 51, NO2 = nitrogen dioxide, SO2 = sulfur dioxide, TCVN 5937:2005 = Vietnamese standards for air quality, TSP = total suspended particulates
Source: Consultant's field survey in August 2007

6. Noise and Vibration

18. Noise levels at the project area are generally below the Vietnamese Standard (TCVN 2549:1998). However, they exceed the limits at the interchanges with NH51 (JBIC and ADB sections) and NH1 (ADB section) because of the heavy traffic. The vibration levels at the Long Thanh Intersection (NH51) slightly exceed the permitted levels (TCVN 7210:2002).

Table 2: Noise Level
(from 6h00 to 18h00)

Location	Noise Level L_{eq} (dBA)
1. Intersection with Ring Road No. 2	43.7
2. Dong Nai River	40.6
3. Long Thanh interchange	80.6
4. Intersection with the NH1	79.8
TCVN 2549:1998	60 (residential areas)

dBA = A-weighted sound level in decibels, L_{eq} = equivalent continuous noise level, TCVN 2549:1998 = Vietnamese standards for noise levels
Source: Consultant's field survey in August 2007

7. Soil Quality

19. CEPT's 2006 sampling data show that the quality of soil collected from the JBIC and ADB sections is generally good, with levels of various parameters, including heavy metals and pesticides, below the Vietnamese standard.

B. Ecological Environment

1. Ecosystems

20. The project area consists mostly of an agroecosystem with extensive paddy fields along the JBIC section and rubber tree plantations along the ADB section. The alignment includes mango orchards, various fruit trees, lotus ponds, and grasslands. The area has no sensitive

areas, such as national parks, protected areas, or special use forests within or near the proposed expressway. Little natural environment remains and no natural forests.

2. Wetland Resources

21. The JBIC section of the expressway crosses a wetland area at the Long Thanh bridge site by Dong Nai River. Approximately 80% of this area is agricultural land with lotus ponds, paddy fields, and sugarcane fields. Natural land remains only in mosaic patches. Water birds occasionally migrate there, but the bird flock is small (around 50 individuals) and not an endangered species.

3. Flora and Fauna

22. The plant species found throughout the project area are both domestic and wild plants found on agricultural land used by households. For example, coconut, rambutan, durian, mango, grapefruit, and sugar apple are grown in fruit gardens. Plants such as peanut, bean, sesame, and corn are cultivated. Pigs, cows, chickens, and ducks are raised in the area.

4. Fisheries and Aquatic Biology

23. Fish cultivation in ponds is common especially in the area from HCMC to Long Thanh along the JBIC section. Common fish species in rivers and streams include anabas, carp, amur, mud carp, eel, and goby. Rare or endangered species have not been found in the project area.

C. Socioeconomic Environment

1. Cultural, Historical, and Tourist Sites

24. Six shrines and a church are located within 300 meters from the expressway alignment. Of these, Phuoc Loc Temple is classified as a provincial cultural heritage site; it is located in Long Thanh town, 230 m from the alignment. Truong Khanh Shrine in Long Phuoc is only 15 m from the expressway. These sites are all located along the JBIC section.

2. Socioeconomic Profile

25. The Project will be located in HCMC and Dong Nai Province, which are among the areas with the lowest poverty rates (10.33% as of 2002) in the country. As such, the Project will have limited impact on poverty reduction. However, improved transport infrastructure is critical for sustained rapid economic growth and overall poverty reduction in the country. The expressway will contribute to regionally balanced and equitable economic growth by stimulating agricultural production, increasing access to employment opportunities, and facilitating better access to social services. Road connectivity with roads linking to the expressway will contribute to poor people’s ability to benefit from economic growth in the long run.

26. The expressway will run through mainly urban and rural/semiurban areas. Ethnic minorities account for only 1.4% of the population in the project area. The ethnic minority data reveal no significant differences and impacts vis-à-vis the larger ethnic population concerning services, occupation, and income.

3. Local Economy

27. In HCMC (JBIC section), the project alignment begins from residential areas continuing to mostly agricultural land. People in this area mainly live on agriculture, services, aquaculture, and small-scale industry (of which agriculture accounts for 70%). Many are involved in small business both in HCMC and Dong Nai Province, with most households involved in operating a stall. Average income per capita in the first section of the Project is around D350,000/month.

28. The route section from Long Thanh town to Dau Giay (ADB section) passes through residential areas of Long Thanh town, Binh Son, and Dau Giay. Rubber plantations provide employment opportunities; agriculture is practiced, including cultivation of rice and fruit, as well as raising of domestic animals. The average income per capita is around D300,000/month.

4. Land Use

29. Plans are in place for several large development schemes in the project area. The Government has approved the Long Thanh Airport project, which will add to the traffic volume between HCMC and Long Thanh. An express railway to be constructed during 2010–2015 will affect a residential area in Phu Huu ward in HCMC. New residential areas are planned near the airport site in Long Thanh and Long Phuoc ward. In Long Phuoc, plans are in place for a tourism area and a university/college. On Dong Nai River, a new bridge is to be built at the existing ferry sight in Nhon Trach.

IV. ALTERNATIVES

30. **No-Action Alternative.** The alternative of not building the expressway would worsen traffic congestion on existing roads and hinder economic development.

31. **Other Transport Modes.** Alternative transportation modes are currently not available to serve transportation needs.

32. **Alternative Alignments.** The expressway is an important part of North-South Expressway axis and is needed to meet transport demand to the Long Thanh International Airport, reduce the transport distance between Delta and Southern provinces, and solve urgent demand for transportation within the project area with regard to current congestion problems and plans to develop new residential areas. The feasibility study did not discuss alternatives to the project alignment because the location of the expressway is determined by the overall plan including various other road projects. However, within the alignment, recommendations have been made to adjust certain sections, specifically, from km 30+00 to km 30 +500 where the road section will be located adjacent to areas that are highly prone to landslide and erosion. These conditions could make the road foundation unstable and/or require high construction and/or maintenance cost. As such, the EIA recommends moving the road corridor beyond the area of slide influence. This can be achieved by extending to the south the transition point of the curve preceding and curve following the landslide and erosion prone area thus shifting the road centerline southeast some 50–100 m. The other area where adjustment to the geometric alignment is recommended is on the approaches to Song Nhan Bridge at km 49 +275. The approach from NH1 combines both a horizontal and vertical curve, which impedes sight distance and does not provide for a safe approach to the bridge. It presents a dangerous situation for high-speed traffic, and does not conform to road safety standards. The horizontal alignment is proposed to be adjusted after investigation during the detailed design. In 2005, the Government commissioned a national firm to assess land acquisition impacts of the Project.

Based on the study, adjustment to the alignment was proposed starting at km 46+500 to the end of the project road at Dau Giay to minimize impacts to populated areas, agricultural land, and religious structures.

33. **Alternative Design.** From around km 4+000 to km 10+800, the feasibility study proposes replacing an embankment structure with soft ground treatments, with a 6.4 km viaduct structure. This is recommended because (i) the section is being developed as a suburban area of HCMC, therefore, the application of viaduct structure will not cause community splits by the expressway in this area; and (ii) the viaduct option will assure the steady progress of construction and completion within the scheduled period without being hampered by issues related to soft ground treatments such as unforeseen longer initial settlement period or unavoidable secondary compression.

V. ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

A. Impacts during Preconstruction

34. To minimize possible negative impacts of the Project, a hydrological study of the Dong Nai River will be conducted to assess the impacts of Long Thanh bridge construction at the JBIC section. Alternative design options and mitigation measures will be considered. Specific measures to avoid erosion on the Dong Nai and other rivers and streams will be formulated. The sensitive receptors along the project alignment are mainly concentrated in residential areas of Long Thanh town (JBIC section) for which mitigation measures have been formulated. The recommended detailed acoustic assessment may need to be conducted during detailed design along the ADB section if sensitive receptors are located in the immediate vicinity of the alignment. Current project information, however, indicates that much of the area along this alignment traverses paddy fields and rubber tree plantations. If additional noise mitigation measures are needed, based on the results of the assessment, corresponding costs will be covered by contingences included in the project cost estimate. The inventory of losses conducted for preparation of the resettlement plan identified 15 earth and cement irrigation canals. These facilities are found in both JBIC and ADB sections, i.e., in all four wards of District 9, HCMC, and communes of four districts in Dong Nai Province. One drainage culvert will be affected in Long Thanh town in Long Thanh district. The resettlement plan has budget provisions for repair and restoration of irrigation and drainage canals affected by the Project.

35. VEC will ensure that environmental clauses are included in the loan covenants and civil work contracts. Environmental baseline data will be collected according to the environmental effects monitoring plan (Appendix 2). Capacity-building measures, including setting up an environmental management unit under VEC's Southern Expressways Management Unit will be implemented before construction begins.

36. The contractor(s) will be required to recruit an environment officer to prepare a site-specific EMP to address the following: (i) selection of sites for material exploitation and storing, as well as sites for concrete, crushing, and asphalt plants; (ii) plans for material transportation routes and timing; (iii) disposal sites for unsuitable soils; (iv) soil erosion control measures including soil stabilization measures at disposal sites; (v) topsoil management at construction sites, work camps, and borrow areas; (vi) wastewater collection and treatment; (vii) construction camp management; (viii) borrow site management and restoration; (ix) traffic management; (x) noise reduction measures including construction of temporary noise barriers; (xi) dust suppression measures; (xii) handling and storage of hazardous substances such as fuel; (xiii) solid waste collection and disposal; (xiv) safety precautions during blasting; (xv) repair of

damaged community facilities such as irrigation canals; and (xvi) emergency response plan in case of spills, and other applicable mitigation measures indicated in the Project's EMP.

