

**Highways Department  
Hong Kong Government**

**Agreement No. CE 22/97  
Route 9 between Tsing Yi  
and Cheung Sha Wan  
Detailed Feasibility Study**

**Final Environmental Impact Assessment Report**

**August 1999**

***Atkins China Ltd***

Supported by

中華人民共和國交通部公路規劃設計院

**Schlaich Bergermann und Partners**

**Chodai Company Limited**

**Parsons Brinckerhoff (Asia) Limited**

**Faithful & Gould Limited**

**Au Posford Consultants Limited**

**Urbis Limited**

Client : Highways Department		
Project : Agreement No. CE/22/97 Route 9 between Tsing Yi and Cheung Sha Wan Detailed Feasibility Study		
Report No. : CE/2746/OR0063-03	Date of Issue : 13 August 1999	
Copy No. :	Transmittal Ref. : 2746/16.31/OC1888/JK/nt	
Report Title : <b>Final Environmental Impact Assessment Report</b>		
Prepared By : _____	<u>Date</u> 13 August 1999 _____	
Reviewed By : _____	13 August 1999 _____	
Authorised By : _____	13 August 1999 _____	
<u>Copy No.</u>	<u>Issue to</u>	<u>Date</u>
1 – 6	HyD, CE/MW 3-1	August 1999
7 – 36	EPD	August 1999
37 – 50	ACE	August 1999
51	ACL, James Kam	August 1999
52	Office Copy	August 1999
c:\2746\report\or006303.doc		

## CONTENTS

### **1 INTRODUCTION**

- 1.1 Background
- 1.2 Aims and Objectives
- 1.3 Evaluation of Impacts
- 1.4 Study Area
- 1.5 Project Description and Representative Sensitive Receivers
- 1.6 Statutory Requirement
- 1.7 Report Construction

### **2 Noise Impact Study**

- 2.1 Introduction and Methodology
- 2.2 Background Conditions and Potential Impacts
- 2.3 Evaluation Criteria and Assumptions Used In Assessment of Noise Impacts
- 2.4 Operational Noise Impact Assessment.
- 2.5 Summary

### **3 Air Quality Impact Study**

- 3.1 Introduction
- 3.2 Background Air Quality
- 3.3 Legislation and Air Quality Criteria
- 3.4 Air Sensitive Receivers
- 3.5 Air Quality Modelling
- 3.6 Operational Air Quality Impact - Nam Wan Tunnel
- 3.7 Operational Air Quality Impact Assessment along the Alignment
- 3.8 Summary

### **4 WATER QUALITY**

- 4.1 Background Water Quality
- 4.2 Legislative Controls
- 4.3 Impacts
- 4.4 Summary

### **5 LANDSCAPE AND VISUAL IMPACTS**

- 5.1 Introduction

- 5.2 Methodology
- 5.3 Summary of Landscape and Visual Assessment
- 5.4 Landscape and Visual Impact Mitigation
- 5.5 Summary
- 6 ECOLOGY**
- 6.1 Introduction
- 6.2 Approach and Methodology
- 6.3 Western Portal Site
- 6.4 Eastern Portal Site
- 6.5 Assessment and Summary of Key Ecological Resources
- 6.6 Mitigation Measures
- 6.7 Summary
- 7 CONSTRUCTION IMPACTS**
- 7.1 Introduction
- 7.2 Construction Programme
- 7.3 Construction Methods for Viaducts
- 7.4 Construction Methods for Stonecutters Bridge
- 7.5 Sensitive Receivers
- 7.6 Noise
- 7.7 Air Quality
- 7.8 Water Quality
- 7.9 Construction Waste
- 7.10 Construction Control
- 8 ENVIRONMENTAL MONITORING & AUDITING**
- 8.1 Introduction
- 8.2 Dust
- 8.3 Noise
- 8.4 Noise Monitoring in the Operation Phase
- 8.5 Construction Waste
- 8.6 Water Quality
- 8.7 Summary
- 9 RISK ASSESSMENT**
- 9.1 Introduction

- 9.2 Study Scope And Objectives
- 9.3 Description of Route 9 Project
- 9.4 Description of Potentially Hazardous Facilities
- 9.5 Hazard Identification
- 9.6 Consequence Assessment
- 9.7 Frequency Estimation
- 9.8 Risk Assessment
- 9.9 Conclusions And Recommendations

## **10 Land use impact**

- 10.1 Introduction
- 10.2 Land Use Impacts on Tsing Yi
- 10.3 Land Use Impacts, Stonecutters Island
- 10.4 Land Use Impacts in Northern West Kowloon Reclamation
- 10.5 Summary of Key Planning and Land Use Interface Issues

