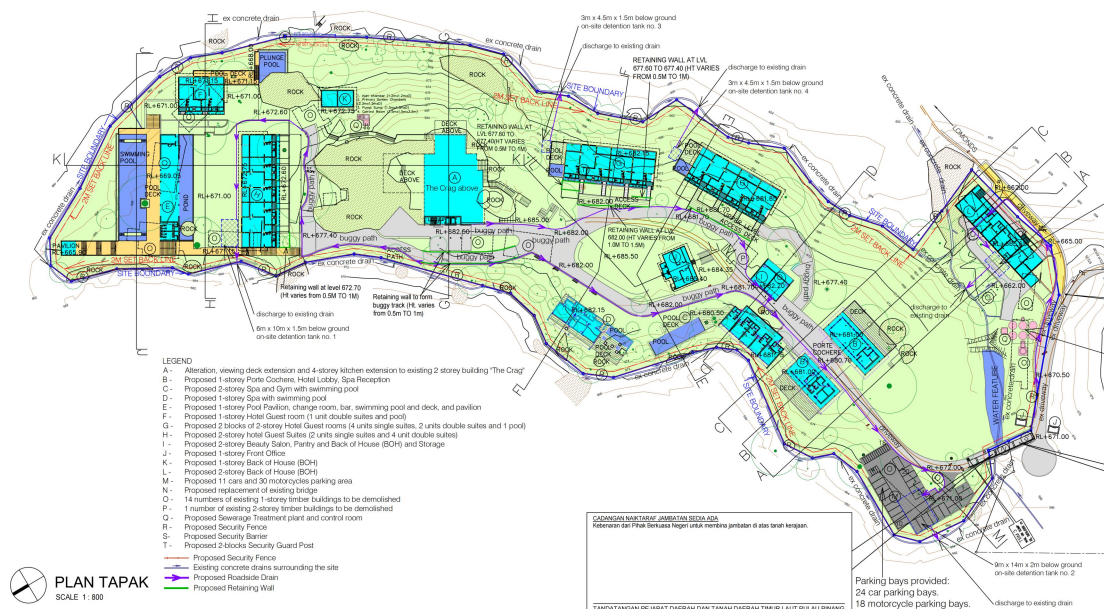


FIRST SCHEDULE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIA)

SRI NISUH SDN BHD

**“CADANGAN MEROBOHKAN BANGUNAN KAYU
SEDIA ADA DAN PEMBANGUNAN HOTEL (28 BILIK)
SERTA KEMUDAHAN BERKAITAN
DI ATAS LOT 10000, BANDAR BUKIT BENDERA,
DAERAH TIMUR LAUT, PULAU PINANG”**



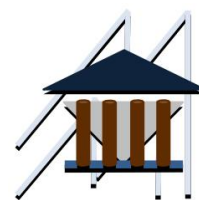
JUNE / 2026

EIA CONSULTANT



SENVIRO RESOURCES
NO 8, LORONG SERULING EMAS 9,
TAMAN SERULING EMAS
14200 SUNGAI BAKAP, PULAU PINANG
Tel: 6012 - 5821710
Email: senviroresources@gmail.com

PROJECT PROPONENT



SRI NISUH SDN BHD
M-01, MENARA MBMR,
NO 1, JALAN SYED PUTRA,
58000 KUALA LUMPUR
Tel: 603-2273 3888
Fax: 603 - 2273 3788

TABLE OF CONTENTS

TABLE OF CONTENT	i.
LIST OF TABLES	vi.
LIST OF FIGURES	ix.
LIST OF APPENDICES	xi.
PROJECT PROPONENTS'S ENVIRONMENTAL PLEDGE	
DECLARATION FROM EIA STUDY TEAM LEADER	
EXECUTIVE SUMMARY	
RINGKASAN EKSEKUTIF	

CHAPTER 1: PROJECT INTRODUCTION

1.1	Project Title	1-1
1.2	Project Proponent Details	1-1
1.3	EIA Consultant Details	1-2
1.4	Appointed Consultants Details	1-5
1.5	Project Location	1-6
1.6	Legal Requirements	1-10
1.6.1	Prescribed Activities Under The EIA Order	1-10
1.6.2	Conformance of Government's Development Plan	1-11
1.6.2.1	National Physical Plan 4 (NPP-4)	1-11
1.6.2.2	National Physical Plan 5 (NPP 5)	1-12
1.6.2.3	Penang Structure Plan (RSNPP 2030)	1-12
1.6.2.4	Penang Hill Special Area Plan 2016 (PHSAP 2016)	1-15
1.6.3	Landuse	1-19