B. Impacts during Construction

1. Physical Impact

a. Water Pollution from Construction Works

37. Construction activities can cause temporary water pollution and higher silt loading in runoff from wastewater, open land surfaces, excavations, and soil stockpiles if proper mitigation measures are not taken. The impacts can be mitigated by erosion control, treatment of wastewater from construction activities and camp sites, and careful handling of chemicals and fuels. Proper disposal of solid waste from construction activities and workers' camps will be ensured.

38. Wastewater from mixing materials will be drained to a separate collecting system, and processed by sediment traps before being released to the public drainage system. Mud from drilling will be collected and processed to avoid pollution of surface water. Drilling solutions for performing the abutment will be processed in a closed system, especially for abutments at the riverbed. Inner-lined drill holes will be used during piling. Site inspections will be done to ensure the site is kept clean and organized, and both surface and groundwater quality will be regularly monitored. The contractor will identify and implement mitigation measures in the site-specific EMP.

39. Extraction of sand and gravel in riverbeds will be prohibited except where (i) no technically and economically feasible alternative is available; and (ii) specific mitigation measures are implemented to minimize impacts on river morphology, water quality (e.g., turbidity), and ecosystems (e.g., reduced extraction during fish spawning).

40. Any source of water (e.g., potable of irrigation) for the community, such as wells, ponds, or tube wells, accidentally damaged or lost will be repaired or replaced immediately. The location and positioning of the replaced source of water will be as per design or as directed by the engineer. In general, only lateral displacement (of the new site from the old) should occur; the replacement will be ready prior to demolition/dismantling of the existing source.

b. Soil Erosion

41. A landslide and erosion site was identified in Binh Sonh commune (km 30+200) along the ADB section, where the expressway crosses a small stream with a very steep and unstable embankment. Erosion or landslides are not expected to be a problem in other areas. However, during construction, erosion will temporarily occur at construction sites at streams, by new bridges, and in areas with steep slopes.

42. Mitigation measures will include proper drainage at construction sites and careful stockpiling of topsoil in suitable locations. Downstream slopes of streams will be stabilized with concrete, rock gabions, or other measures as necessary. The contractor will specify appropriate mitigation measures. Special attention should be paid to erosion protection at the Long Than Bridge site in the JBIC section, as erosion is already a problem on Dong Nai River. The measures used will be determined during final design of the bridge.

c. Change in Hydrological Situation

43. Construction activities can temporarily change or block the water flow of streams and creeks. Digging and filling activities can prolong inundation during the rainy season causing problems for irrigation and drainage facilities. The contractor will ensure that activities will not obstruct flows along watercourses or disrupt irrigation into surrounding croplands. Damaged irrigation facilities will be repaired immediately.

44. The PPTA studies and field investigations identified additional drainage needs especially for the expressway section from NH51 to the end of the project road along the ADB section. The alignment of this section is affected by many small catchment areas and drainage channels established by local inhabitants. Some catchment areas, consisting mainly of rice fields, are currently subject to flooding. Temporary drainage systems need to be established during construction to avoid local inundation and to ensure safety during the rainy season.

d. Disposal of Solid Waste and Surplus Soil

45. Waste from construction activities, including the demolishing of structures before construction begins, will be collected and recycled when possible. The contractor will establish hygienic groups to collect waste from construction camp sites and to ensure the cleanliness of the entire construction area. The contractor will cooperate with local authorities or companies to organize the waste recycling and specify the measures in the site-specific EMP.

46. The volume of spoil to be generated will be dependent on the detailed design. However, given that the JBIC section will be entirely on embankment or viaduct and the ADB section can be designed for balanced cut-and-fill, soil disposal is not considered to be a significant issue. The EMP will be updated during detailed design and require that contractors be responsible for spoil disposal in a manner consistent with a site-specific EMP that they will be required to prepare prior to any construction work. Spoils from the works will be disposed of in selected locations to avoid any adverse impacts to water or soil quality. The locations will be specified by the contractor in the site-specific EMP before beginning construction activities.

e. Borrow Pit Operation

47. Borrow pits will be constructed with proper drainage to prevent the creation of mosquito-breeding sites. Upon completion of extraction activities, the contractor will restore borrow pits by dewatering and installing fences, as appropriate, to minimize health and safety risks. Borrow pits will be left in a tidy state with stable side slopes and proper drainage to avoid creating stagnant water bodies.

f. Air Pollution

48. During construction, air quality will be adversely affected by dust and air pollution caused by construction vehicles, equipment, and plants (asphalt, crushers, and batching). Impacts will be minimized by ensuring that vehicles and machinery are properly used and maintained, preferring fuel-efficient vehicles. Dust suppression measures will be used, including covering and wetting loads, setting a speed limit for vehicles transporting construction materials, selecting suitable transport routes and vehicles, and regularly watering roads and other open areas. Careful planning of transportation will help minimize traffic congestion.

49. Impacts from concrete and asphalt plants, crushing, and other operations will be minimized by selecting sites away from sensitive receptors and using dust suppression and other control measures. In sensitive areas, such as the residential areas at An Phu and Long Thanh along the JBIC section, 3 m high iron sheet or fiberboard fences will be used around construction sites to minimize dust and noise, as specified in the CEPT EIA. The contractor will provide a map of the location of plants and sites where fences will be used, in addition to specifying other mitigation measures. During construction, air pollution parameters will be monitored regularly to ensure they remain within permitted levels. The environment management unit with the assistance of the project supervision consultant and the contractor's environment officer will conduct regular site inspections to ensure the use of best practices.

g. Noise and Vibration

50. Construction operations, especially pile-driving and blasting, will create noise and vibration, as will the passage of trucks and heavy equipment. Vehicles and machinery will be properly maintained to reduce noise emission and vibration. Plants will be located away from sensitive areas and noisy construction work, such as crushing, concrete mixing, and batching will be done during daylight hours. Use of machines causing loud noise and vibration (e.g., drills, excavators) is prohibited between 11:00 at night and 5:00 in the morning. If nighttime construction is necessary, the contractor will apply for permits from local authorities and inform residents of proposed activities.

51. At sensitive areas, which are mainly located along the JBIC section in Long Thanh town, temporary noise walls or boards will be used to minimize noise impacts from construction activities. VEC and the contractor will ensure that residents are notified prior to blasting operations, either directly of through local authorities. The effectiveness of mitigation activities will be monitored regularly by noise measurements.

h. Handling of Hazardous Materials

52. During construction, fuel, oil, and other dangerous chemical substances will be transported, stored, and handled at the site. Without adequate mitigation measures spills into the surrounding area could occur. The contractor will apply for appropriate permits for the transport and handling of hazardous materials, and prepare an emergency and contingency plan for fuel and oil spillage. Fuel storage sites will be located away from water bodies on cement pavement with a surrounding embankment, and provided with a canal leading to an oil and water separator to facilitate the capture and removal of spilled oil. The contractor will ensure that employees are trained on handling hazardous materials.

2. Ecological Impact

a. Local Ecosystems

53. The project area is an agroecosystem with no forested areas except for rubber tree plantations. The construction of the highway will not cause any major changes in the present ecological situation.

b. Flora and Fauna

54. Habitats of vulnerable, threatened, or endangered species were not observed in the project area. The removal of vegetation during construction will cause common animals

(insects, rodents, frogs, small reptiles) in agricultural lands to move to nearby habitats. Construction operations on streams and rivers will temporarily affect fish and other species.

55. The impacts can be mitigated by minimizing the areas to be cleared for construction, using noise prevention measures, replanting vegetation, and implementing pollution control measures for construction operations to avoid any contamination of water and soil.

3. Social Impacts

56. About 307 hectares will be acquired for the Project. Of these, about 62 hectares will be in HCMC and 246 in Dong Nai Province. The recommended mitigation measures involve timely land acquisition and compensation according to the resettlement plan prepared for the Project.

57. The PPTA-prepared census and inventory of losses identified 975 households that will be affected by the Project. Of these, 242 will be required to relocate to individual or group resettlement sites, while 165 households can rebuild their houses on their residual land. The four resettlement sites identified in the three districts of Dong Nai Province are either owned by the Government or rubber plantation companies. With regard to the severity of impacts on productive land, 392 households from the four districts of Dong Nai Province will lose more than 10% of their productive land, as will 37 households in HCMC. In HCMC, while the impact on agricultural land is high, this type of land is considered as an investment rather than a household's main source of income, and as a consequence is often left idle or unutilized.

58. A gender strategy was prepared including activities aimed at improving women's income and employment opportunities, and increasing awareness of internal and external human trafficking. The strategy provides specific HIV prevention measures.

59. During the construction and postconstruction phase, risks of HIV transmission and human trafficking could increase around the construction camps and in the project areas. The consultant prepared an HIV awareness and antitrafficking strategy for implementation.

60. Basic medical care will be provided at camp sites. Workers will be provided with potable water supply and appropriate protective equipment. Work camps will be provided with facilities to ensure the safety of workers, e.g., fire-fighting equipment, adequate storage for hazardous materials, and contingency measures in case of accidents.