## **11 SCHEDULE OF ENVIRONMENTAL IMPACT ASSESSMENT**

### **APPENDICES**

- Appendix 1 Supporting information for Noise Modelling
- Appendix 9A Shell and Caltex and Major LPG Failure Case Tables
- Appendix 9B ESSO and CRPC Major LPG Failure Case Tables
- Appendix 9C PHI Interim Risk Guideline Chart
- Appendix 9D Fireball Equations
- Appendix 9E Population Data
- Appendix 9F References
- Appendix 12 Responses to comment

### **LIST OF TABLES**

- Table 2.1 : Noise Control Legislation and Guidelines
- Table 2.2 : Summary of Noise Standards
- Table 2.3 : Existing Noise Sensitive Receivers
- Table 2.4 : Potential Future Noise Sensitive Receivers
- Table 2.5 : Predicted Noise Levels in dB(A) for the Year 2021 at NSRs in the CT9 Terminal Zone
- Table 2.6 : Predicted Noise Levels in dB(A) for the Year 2021 at NSRs in the CT9 Terminal Zone with a 5m High Barrier
- Table 2.7 : Noise Levels at Tsing Yi Receivers with a 5.1m High Barrier with

## 2.8m Cantilever

Table 2.8 : Predicted Noise Levels at NSRs in the Stonecutter Island Zone

Table 2.9 : Predicted Noise Levels in dB(A) L10 (1-hour) at NSRs

Table 2.10 : Low Noise Road Surface (LNS) on all roads of Route 9 & Route 16, plus 3m high barrier along Route 16/Route 9 Main Carriageway and the Route 9 WKE Link Roads

Table 3.1 : 1996 Measured Pollutant Levels at Sham Shui Po Station

Table 3.2 : Air Quality Objectives

Table 3.3 : Existing and Planned Air Sensitive Receivers

Table 3.4 : Air Quality Guidelines for Vehicle Tunnels

Table 3.5 : Tunnel Portal Emissions

Table 3.6 : Maximum Hourly NO<sub>2</sub> Concentration(Stonecutters Island Zone)

Table 4.1 : Standards for Effluents Discharged into the Marine Waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zone

Table 4.2 : Standards for effluents discharged into the Marine Waters of Victoria Harbour Water Control Zone

Table 4.3 : Standards for effluents discharged into the Inshore Waters of Victoria Harbour Water Control Zone

Table 4.4 : Standards for effluents discharged into the Inshore Waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zone

Table 4.5 : Standards for effluents discharged into the Group D Inland Waters

Table 4.6 : Water Quality Objectives (WQOs) for Victoria Harbour

Table 4.7 : Summary of the Water Quality Objectives (WQOs) for the Western Buffer Zone WQZ

Table 6.1 : Reptilian and Amphibian Fauna Record

Table 6.2 : Bird Record

Table 6.3 : Aquatic Macro-Invertebrates Record

Table 6.4 : Plant Species Recorded From the Proposed Portal Areas on Tsing Yi in November 1997

Table 6.5 : Table of Ecological Impacts

Table 7.1 : Equipment Schedule and Sound Power Levels

Table 7.2 : Unmitigated Construction Noise Levels at Noise Sensitive Receivers (NSRs)

Table 7.3 : Silenced Equipment Schedule and Sound Power Levels

Table 7.4 : Mitigated Construction Noise Levels at Noise Sensitive Receivers (NSRs)

Table 7.6 : Predicted TSP levels at Distances from the Construction Works

Table 7.7 : Predicted TSP levels at Receivers

Table 7.8 : Environmental Mitigation Measures for Route 9 Contractors

Table 8.1 : AL Levels for Total Suspended Particulate (TSP)

Table 8.2 : AL Levels for Noise Measured at NSRs during Construction

Table 9.3.1 : Location of Population Centres Relative to Route 9 (R9)

Table 9.3.2	: Road Section Details in Tsing Yi Study Area
Table 9.4.1	: Distance (m) to Route 9 from Depots
Table 9.4.3	: Windspeed and Stability Classes
Table 9.4.4	: Weather Class - Wind Direction Percentage Frequencies at "TYSOUTH", Tsing Yi Island
Table 9.4.5	: Tsing Yi Weather /Wind Frequency Data Converted to Sixteen Points
Table 9.4.6	: Analysis of Weather Category Direction
Table 9.4.7	: Weather Categories
Table 9.5.1	: Hazard Identification
Table 9.6.1	: Distance of PHIs and Typical Effect Distances
Table 9.6.2	: LPG Release Scenarios
Table 9.6.3	: LPG Concentrations at 500m for 600 te Liquid Release
Table 9.6.4	: LPG Concentrations at 300m for 600 te Vapour Release
Table 9.6.5	: Fireball Distances based on rupture at relief valve pressure
Table 9.6.6	: Fireball Distances based on Cold Fracture Rupture at Normal Pressure
Table 9.6.7	: Distances to Over Pressure Values
Table 9.7.1	: Industry Population Data
Table 9.7.2	: Traffic Data for Route 9
Table 9.8.1	: Comparison of Results with Previous Assessments
Table 9.8.2	: Fatality Group (Number of fatalities from any single event)