61. The construction works will form barriers for existing roads and pedestrian routes. To minimize the disturbance, the contractor will ensure that clearly marked and protected passageways are provided and maintained during construction. Contractors will warn local residents of any blasting activities well in advance and ensure that the blasting area is clear prior to operations. Sirens and other appropriate means will be used as warning signals and blocks set up to ensure people are at a safe distance if blasting is near the road.

62. Existing local roads must be maintained during the works. Local residents should be informed on any interruptions for traffic and on safety issues related to the works. VEC will establish a warning system to avoid accidents along rivers during construction.

C. Impacts during Operation

1. Physical Impact

a. Air Pollution

63. According to JBIC's air quality modeling results for the first section of road (An Phu–Long Thanh along the JBIC section), the concentrations of sulfur dioxide 100 meters downwind from the road will be 359 micrograms/cubic meter (μg/m^3), which slightly exceeds the allowed TCVN limit of 350 μg/m^3. The sulfur dioxide concentration at Truong Khanh Shrine will be just above the allowed level, and the concentration farther from the road is below the permitted level. The nitrogen dioxide concentration is estimated to vary between 40 and 382 μg/m^3, which means that the permitted level of 200 μg/m^3 will be exceeded at some locations during unfavorable weather conditions (high temperature, downwind from the expressway). Other parameters such as carbon monoxide, total suspended particulates, and hydrocarbons are below the Vietnamese standards.

64. According to a corresponding analysis by CEPT for both JBIC and ADB road sections, in 2015 air quality parameters will be below the Vietnamese standard at distances of 30–40 m from the road. In 2020, values will be higher but only carbon monoxide values in the first section of road will be above the permitted level at a distance of 50 m from the expressway. Other parameters are within the prescribed TCVN limits at 30–40 m distance. On the whole, air pollution parameters will be lower along the ADB alignment (Long Thanh–Dau Giay section) than in the first section of the road. As some of the traffic on existing roads will be transferred to the new expressway, some reduction of emissions along such roads may be expected. However, increasing volume of traffic over the years may offset this benefit.

65. Air pollution during operation will be minimized by ensuring a steady flow of traffic, and avoiding congestion situations. This is influenced by road design, especially the intersections. Traffic control will be enforced, including the control of vehicle emissions to ensure emissions are within permitted levels. VEC will cooperate with the Traffic Police and relevant local authorities to ensure traffic control is implemented. Two bands of trees will be planted on both sides of the road to prevent the spreading of dust, as specified in the technical design.

b. Noise and Vibration

66. Noise from the expressway will exceed the Vietnamese standards for residential areas even at distances of more than 100 m from the road.

67. The two residential areas affected by elevated noise are the area south of the expressway in District 9 from km 5+00 to km 6+300 and the area in Long Thanh town and Long An commune (from km 23 + 100m to km 23 + 500). Both areas are along the JBIC alignment. The affected area in District 9 will be impacted by the construction of an express railway during 2010–2015. Noise due to railway operation will be higher for this particular site than due to the expressway. JBIC proposes that appropriate noise mitigation measures be determined based on the railway impacts. For the affected area in Long Thanh town and Long An commune, JBIC recommends installing a sound insulating wall 150 millimeters thick, 2 m high, and 400 m long. Noise levels with and without the wall at distances of 7.5 m to 135 m from the expressway were calculated. Results show that the expected noise reduction due to installation of the sound insulating wall would be 18 dB(A) (Table 3). The proposed mitigation measures will result in noise generally below the 60 dB(A) standard.

Table 3. Estimated Noise Levels in 2015

Section Ring Road No. 2 - Long Thanh Interchange	Distance from the Road (meters)									
	7.5	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0
Without Wall dB(A)	83.6	80.2	77.3	75.6	74.5	73.6	72.9	72.3	71.8	71.3
With Wall dB(A)	65.6	62.2	59.3	57.6	56.5	55.6	54.9	54.3	53.8	53.3

dBA = A-weighted sound level in decibels
Source: 2007 SAPROF Study by JBIC

68. Along the JBIC alignment are six shrines, a church, three primary schools, and a clinic. With the exception of Truong Khanh Shrine in Long Phuoc, which is 15 m from the alignment, the structures are located 150 m to 300 m from the expressway and are not anticipated to be significantly affected during project operation. Truong Khanh Shrine is mainly used for daily incense burning by about 1–3 people. Ceremonial offerings attended by 50–100 people are conducted about twice a year. Anticipated impacts due to air and noise emissions as well as vibration generated by passing vehicles are not anticipated to significantly affect shrine users/devotees, hence, no specific mitigation measures are recommended.

69. The estimated vibration during operation will be less than 57 dB in residential areas, which is below the standard of 60–65 dB (TCVN 7210:2002).

c. Altered Hydrological Conditions

70. Along the JBIC section, the Long Thanh bridge over Dong Nai River will be a large construction with a total length of 1.7 km and width of 19.75 m. Based on the design documents of TEDI South (the feasibility study consultant), three design options can be considered: cantilever concrete bridge, circled bridge, and cable-hanging bridge.

71. The Ministry of Transportation has decided that the bridge will be the continuous prestressed reinforced concrete box girder type constructed by balanced cantilever method with a slope of 4%. Using this option, the profile of passage will remarkably decrease after the construction of the piers for the bridge. The width of the foundation slabs is 5 x 20 m, which together, represent 16% of the width of the 650 m wide river. The possible consequence is the raising of the water level in the upstream side. The river flow at the bridge site has two flow directions: normal water flow from higher areas and current from the sea caused by high tides. The potential negative effects of decreasing the passage profile will be directed to agriculture and residential communities in surrounding areas with a possibility of flooding and increased erosion. Furthermore, at the Long Thanh bridge site in the JBIC section, the expressway runs over a curved river section with a radius of 1,000 m. Waterway transportation may experience difficulties due to this curved river section and the pier in the center of the river.

72. A hydrological study of the Dong Nai River during the project design stage is essential to identify impacts of the Long Thanh bridge. Mitigation measures will be specified and consideration given to using a cable-stayed bridge instead. Other possible mitigation measures include widening the river, which would require additional acquisition of about 36 ha and removal of 2.5 m^3 of soil and 534 m of bank protection. If river widening is considered, an additional environmental assessment study should be conducted.

2. Ecological Impact

73. As the project area is an agroecosystem, significant changes during project operation are not anticipated. Surface runoff from the expressway containing oil, grease, and precipitates from diesel emissions, may affect nearby water bodies. Service areas are the most likely locations where contamination could occur, and as such, will be equipped with an interceptor tank to remove oil and grease from surface runoff before discharge.

3. Social Impact

74. The expressway construction will divide two residential areas and agricultural land along the road. The building of intersections could affect existing transport routes. To minimize disturbance for residents near the expressway, an underpass, overpass bridges, and frontage roads for communication between both sides will be constructed. The optimum location of crossing points will be determined during the design phase in consultation with local communities and their representatives.

75. The expressway could become a new pathway for diseases. Mobile groups (such as drivers and guides of tour buses, truck drivers, and workers) are particularly vulnerable to sexually transmitted diseases and HIV. The HIV and antitrafficking strategy is gender focused. The main target group is the victims of internal trafficking, which is very high in the project area, and who are predominantly young women. The HIV strategy used a gender planning framework in developing its priority plans for construction sites. No trafficked person or child labor will be used for construction and maintenance.

VI. ECONOMIC ASSESSMENT

76. The Project provides environmental benefits in terms of fuel consumption savings and reduced emissions due to the shortening of travel distance and reduction of traffic congestion. However, the benefits will be offset by the increased number of journeys made. The expressway design, including divided carriageways and no access for motorbikes, makes it safer and will lead to fewer accidents per vehicle-kilometer.

77. The construction of the expressway will result in economic cost from the loss of arable land, together with the investment cost of the construction and land acquisition. However, the economic benefits of vehicle operating cost savings, and time savings for users outweigh the losses. The expressway will contribute to regionally balanced and equitable economic growth by stimulating agricultural production, increasing access to employment opportunities, and facilitating better access to social services.

78. The estimated total cost for EMP implementation is $338,918 covering environmental training and monitoring. The cost for installation of a sound insulating wall in Long Thanh, sewage treatment facilities, protective barriers to prevent noise and dust on sensitive sites, and provision of greenbelts are included in the overall project cost and are not reflected in the EMP budget.

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management Plan

79. The project EMP (Appendix 1) will be implemented for the entire expressway. The design consultants will ensure that environmental protection measures are incorporated into the design, additional studies are conducted, and the EMP is updated. VEC will ensure that contractors prepare a site-specific EMP based on the actual situation on-site and that bidding documents for contractors and construction contracts include environmental clauses requiring the contractors to implement the EMP.

B. Environmental Monitoring Plan

80. The environmental performance of contractors will be monitored by VEC's Environment management unit with the assistance of the project supervision consultant to ensure that mitigation measures are properly implemented. The contractors will submit monthly reports to VEC on the status of implementation of mitigation measures.

81. An environmental effects monitoring program (Appendix 2) will be implemented during preconstruction, construction, and operation phases of the Project. VEC will gather environmental baseline data during preconstruction. It will submit monitoring reports to the departments of natural resources and environment in HCMC and Dong Nai Province, ADB, JBIC, and the Ministry of Natural Resources and Environment. During construction, the contractor will conduct quarterly monitoring and submit the corresponding report to VEC. During operation, VEC will conduct monitoring every 6 months for the first 2 years to ensure the effectiveness and maintenance of mitigation measures. VEC will submit monitoring reports to the departments of natural resources and environment in HCMC and Dong Nai Province, ADB, JBIC, and the Ministry of Natural Resources and Environment .

C. Institutional Requirements

82. VEC will ensure the Project is implemented in an environmentally responsible manner and will be responsible for operation and maintenance of the expressway. The institutional arrangements for EMP implementation are provided in Table 4.

Table 4: Responsibilities for Implementing the EMP

Organization	Responsibilities
VEC (through SEPMU)	• Establish an EMU within the SEPMU with one full-time environmental specialist initially. Hire additional staff as necessary. • Prepare contractual requirements and ensure that contractors follow the EMP. • Ensure that the provisions of the EMP prepared under ADB PPTA are implemented for the entire Project (JBIC and ADB sections). • Before the start of construction, require contractors to prepare site-specific EMPs. • Submit site-specific EMPs and send these for review to ADB and JBIC. • Ensure that environmental protection measures proposed in the Project EMP are incorporated in the detailed designs. • Ensure that construction contractors implement mitigation measures stated in the site-specific EMPs via environmental protection provisions in construction contracts. • Gather environmental baseline data during the preconstruction phase and conduct environmental effects monitoring during the first 2 years of operation. • Provide monitoring reports related to EMP implementation to the DONREs, ADB, and JBIC. • Inform local authorities and communities on status of the Project and EMP implementation.
EMU	• Supervise EMP implementation, and review the environmental monitoring reports from contractors. • Document and address comments or complaints from the local residents. • Supervise the environmental monitoring and conduct regular spot checks to ensure that contractors are following the EMP. • Report any environmental incidents to the project director. • Submit environmental monitoring reports to the DONREs, MONRE, ADB, and JBIC.
ADB and JBIC	• Review results of additional studies to be conducted during detailed design, the updated EMP to be prepared by the detailed design consultants, site-specific EMPs to be prepared by contractors, and monitoring reports during various project phases for the entire expressway. • Ensure that appropriate provisions of the EMP are implemented by the PSC and contractors for their respective sections.
Design Consultants	• Conduct a detailed hydrological study of the Dong Nai River to assess the impacts of bridge building. Reconsider design options and specify mitigation measures to prevent problems related to flooding, riverbank erosion, and safety on the river • Conduct detailed acoustic assessment of sensitive sites (schools, hospitals, and shrines) along the alignment. If noise exceeds Vietnamese standards, design acoustic measures to reduce noise levels to would meet allowed limits. • Ensure that environmental protection measures are incorporated into the design. • Update the EMP during the detailed design phase.
PSC (for JBIC and ADB sections)	• Ensure environmental contract clauses are incorporated into project contracts. • Assist VEC in reviewing site-specific EMPs prepared by contractors prior to implementation of site works. • Recommend additional mitigation measures during construction, if necessary • Train staff of VEC, Southern Expressways Management Unit and contractors on environmental assessment, implementation of EMP, and monitoring. • Review and analyze environmental effects monitoring reports submitted by contractors. • Conduct monitoring of the contractor's environmental performance with regard to implementation of EMP provisions and prepare quarterly monitoring reports

Organization	Responsibilities
Contractors (for JBIC and ADB sections)	• Undertake regular spot check inspections to ensure that the contractor is following the EMP, and advise the project director in case of any failures in implementation. • Prepare a monitoring framework/mechanism and communicate this to local residents. The framework will provide guidance to representatives of affected communities on how they can participate during monitoring of environmental effects during construction and operation phases as well as during monitoring of contractors' environmental performance. • Coordinate activities with the contractor and VEC. • Hire an environment officer to fulfill contractual obligations. • Prepare a site-specific EMP prior to construction and ensure it is implemented. • Conduct environmental effects monitoring during construction. • Undertake regular site inspections to ensure best practices are used. • Implement additional mitigation measures, as necessary. • Submit environmental monitoring reports to VEC and PSC. Such reports are to include results of environmental effects monitoring, implementation of mitigation measures, safety issues, and any complaints received.

ADB = Asian Development Bank, DONRE = Department of Natural Resources and Environment, EMP= environmental management plan, EMU = environmental management unit, JBIC = Japan Bank for International Cooperation, MONRE = Ministry of Natural Resources and Environment, PSC = project supervision consultant, SEPMU = Southern Expressways Management Unit , VEC = Vietnam Expressway Corporation
Source: Consultant

D. Estimated Costs for Environmental Management Plan Implementation

83. The budget for EMP implementation includes the cost of mitigation measures that are directly attributable to environmental protection. Cost for such mitigation measures are estimated as marginal costs as these are above the normal project construction. This is done to avoid double counting of budget items in the EMP and overall budget calculation. Since the following costs are already included in the overall project costs, they are not included in Table 5:

(i) sound insulating wall at Long Thanh ($50,000);
(ii) solid barriers to prevent noise and dust during construction ($18,780);
(iii) installation of sewage treatment facilities in construction camp sites ($21,900); and
(iv) provision of greenbelts on both sides and median of the expressways ($2,265,653).

84. The EMP costs consist of nonrecurring costs (environmental training and one-time baseline data gathering during preconstruction) and recurring costs (environmental monitoring during construction and operation phases).

Table 5: Estimated Costs for EMP Implementation

Item	Cost in Dong (1,000)	Cost in Dollars
1. Environmental training	1,001,660	62,600
2. Monitoring in three phases	4,421,088	276,318
Total	**5,422,748**	**338,918**

Source: Consultant

VIII. PUBLIC CONSULTATION AND DISCLOSURE

85. The consultant conducted two rounds of public consultations during the environmental assessment process. The first consultations were conducted on 21–28 September 2007, with 12 meetings in 11 communes and towns along the project area. Three different methods were used to inform people about the meetings: (i) invitation letters were sent to project-affected people contacted during the socioeconomic survey; (ii) posters were set up at commune people's committee offices, markets, and other public places; and (iii) an announcement by loudspeaker was done in the ward once a day for 7 days before the consultations. Participants included those affected by the Project, representatives of people's committees and fatherland committees, youth unions, women's unions, and representatives of VEC, ADB, and JBIC. The meetings included presentations on the Project, its social and environmental impacts and mitigation, and compensation and resettlement issues. Consultations were held for each topic with the assistance of group facilitators.

86. The main concerns of those affected related to resettlement and compensation issues. The consultations identified some potential environmental and social impacts and perceptions of the affected communities on the construction work in terms of project benefits and impacts. Topics included noise and air pollution during construction, and the impacts of expressway construction on the local transportation routes. The participants asked that access to local roads and a safe crossing of expressway be ensured. The people affected were also concerned with negative impacts on irrigation channels and pollution to fish ponds, and wanted to know who would be responsible for possible damage. Attendees also expressed concern that the construction would harm existing houses along the alignment. The participants were advised that the resettlement plan being prepared for the Project will address their concerns on resettlement and compensation issues.

87. During 21–29 January 2008, another round of public consultation involving visits to project-affected sites, and other members of local communities was conducted. Public meetings were organized in 11 communes and wards along the expressway. Communities were informed about consultations using similar methods as for the first round of consultations. The meetings focused on the Project's anticipated environmental impacts as well as the mitigation measures to be implemented. Information was provided on how local people will be informed about the Project and upcoming construction activities, and how to get in touch with VEC in case of complaints during the construction process. Residents indicated their desire to establish a community environmental monitoring team. To address this concern, a framework will be developed by VEC, with the assistance of the project supervision consultant, to allow representatives of affected communities to participate during the environmental monitoring for the construction and operation phases.

IX. CONCLUSIONS

88. The predicted environmental impacts of the Project during various phases have been identified and mitigation measures formulated. An EMP, which includes mitigation measures and monitoring program for the entire expressway, has been developed. Responsibilities for implementation of the EMP are defined clearly. The effective implementation of the EMP requires environmental training, supervision, and monitoring. VEC’s capacity will be enhanced to be able to adequately supervise project implementation.

89. Provided the mitigation measures defined in the EMP are properly implemented, the Project can proceed without serious environmental effects.