## LIST OF FIGURES

Figure 1.1	Study Area
Figure 1.2	Western Portal of Nam Wan Tunnel Leading to North West Tsing Yi Interchange
Figure 1.3	Eastern Portal of Nam Wan Tunnel and CT9 Slip Roads
Figure 1.4	Ngong Shuen Chau Viaduct and Stonecutter Base
Figure 1.5	Mei Foo Sun Chuen and Development in Northern West Kowloon Reclamation
Figure 2.1	Location of Proposed Noise Barrier CT9 Slip Road
Figure 2.2	Recommended Noise Mitigation Measures Lai Wan Interchange
Figure 2.3	Cantilever Barrier Cross Section
Figure 2.3a	Typical 3m High Noise Barrier
Figure 2.4	Mitigated Traffic Noise Levels
Figure 3.1	Maximum Hourly NO <sub>2</sub> Concentration (ug/m <sup>3</sup> ) at Nam Wan Tunnel Western Portal. Traffic Emissions plus Background Level, 10m below viaduct
Figure 3.2	Maximum Hourly NO <sub>2</sub> Concentration (ug/m <sup>3</sup> ) at Nam Wan Tunnel Western Portal. Portal Emissions only, 18m above ground
Figure 3.3	Maximum Hourly NO <sub>2</sub> Concentration (ug/m <sup>3</sup> ) at Nam Wan Tunnel Western Portal. Portal plus Traffic Emissions including Background Level

- Figure 3.4 Maximum Hourly NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Nam Wan Tunnel Eastern Portal. Traffic Emission plus Background Level, 10m below viaduct
- Figure 3.5 Maximum Hourly NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Nam Wan Tunnel Eastern Portal. Portal plus Traffic Emissions including Background Level
- Figure 3.6 Maximum Hourly NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at CT9 Terminal Zone. Traffic Emissions plus Background Level, 1.5m above ground
- Figure 3.7 Maximum Hourly NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Mei Foo Sun Chuen. Traffic Emissions plus Background Level, 1.5m above ground
- Figure 3.8 AQO NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Site 6 and Site 10 Northern WKR. Traffic Emission plus Background Level, 1.5m above ground
- Figure 3.9 AQO NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Site 6 and Site 10 Northern WKR. Traffic Emission plus Background Level, 15m above ground
- Figure 3.10 Maximum Hourly NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Sites 6 Northern WKR. Traffic Emission plus Background Level, 10m above ground
- Figure 3.11 Maximum Hourly NO<sub>2</sub> Concentration (ug/m<sup>3</sup>) at Sites 6 Northern WKR. Traffic Emission plus Background Level, 12m above ground
- Figure 6.1 Habitat – Western & Eastern Portals
- Figure 6.2 Vegetation Cover in Vicinity of R9 Alignment
- Figure 6.3 Vegetation around the Nam Wan Tunnel Portals
- Figure 9.3.1 R9 Study Area and PHIs
- Figure 9.6.1 Worst Case Scenario LPG Clouds Relative to Route 9
- Figure 9.7.1 LPG Release Event Tree
- Figure 9.8.1 Shell Individual Risk
- Figure 9.8.2 Caltex Individual Risk
- Figure 9.8.3 Shell and Caltex Combined Risk
- Figure 9.8.4 CRPC Individual Risk
- Figure 9.8.5 Esso Individual Risk
- Figure 9.8.6 CRPC and Esso Combined Risk
- Figure 9.8.7 PHIs Combined Risk
- Figure 9.8.8 Societal Risk: FN Curve Shell including Route 9
- Figure 9.8.9 Societal Risk: FN Curve Caltex including Route 9
- Figure 9.8.10 Societal Risk: FN Curve CRPC Oil including Route 9
- Figure 9.8.11 Societal Risk: FN Curve ESSO LPG Terminal (Mounded)
- Figure 10.1 Landuse Constraints



**ABBREVIATIONS**

ALARP	As Low As Reasonably Practicable
APCO	Air Pollution Control Ordinance
AQO	Air Quality Objective
BLEVE	Boiling Liquid Expanding Vapour Explosion
CT 8/9	Container Terminal 8/9
DGs	Dangerous Goods
EMSD	Electrical & Mechanical Services Department
EPD	Environmental Protection Department
LFL	Lower Flammable Limit
LPG	Liquefied Petroleum Gas
NCO	Noise Control Ordinance
NSR	Noise Sensitive Receiver
ODP	Outline Development Plan
PHI	Potentially Hazardous Installation
SR	Sensitive Receiver
TM	Technical Memorandum
USAEPA	United States of America Environmental Protection Agency
WPCO	Water Pollution Control Ordinance
WDO	Waste Disposal Ordinance
WKE	West Kowloon Expressway