SUMMARY ENVIRONMENTAL MANAGEMENT PLAN

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
A. Preconstruction Period (Design Phase)						
1. Social impact	Ensure that resettlement activities are completed for each section before beginning construction, and that any adverse impacts due to additional property acquisition and resettlement are mitigated.	Implement resettlement and compensation schemes as specified in the resettlement plan. If additional property acquisition is needed, ensure that affected people are given enough time, compensation money, and assistance to resettle satisfactorily.	Before removing houses and other structures	Resettlement and compensation action plan	VEC	VEC
2. Gathering of baseline data	Ensure that environmental monitoring is done.	Conduct environmental monitoring according to the environmental monitoring plan.	Once, shortly before the beginning of construction	Air quality: SO_2, CO, NO_2, TSP, HC Noise and vibration levels Surface water: pH, turbidity, temperature, conductivity, DO, BOD, COD, SS, total N, total P, Cu, Hg, oil and grease, total coliform Groundwater: pH, color, odor, turbidity, temperature, conductivity hardness, Mn, Fe, NO_3, Cl, SO_4, Cd, Pb, Zn, total coliform Soil: pH, organic matter, total P,	VEC	VEC

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
				total N, Cl, SO_4, Cu, Zn, Cd, Pb, Hg, As		
3. The Impacts of Long Thanh bridge	Ensure that the chosen design option for the bridge will not cause a risk of flooding, erosion, or transportation safety.	Conduct a detailed hydrological study of Dong Nai River to assess the impacts of bridge building. Reconsider design options and specify mitigation measures to prevent problems related to flooding, riverbank erosion, and safety on the river.	During detailed design	Hydrological situation of the Dong Nai River	Design consultant	VEC
4. Hydrological design	Ensure measures are included in the design to prevent flooding in flood-prone areas.	Ensure that existing irrigation and drainage schemes are identified and needs for additional drainage are specified.	During detailed design	Irrigation and drainage scheme	Design consultant	VEC
5. Erosion control	Ensure measures are included in the design to prevent erosion at rivers, streams, and other erosion-prone areas.	Prepare plans to avoid or manage erosion at Dong Nai and other rivers and streams, as well as at any other sites prone to erosion.	During detailed design	Erosion prevention plan	Design consultant	VEC
6. Noise impact	Ensure noise impact during construction is acceptable.	Conduct detailed acoustic assessment of sensitive structures (schools, hospitals, shrines) that may be located along the ADB section. If noise exceeds Vietnamese standards, design acoustic measures, such as a solid barrier, to control noise impact.	Once, during detailed design	Noise level	Design consultant	VEC
7. Exploitation, handling, transportation, and storing of construction materials	Minimize pollution related to construction activities.	Select the sites for material exploitation and storing to avoid or minimize adverse environmental impacts. Also plan routes and timing for material transportation.	Before construction		VEC and contractor	VEC
8. Spoil disposal	Ensure adequate disposal options for unsuitable soil.	Identify adequate disposal sites for unsuitable soil. Designate sites in the contract with cost unit disposal rates.	During detailed design/before construction		VEC and contractor	VEC
9. Specification of loan covenants and civil works contract	Ensure that the loan covenants include environmental clauses, and that civil works contract specifies measures listed in	Provide drafts of key environmental inputs for inclusion in bid preparation projects and contractor selection. Ensure that civil works contract specifies EMP measures.	Before procurement of civil works	Contracts	VEC and design consultant	VEC

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
	the EMP.					
10. Environmental capacity	Ensure that VEC and contractors have adequate environmental capacity to implement the EMP.	VEC will set up an environment management unit (EMU) under SEPMU Provide training for key personnel in VEC and for the field manager and environment staff of winning contractors. VEC will ensure that contractors hire an environment officer responsible for preparing a site-specific EMP, reporting on implementation of mitigation measures, and conducting inspections on site. Specify procedures for reporting on environment issues.	Before construction	EMU staffing, VEC training, updates of National Transport Plan, updates of contract procedure manuals, condition surveys, progress reports	VEC (training to be conducted by PSC)	VEC
B. Construction Period						
1. Air quality						
Vehicle operation	Minimize air pollution and dust caused by use of vehicles and machinery; ensure that air quality parameters remain below permitted levels (TCVN 5938:2005).	Ensure that vehicles and machinery are used and maintained properly preferring fuel-efficient vehicles. Use dust suppression measures: cover and wet loads, limit the speed for vehicles transporting construction materials, select suitable transport routes and vehicles, and water roads and other open areas regularly. Limit traffic congestion through planning of transportations. Conduct regular site inspections to ensure the use of best practices and report any complaints from local people.	During construction	SO_2, CO, NO_2, TSP, HC	Contractor	VEC, PSC, DONREs, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
Crushing, concrete, and asphalt plant operation	Minimize adverse impacts from operation of crushing, concrete, asphalt plants.	Do not locate asphalt hot mix, crushing and batching plants within 1,000 m of settlements, schools, health facilities, and other sensitive sites. In residential areas, such as An Phu and Long Than towns, build 3 m high fences with fiberboard and iron sheets to minimize dust. Use dust suppression measures and control activities.			Contractor	VEC, PSC, DONREs, MONRE
Borrow pit operation		The contractor will restore borrow pits by dewatering and installation of fences, as appropriate, to minimize health and safety risks.	During construction		Contractor	VEC, PSC, DONREs, MONRE
2. Water quality	Avoid water pollution by collecting and processing wastewater and using appropriate construction methods. Ensure that water quality parameters remain within permitted limits (TVCN 5942:1995, TVCN 5944:1995).	Drain wastewater from mixing materials to a separate collecting system, and process it by sediment traps before release to the public drainage system. Collect mud from drilling and process it to avoid pollution of surface water. Process drilling solutions for performing the abutment in a closed system, especially for abutments at the riverbed. Use inner-lined drill holes during piling. Provide proper drainage systems at all construction, material exploitation, and storage sites. At construction camp sites, collect and treat wastewater before discharging into canals or rivers. Provide proper drainage to avoid creation of stagnant water bodies. Prohibit extraction of sand and gravel in	During construction	Surface water: pH, turbidity, temperature, conductivity, DO, BOD, COD, SS, total N, total P, Cu, Hg, oil and grease, total coliform Groundwater: pH, color, odor, turbidity, temperature, conductivity hardness, Mn, Fe, NO_3, Cl, SO_4, Cd, Pb, Zn, total coliform	Contractor	VEC, PSC, DONREs, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
		riverbeds except (i) where no technically and economically feasible alternative is available, and (ii) provided specific mitigation measures are implemented to minimize impacts on river morphology, water quality (e.g., turbidity), and ecosystems (e.g., reduced extraction during fish spawning period). Provide equipment and vehicle maintenance area with adequate drainage facility as well as oil and grease separator to avoid discharge of oil-laden water into the surrounding soil and water courses. Do not locate stockpiles near rivers and streams. Avoid dumping of spoils and obstructing flows along rivers and streams. Prepare emergency response plan in case of fuel and chemical spills.				
Loss of water sources and damage to other community facilities.		Immediately repair or replace any source of water (potable, irrigation or otherwise) for the community, such as wells, ponds or tubewells, as well as other community facility accidentally damaged or lost. Locate and site the replaced source of water as per design or as directed by the engineer. In general, only lateral displacement (of the new site from the old) should be followed; the replacement will be ready prior to demolition/dismantling of the existing source.			Contractor	VEC, PSC, DONREs, MONRE
3. Noise and vibration	Minimize noise and vibration from vehicles, plants and equipment.	Ensure that vehicles and machinery are used, maintained, and equipped to avoid unnecessary noise and vibration.	During construction	Noise: Leq, L10, L90 Vibration: LAeq,	Contractor	VEC, PSC, DONREs, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
	Ensure that noise and vibration do not exceed allowed limits (TCVN 5949:1998, TVCN 7210: 2002).	Locate plants away from sensitive areas and conduct noisy construction work, such as crushing, concrete mixing, and batching during daylight hours. Prohibit the use of machines causing loud noise and vibration (drill, excavator etc.) between 23:00 and 5:00. Contractors will ensure that blasting activities do not cause damage to lives and properties by making sure that the area is clear; people are adequately warned by sirens and other appropriate means, and are stopped at a safe distance if blasting is near the road. Adopt available acoustic measures to minimize noise impacts and follow good housekeeping practices in all operations		Lveq		
4. Waste	Ensure solid waste from construction activities and labor camps is collected and treated properly.	Establish hygiene groups to regularly clean solid waste from the construction field and construction camp sites. After finishing work at a site, clear all debris and remove all temporary structures (office buildings, shelters, toilets).	During construction and after completion of works	Visible cleanliness on site	Contractor	VEC, PSC, DONREs, MONRE
5. Handling of hazardous and toxic materials	Ensure careful handling of hazardous and dangerous materials, prevent any accidental spills.	Follow environmental regulations in handling hazardous materials including appropriate storing of materials. Locate fuel storage sites away from water bodies on a cement pavement with embankment. A canal leading to an oil and grease separator will be installed to facilitate the capture and removal of spilled oil. Use and maintain vehicles and machinery properly to avoid accidental	During construction	Number of incidents involving hazardous materials	Contractor	VEC, PSC, DONREs, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
		spills. Prepare emergency plans in case of accidental spills.				
6. Soil						
Contamination of soil	Avoid contamination of soil by careful handling of waste and hazardous materials, ensure that soil quality parameters are within allowed limits (TVCN 7209: 2002).	Keep the construction site clean to avoid any contamination of soil from solid wastes or wastewater. Spoils are disposed in designated disposal sites. Ensure all workers are aware of the importance of careful handling of hazardous and dangerous materials. Prepare emergency plans for accidents.	During construction	pH, organic matter, total P, total N, Cl, SO_4, Cu, Zn, Cd, Pb, Hg, As	Contractor	VEC, PSC, DONREs, MONRE
Erosion	Avoid erosion caused by construction activities.	Provide temporary or permanent drainage to protect sites susceptible for erosion. Stabilize downstream slopes on rivers and streams prone to erosion problems. Protect sensitive surface with vegetation and replace removed trees to ensure interception of rainwater and deceleration of surface runoff.	During construction		Contractor	VEC, PSC, DONREs, MONRE
7. Loss of vegetation cover	Avoid negative impacts related to the removal of vegetation.	Minimize the clearing of vegetation for construction activities and borrow areas. Revegetate embankment slopes and road cuts. Landscape road verges and plant vegetation to contribute to aesthetic value.	During construction and after completion of works	Amount of lost vegetation	Contractor	VEC, PSC, DONREs, MONRE
8. Traffic conditions and use of waterways	Minimize access problems for local population during construction. Ensure traffic safety and minimize disturbance to the vehicular traffic and pedestrians.	Formulate and implement a traffic management plan minimizing the disturbance caused by construction activities. Organize temporary means of access to avoid short-term negative impacts. Install traffic warning signs and assign traffic control personnel.	Before and during construction	Number of construction related traffic accidents	VEC and contractor	VEC, PSC, DONREs, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
		Maintain local roads and bridges used by construction vehicles. On rivers, set up temporary signaling stations to warn boats on any obstructions to traffic.				
9 Health and safety	Minimize health and safety risks to communities and workers.	Provide basic medical care at camp sites. Provide workers with potable water supply and appropriate protective equipment. Provide work camps with facilities to ensure the safety of workers, e.g., fire-fighting equipment, adequate storage for hazardous materials, and contingency measures in case of accidents. Construct borrow pits with proper drainage to prevent the creation of mosquito-breeding sites. Upon completion of extraction activities, the contractor will restore borrow pits by dewatering and installing fences, as appropriate, to minimize health and safety risks. Borrow pits will be left in a tidy state with stable side slopes and proper drainage to avoid creation of stagnant water bodies.				
10. Social impacts	Minimize disturbance to daily activities.	Provide local communities with information on upcoming construction-related activities and issues related to traffic safety. Record any complaints received and respond to them promptly. Cooperate with local authorities to prevent and solve problems related to environmental issues.	Before and during construction		VEC and contractor	VEC, PSC, DONREs, MONRE
C. Operation Period						
1. Air quality	Minimize air pollution from road usage. Ensure that air quality parameters remain	Enforce laws on vehicle condition and emission of vehicles to reduce pollution load. Ensure smooth flow of traffic to	During operation	NO_2, SO_2, CO, HC, TSP	VEC	VEC, DONREs, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
	below permitted levels (TCVN 5938:2005)	avoid congestion. Plant trees on both sides of expressway for prevention of dust, as specified in technical design.				
2. Noise and vibration	Minimize noise and vibration from road usage. Ensure that noise and vibration levels do not exceed allowed limits (TCVN 5949:1998, TVCN 7210: 2002.	Ensure loading and noise of vehicles is within the allowable range. Plant trees on both sides of expressway, as specified in technical design. Construct a noise barrier in Long Thanh residential area	During operation	Noise: Leq, L10, L90 Vibration: LAeq, Lveq	VEC, Traffic Police	VEC, DONREs, MONRE
3 Water and soil pollution	Minimize pollution caused by runoff from the road.	Equip service areas with an interceptor tank to remove oil and fuel grease from surface water before discharge. Prepare emergency action plans to ensure timely response to any accidents. Conduct regular water and soil quality monitoring during operations to detect any problems.	During operation	Surface water: pH, turbidity, temperature, conductivity, dissolved oxygen, BOD, COD, SS, total N, total P, Cu, Hg, oil and grease, total coliform Groundwater: pH, color, odor, turbidity, temperature, conductivity hardness, Mn, Fe, NO_3, Cl, SO_4, Cd, Pb, Zn, total coliform	VEC	VEC, DONREs, MONRE
4. Waste	Collect and recycle waste.	Place garbage collection bins at tolling and service stations. Provide information campaigns and regularly clean roadsides.	During operation		VEC	VEC, DONREs, MONRE
5. Erosion	Prevent and minimize erosion of slopes and waterways.	Maintain proper vegetation cover and erosion protection. Conduct regular surveillance as part of routine maintenance.	During operation and rainy seasons		VEC	VEC, DONREs, MONRE
6. Traffic safety	Minimize the risk of accidents.	Ensure that adequate traffic control and traffic warning devices are used. Provide road user information and	During operation	Number of accidents	Traffic Police, relevant local authorities	DONREs, Traffic Police, MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Indicator	Implementation Responsibility	Monitoring / Supervision
		enforce the law. Provide emergency services and set up an accident review committee.				
7. Transportation of hazardous and dangerous materials	Minimize the risk of pollution from accidents involving transportation of dangerous chemicals or other substances	Require permits for transport of dangerous substances and place warning signs on vehicles. Develop and implement an emergency action plan to ensure quick response to any accidents.	During and before operation	Number of accidents involving dangerous substances	VEC, relevant local authorities	DONREs, Traffic Police, MONRE
8. Social impacts	Control and minimize negative traffic impacts on people living in nearby areas.	Monitor environmental impacts regularly and inform the public about the results. Enforce regulations and ensure road safety. Record any complaints received and respond to them in a timely manner. Provide a framework for residents to be able to freely participate during the environmental monitoring to be conducted by a third party monitor. Residents should be able to join the construction supervision consultants when conducting environmental performance monitoring of contractors. Environmental monitoring reports and laboratory results will be provided to local government units (e.g., ward and commune people's committees).	During operation		VEC, relevant local authorities	VEC, DONREs, MONRE

As = arsenic, BOD = biological oxygen demand, Cd = cadmium, Cl = chlorine, CO = carbon monoxide, COD = chemical oxygen demand, Cu = copper, DO = dissolved oxygen, DONRE = Department of Natural Resources and Environment, EMP = environmental management plan, EMU = environmental management unit, Fe = iron, Hg = mercury, HC = hydrocarbon, Mn = manganese, MONRE = Ministry of Natural Resources and Environment, N = nitrogen, NO_2 = nitrogen dioxide, NO_3 = nitrate, P = phosphorous, Pb = lead, pH = potential of hydrogen, PSC = project supervision consultant, SEPMU = Southern Expressway Project Management Unit, SO_2 = sulfur dioxide, SO_4 = sulfate, SS = suspended solids, TSP = total suspended particulates, VEC = Viet Nam Expressway Corporation, Zn = zinc

Source: Consultant

ENVIRONMENTAL EFFECTS MONITORING PLAN

Table A2.1: Air Quality

Parameter	Monitoring Locations	Number of Samples per Location	Frequency	Implementation	Supervision
SO_2, CO, NO_2, TSP, HC	1. Ong Nhieu Bridge 2. Long Thanh Bridge 3. Long Thanh Interchange 4. Intersection with NH1	8	Preconstruction: Once	VEC	VEC
			Construction: Quarterly	Contractor	VEC, PSC, DONRE
			Operation: Semiannually during first 2 years of operation	VEC	VEC, DONRE

CO = carbon monoxide, DONRE = Department of Natural Resources and Environment, HC = hydrocarbon, NH1 = National Highway 1, NO_2 = nitrogen dioxide, PSC = project supervision consultant , SO_2 = sulfur dioxide, TSP = total suspended particulates VEC = Viet Nam Expressway Corporation
Sources: Consultant and JBIC

Table A2.2: Noise

Parameter	Monitoring Locations	Number of Samples	Frequency	Implementation	Supervision
Noise Level L_{eq} (dBA)	1. Ong Nhieu Bridge 2. Long Thanh Bridge 3. Long Thanh Interchange 4. Interchange with NH1	3 per hour between 06h00 and 18h00	Preconstruction: Once	VEC	VEC
			Construction: Quarterly	Contractor	VEC, PSC, DONRE
			Operation: Semiannually during first 2 years of operation	VEC	VEC, DONRE

dBA = A-weighted sound level in decibels, DONRE = Department of Natural Resources and Environment, Leq = equivalent continuous noise level , NH1 = National Highway 1, PSC = project supervision consultant , VEC = Viet Nam Expressway Corporation
Sources: Consultant and JBIC

Table A2.3: Vibration

Parameter	Monitoring Locations	Number of Samples	Frequency	Implementation	Supervision
Vibration Level Leq (dB)	1. Ong Nhieu Bridge 2. Long Thanh Bridge 3. Long Thanh Interchange 4. Interchange with NH1	3 per hour between 06h00 and 18h00	Preconstruction: Once	VEC	VEC
			Construction: Quarterly	Contractor	VEC, PSC, DONRE
			Operation: Semiannually during the first 2 years of operation	VEC	VEC, DONRE

dB = decibel, DONRE = Department of Natural Resources and Environment, Leq = equivalent continuous noise level , NH1 = National Highway 1, PSC = project supervision consultant , VEC = Viet Nam Expressway Corporation
Sources: Consultant and JBIC

Table A2.4: Surface Water Quality

Parameter	Monitoring Locations	Number of Samples per Location	Frequency	Implementation	Supervision
pH, Temperature, Turbidity, Conductivity, DO, BOD, COD, SS, Total N, Total P, Cu, Hg, Oil and Grease, Total Coliform	1. Song Tac Bridge 2. Long Thanh Bridge 3. Ben San Bridge 4. Stream in Xuan Que Ward 5. To be determined during detailed design phase 6. To be determined during detailed design phase	2	Preconstruction: Once	VEC	VEC
			Construction: Quarterly	Contractor	VEC, PSC, DONRE
			Operation: Semiannually during first 2 years of operation	VEC	VEC, DONRE

BOD = biological oxygen demand, COD = chemical oxygen demand, Cu = copper, DONRE = Department of Natural Resources and Environment, DO = dissolved oxygen, Hg = mercury, SS = suspended solids, N = nitrogen, P = phosphorous, pH = potential of hydrogen, PSC = project supervision consultant, VEC = Viet Nam Expressway Corporation
Sources: Consultant and JBIC

Table A2.5: Groundwater Quality

Parameter	Monitoring Locations	Number of Samples per Location	Frequency	Implementation	Supervision
pH, temperature, color, odor, conductivity turbidity, hardness, Mn, Fe, NO_3, Cl, SO_4, Cd, Pb, Zn, total coliform	1.Tan Dien A Hamlet (Phu Huu Ward)	2	Preconstruction: Once	VEC	VEC
	2. Long Phuoc Ward, near Dong Nai River		Construction: Quarterly	Contractor	VEC, PSC, DONRE
	3. Long Thanh Town		Operation:	VEC	
	4. Nguyen Thai Hoc Hamlet (Bau Ham 2 Ward)		Semiannually during first 2 years of operation		VEC, DONRE

Cl = chlorine, DONRE = Department of Natural Resources and Environment, Cd = cadmium, Fe = iron,, Mn = manganese, NO_3 = nitrate, Pb = lead, pH = potential of hydrogen, PSC = project supervision consultant, SO_4 = sulfate, VEC = Viet Nam Expressway Corporation, Zn = zinc
Sources: Consultant and JBIC

Table A2.6: Soil Quality

Parameter	Monitoring Locations	Number of Samples per Location	Frequency	Implementation	Supervision
pH, organic matter, total P, total N, Cl, SO_4, Cu, Zn, Cd, Pb, Hg, As	1. Phu Huu District	3	Preconstruction: Once	VEC	VEC
	2. Long Thanh Town				
	3. Nguyen Thai Hoc Hamlet (Bau Ham 2 Ward)	3	Construction: Quarterly	Contractor	VEC, PSC, DONRE
	4. Service station at km 41 + 100	2	Operation: Semiannually during first 2 years of operation	VEC	VEC, DONRE

As = arsenic, Cd = cadmium, Cl = chlorine, Cu = copper, DONRE = Department of Natural Resources and Environment, Hg = mercury, N = nitrogen, P = phosphorous, Pb = lead, pH = potential of hydrogen, PSC = project supervision consultant, SO_4 = sulfate, VEC = Viet Nam Expressway Corporation, Zn = zinc
Sources: Consultant and JBIC

ESTIMATED COST FOR ENVIRONMENTAL EFFECTS MONITORING

Item	Activity	Unit	Quantity	Price Unit ($)		Total Price ($)	
				Labor	Other	Labor	Other
A.	**Preconstruction phase (7 days)**						
1.	**Cost of human resources**						
a.	Take air samples and microclimate samples: 2 people x 1 day/position x 4 positions (working16 h/day).	Person-day	8	25		200	
b.	Take noise samples: 2 people x 1 day/position x 4 positions (working 16 h/day).	Person-day	8	25		200	
c.	Take vibration samples: 2 people x 1 day/position x 4 positions (working 16 h/day).	Person-day	8	25		200	
d.	Take samples of surface water, underground water: 1 person x 1 day/position x 10 positions	Person-day	10	20		200	
e.	Take soil samples: 2 people x 1 day/position x 4 positions	Person-day	8	20		160	
f.	Staffing of monitoring team for mobilization/ demobilization period (9 people x 4 days)	Person-day	36	20		720	
g.	Salary of monitoring team leader (0.5 month x $1,800/month)	Person-month	0.5	1,800		900	
	Subtotal (A1)					**2,580**	
2.	**Cost of equipment**						
a.	Vehicle rental	Day	11		50		550
	Subtotal (A2)						**550**
3.	**Cost of stationery**						
a.	Office stationery, telephone, fax						300
b.	Cost of printing of map, document, picture, report, photocopying						200
	Subtotal (A3)						**500**
4.	**Other cost**						
a.	**Air quality analysis (4 positions x 8 times/1 position) x 1 day**						
i.	CO	Sample	32		18.75		600
ii.	NO2	Sample	32		18.75		600
iii.	SO2	Sample	32		18.75		600
iv.	HC	Sample	32		5		160
v.	TSP	Sample	32		5		160
vi.	Temperature (^{0}C)	Sample	32		1		32
vii.	Humidity	Sample	32		1		32
viii.	Atmospheric pressure	Sample	32		2		64
ix.	Wind speed, wind direction	Sample	32		2		64
b.	**Noise monitoring**						
i.	L_{eq}: 4 positions x 3 times/h x 16h x 1 day	Sample	192		2		384
ii.	La max: 4 positions x 3 times/h x 16h x 1 day	Sample	192		2		384
iii.	L50: 4 positions x 3 times/h x 16 h x 1 day	Sample	192		2		384

Item	Activity	Unit	Quantity	Price Unit ($)		Total Price ($)	
				Labor	Other	Labor	Other
c.	**Vibration's monitoring**	Sample					
i.	Vibration acceleration: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
ii.	Vibration speed: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
iii.	Vibration frequency: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
d.	**Analysis of surface water: 4 samples/position (i.e., 2 downstream and 2 upstream) x 6 positions x 1 day**						
i.	Temperature (^{0}C)	Sample	24		2		48
ii.	pH	Sample	24		2		48
iii.	Turbidity	Sample	24		3		72
iv.	Conductivity	Sample	24		3		72
v.	DO	Sample	24		4		96
vi.	COD	Sample	24		5		120
vii.	BOD	Sample	24		5		120
viii.	SS	Sample	24		3		72
ix.	Total N	Sample	24		3		72
x.	Total P	Sample	24		4		96
xi.	Cu	Sample	24		4		96
xii.	Hg	Sample	24		5		120
xiii.	Oil and grease	Sample	24		18.75		450
xiv.	Total coliform	Sample	24		5		120
e.	**Analysis of underground water (2 samples/position x 4 positions) x 1 day**						
i.	Temperature (^{0}C)	Sample	8		2		16
ii.	pH	Sample	8		2		16
iii.	Color	Sample	8		2		16
iv.	Odor	Sample	8		2		16
v.	Conductivity	Sample	8		3		24
vi.	Turbidity	Sample	8		3		24
vii.	Hardness	Sample	8		5		40
viii.	Mn	Sample	8		4		32
ix.	Fe	Sample	8		4		32
x.	NO_3^-	Sample	8		4		32
xi.	Cl^-	Sample	8		4		32
xii.	SO_4^{2-}	Sample	8		4		32
xiii.	Cd	Sample	8		3		24
xiv.	Pb	Sample	8		4		32
xv.	Zn	Sample	8		4		32
xvi.	Total coliform	Sample	8		5		40
f.	**Soil quality (3 samples/position x 4 positions) x 1 day**						
i.	pH	Sample	12		3		36
ii.	Organic matter	Sample	12		5		

Item	Activity	Unit	Quantity	Price Unit ($) Labor	Price Unit ($) Other	Total Price ($) Labor	Total Price ($) Other
							60
iii.	Total N	Sample	12		5		60
iv.	Total P	Sample	12		5		60
v.	Cl^-	Sample	12		5		60
vi.	SO_4^{2-}	Sample	12		5		60
vii.	Cu	Sample	12		5		60
viii.	Zn	Sample	12		5		60
ix.	Cd	Sample	12		5		60
x.	Pb	Sample	12		5		60
xi.	Hg	Sample	12		6		72
xii.	As	Sample	12		6		72
	Subtotal (A4)						**8,242**
	Subtotal (A)					**2,580**	**9,172**
						Total	**11,752**
B.	**Construction phase (4 years) (1 sampling course every 3 months = 16 sampling courses)**						
1.	**Total cost for 1 course**						
a.	**Cost of human resources**						
i.	Take air samples and microclimate samples: 2 people x 1 day/position x 4 positions (working 16h /day).	Person-day	8	25		200	
ii.	Take noise sample: 2 person x 1 day/position x 4 positions (working 16h/day).	Person-day	8	25		200	
iii.	Take vibration sample: 2 person x 1 day/position x 4 positions (working 16h/day).	Person-day	8	25		200	
iv.	Take samples of surface water, underground water: 1 person x 1 day/position x 10 positions	Person-day	10	20		200	
v.	Take soil samples: 2 people x 1 day/position x 4 positions	Person-day	8	20		160	
vi.	Staffing of monitoring team during mobilization/demobilization period (9 people x 4 days)	Person-day	36	20		720	
vii.	Salary of monitoring team leader (0.5 month x $1,800/month)	Person-month	00.5	1,800		900	
	Subtotal (B1a)					**2,580**	
b.	**Cost of equipment**						
i.	Vehicle rental	Day	11		50		550
	Subtotal (B1b)						**550**
c.	**Cost of stationery**						
i.	Office stationery, telephone, fax						100
ii.	Cost of printing of map, document, picture, report, photocopying						100
	Subtotal (B1c)						**200**
d.	**Other cost**						
i.	**Air quality analysis (4 positions x 8 times/1 position) x 1 day**						

Item	Activity	Unit	Quantity	Price Unit ($)		Total Price ($)	
				Labor	Other	Labor	Other
	CO	Sample	32		18.75		600
	NO_2	Sample	32		18.75		600
	SO_2	Sample	32		18.75		600
	HC	Sample	32		5		160
	TSP	Sample	32		5		160
	Temperature (^{0}C)	Sample	32		1		32
	Humidity	Sample	32		1		32
	Atmospheric pressure	Sample	32		2		64
	Wind speed, wind's direction	Sample	32		2		64
ii.	**Noise monitoring**						
	L_{eq}: 4 positions x 3 times/h x 16h x 1 day	Sample	192		2		384
	La max: 4 positions x 3 times/h x 16h x1 day	Sample	192		2		384
	L50: 4 positions x 3 times/h x 16h x1 day	Sample	192		2		384
iii.	**Vibration's monitoring**						
	Vibration acceleration: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
	Vibration speed: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
	Vibration frequency: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
iv.	**Analysis of surface water: 4 samples/position (i.e., 2 downstream and 2 upstream) x 6 positions x 1 day**						
	Temperature (^{0}C)	Sample	24		2		48
	pH	Sample	24		2		48
	Turbidity	Sample	24		3		72
	Conductivity	Sample	24		3		72
	DO	Sample	24		4		96
	COD	Sample	24		5		120
	BOD	Sample	24		5		120
	SS	Sample	24		3		72
	Total nitrogen	Sample	24		3		72
	Total phosphorous	Sample	24		4		96
	Cu	Sample	24		4		96
	Hg	Sample	24		5		120
	Oil and grease	Sample	24		18.75		450
	Total coliform	Sample	24		5		120
v.	**Analysis of underground water (2 sample/position x 4 position) x 1 day**						
	Temperature (^{0}C)	Sample	8		2		16
	pH	Sample	8		2		16
	Color	Sample	8		2		16
	Smell	Sample	8		2		16
	Conductivity	Sample	8		3		24
	Turbidity	Sample	8		3		24

Item	Activity	Unit	Quantity	Price Unit ($) Labor	Price Unit ($) Other	Total Price ($) Labor	Total Price ($) Other
	Hardness	Sample	8		5		40
	Mn	Sample	8		4		32
	Fe	Sample	8		4		32
	Total coliform	Sample	8		5		40
	NO_3^-	Sample	8		4		32
	Cl^-	Sample	8		4		32
	SO_4^{2-}	Sample	8		4		32
	Cd	Sample	8		3		24
	Pb	Sample	8		4		32
	Zn	Sample	8		4		32
vi.	**Soil quality (3 sample/position x 4 position) x 1 days**						
	pH	Sample	12		3		36
	Organic substance	Sample	12		5		60
	Total N	Sample	12		5		60
	Total P	Sample	12		5		60
	Cl^-	Sample	12		5		60
	SO_4^{2-}	Sample	12		5		60
	Cu	Sample	12		5		60
	Zn	Sample	12		5		60
	Cd	Sample	12		5		60
	Pb	Sample	12		5		60
	Hg	Sample	12		6		72
	As	Sample	12		6		72
	Subtotal (B1d)						**8,002**
	Subtotal (B1)					**2,580**	**8,752**
2.	**Cost for 16 courses**					**41,280**	**140,032**
						Total	**181,312**
C.	**After construction phase (2 years) (sampling to be conducted every 6 months = total of 4 sampling courses)**						
1.	**Total cost for 1 sampling course**						
a.	**Cost of human resources**						
i.	Take air samples and microclimate samples: 2 people x 1 day/position x 4 positions (working 16h/day)	Person-day	8	25		200	
ii.	Take a noise sample: 2 people x 1 day/position x 4 positions (working 16h/day)	Person-day	8	25		200	
iii.	Take a vibration sample: 2 people x 1 day/position x 4 positions (working 16h/day).	Person-day	8	25		200	
iv.	Take a sample of surface water, underground water: 1 person x 1 day/position x 10 positions	Person-day	10	20		200	

Item	Activity	Unit	Quantity	Price Unit ($)		Total Price ($)	
				Labor	Other	Labor	Other
v.	Take a soil sample: 2 people x 1 day/position x 4 positions	Person-day	8	20		160	
vi.	Staffing of monitoring team during mobilization/demobilization (9 people x 4 days)	Person-day	36	20		720	
vii.	Salary of monitoring team leader (0.5 month x $1,800/month)	Person-month	00.5	1,800		900	
	Subtotal (C1a)					**2,580**	
b.	**Cost of equipment**						
i.	Rental car	Day	11		50		550
	Subtotal (C1b)						**550**
c.	**Cost of office stationery**						
i.	Office stationery, telephone, fax						100
ii.	Cost of printing of map, document, picture, report, photocopying						100
	Subtotal (C1c)						**200**
d	**Other cost**						
i.	**Air quality analysis (4 positions x 8 times/1 position) x 1 day**						
	CO	Sample	32		18.75		600
	NO_2	Sample	32		18.75		600
	SO_2	Sample	32		18.75		600
	HC	Sample	32		5		160
	TSP	Sample	32		5		160
	Temperature (^{0}C)	Sample	32		1		32
	Humidity	Sample	32		1		32
	Atmospheric pressure	Sample	32		2		64
	Wind speed, wind's direction	Sample	32		2		64
ii.	**Noise monitoring**						
	L_{eq}: 4 positions x 3 times/h x 16h x 1 day	Sample	192		2		384
	La max: 4 positions x 3 times/h x 16h x 1 day	Sample	192		2		384
	L50: 4 positions x 3 times/h x 16h x1 day	Sample	192		2		384
iii.	**Vibration's monitoring**						
	Vibration acceleration: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
	Vibration speed: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
	Vibration frequency: 4 positions x 3 times/h x 16h x 1 day	Sample	192		3.5		672
iv.	**Analysis of surface water: 4 samples/position (i.e., 2 downstream and 2 upstream) x 6 positions x 1 day**						
	Temperature (^{0}C)	Sample	24		2		48
	pH	Sample	24		2		48
	Turbidity	Sample	24		3		72
	Conductivity	Sample	24		3		72
	DO	Sample	24		4		96
	COD	Sample	24		5		120
	BOD	Sample	24		5		120

Item	Activity	Unit	Quantity	Price Unit ($)		Total Price ($)	
				Labor	Other	Labor	Other
	SS	Sample	24		3		72
	Total N	Sample	24		3		72
	Total P	Sample	24		4		96
	Cu	Sample	24		4		96
	Hg	Sample	24		5		120
	Oil and grease	Sample	24		18.75		450
	Total coliform	Sample	24		5		120
v.	**Analysis of underground water (2 sample/position x 4 position) x 1 day**						
	Temperature (^{0}C)	Sample	8		2		16
	pH	Sample	8		2		16
	Color	Sample	8		2		16
	Smell	Sample	8		2		16
	Conductivity	Sample	8		3		24
	Turbidity	Sample	8		3		24
	Hardness	Sample	8		5		40
	Mn	Sample	8		4		32
	Fe	Sample	8		4		32
	Total coliform	Sample	8		5		40
	NO_3^-	Sample	8		4		32
	Cl^-	Sample	8		4		32
	SO_4^{2-}	Sample	8		4		32
	Cd	Sample	8		3		24
	Pb	Sample	8		4		32
	Zn	Sample	8		4		32
vi.	**Soil quality (2 sample/position x 4 position) x 1 day**						
	pH	Sample	8		3		24
	Organic matter	Sample	8		5		40
	T N	Sample	8		5		40
	T P	Sample	8		5		40
	Cl^-	Sample	8		5		40
	SO_4^{2-}	Sample	8		5		40
	Cu	Sample	8		5		40
	Zn	Sample	8		5		40
	Cd	Sample	8		5		40
	Pb	Sample	8		5		40
	Hg	Sample	8		6		48
	As	Sample	8		6		48
	Subtotal (C1d)						**8,002**

Item	Activity	Unit	Quantity	Price Unit ($) Labor	Price Unit ($) Other	Total Price ($) Labor	Total Price ($) Other
	Subtotal (C1)					**2,580**	**8,752**
2.	**Cost for four sampling courses**					**10,320**	**35,008**
						Total	**45,328**
	Total (preconstruction)						**11,752**
	Total (construction)						**181,312**
	Total (after construction)						**45,328**
D.	**Cost of management (70% of total staffing cost)**						**37,926**
	Total (A+B+C+D), exclusive of applicable government taxes						**$276,318**

As = arsenic, dBA = A-weighted sound level in decibels, BOD = biological oxygen demand, ºC = Celsius, Cd = cadmium, Cl = chlorine, CO = carbon monoxide, COD = chemical oxygen demand, Cu = copper, DO = dissolved oxygen, Fe = iron, HC = hydrocarbon, Hg = mercury, L_{eq} = equivalent continuous noise level, Mn = manganese, N = nitrogen, NO_2 = nitrogen dioxide, NO_3 = nitrate, P = phosphorous, Pb = lead, pH = potential of hydrogen, SO_2 = sulfur dioxide, SO_4 = sulfate, SS = suspended solids, TSP = total suspended particulates, Zn = zinc

Note : The results of laboratory analyses will be compared with applicable national and international standards (European Union, TCVN = Vietnamese Standards, United States Environmental Protection Agency, World Bank, World Health Organization).

Sources: Consultant and JBIC