CHAPTER 2: SCOPING NOTES

2.1	Introduction	2-1
2.2	Scoping Notes	2-1

CHAPTER 3: STATEMENT OF NEED

3.1	Introduction	3-1
3.2	Statement of Need of Proposed Project	3-1
3.3	Aims of the Proposed Development	3-2

CHAPTER 4: PROJECT OPTIONS AND ALTERNATIVES

4.1	Site Suitability Assessment (SSA) and Consideration in Project Alternatives and Options	4-1
4.1.1	SSA for Revitalisation of Historical Heritage Buildings	4-1
4.1.2	Project Sitting / Site Options	4-1
4.1.3	Project Options and Alternatives	4-2
4.1.3.1	The 'No Project' Alternative	4-2

4.1.3.2 The ‘Yes Project’ Alternative	4-3
4.1.4 Layout Options	4-3
4.1.5 Operations Options	4-4
4.2 Summary	4-4
4.3 Conclusion and Evaluation	4-5

CHAPTER 5: PROJECT DESCRIPTION

5.1 Project Location	5-1
5.2 Site Ownership, Size, Zoning and Land Use	5-2
5.3 Project Concept and Development Components	5-3
5.3.1 Planning Permission Application	5-3
5.3.2 Project Concept	5-3
5.3.3 Heritage Preservation in Project Concept	5-9
5.4 Accessibility	5-11
5.5 Infrastructure And Utility Demand	5-13
5.5.1 Utility Demand	5-13
5.5.2 Sewage Treatment Plant	5-19
5.5.3 Solid Waste Management	5-21
5.6 Project Activities	5-21
5.7 General Construction Method Statement based on Geotechnical Report	5-26
5.7.1 Method Statement for Soil Nailing	5-26
5.7.2 Earthworks	5-26
5.7.3 Temporary and Permanent Slope Protection	5-27
5.8 Method Statement for Demolition Works	5-27
5.8.1 Scope of Works	5-27
5.8.2 Methodology	5-27
5.8.3 Safety	5-27
5.9 Project Timeline	5-28

CHAPTER 6: EXISTING ENVIRONMENT

6.1 Introduction	6-1
6.2 Physico-Chemical Environment	6-2
6.2.1 Topography and Terrain Classification	6-2
6.2.2 Soil and Geology	6-5
6.2.2.1 Site Geology	6-5
6.2.2.2 Soil Profile based on SI Report	6-6
6.2.3 Geological Terrain Mapping	6-8
6.2.3.1 Slope Gradient Map	6-8
6.2.3.2 Construction Suitability Map	6-8
6.2.3.3 Geological Terrain Classification Map	6-8
6.2.3.4 Erosion Map	6-8
6.2.3.5 Physical Constraints Map	6-8
6.2.3.6 Engineering Geology Map	6-8
6.2.3.7 Geohazard Map	6-8

6.2.3.8 Conclusion and Recommendations from GTM Report	6-10
6.2.4 Geotechnical Report Findings	6-19
6.2.4.1 Sub Surface Soil Investigation	6-19
6.2.4.2 Geophysical Survey	6-19
6.2.4.3 Engineering Properties of Subsoil	6-21
6.2.4.4 Slope Design & Stability Analysis	6-22
6.2.4.5 Foundation Design	6-24
6.2.4.5 Slope Design & Stability Analysis	6-25
6.2.4.6 Instrumentation and Monitoring	6-25
6.2.4.7 Conclusion and Recommendation (Geotechnical Report)	6-26
6.2.5 Hydrology and Drainage System	6-27
6.2.6 Flood Prone Area	6-32
6.2.7 Climate and Meteorology	6-34
6.2.7.1 Rainfall	6-35
6.2.7.2 Temperature	6-37
6.2.7.3 Relative Humidity (RH)	6-38
6.2.7.4 Wind Speed and Direction	6-39
6.2.8 Environmental Baseline	6-41
6.2.8.1 Air Quality	6-41
6.2.8.2 Noise Level	6-44
6.2.8.3 Vibration	6-47
6.2.8.4 Water Quality	6-50
6.3 Biological Environment	6-56
6.3.1 Flora and Fauna Assessment	6-57
6.3.1.1 Objective of Assessment Study	6-57
6.3.1.2 Existing Environment	6-57
6.3.1.3 Key Policies and Relevant Legislatives	6-59
6.3.1.4 Ecological and Biological Conditions of Site	6-59
6.3.1.5 Survey Methodology	6-62
6.3.1.6 Results and Findings	6-65
6.3.1.6.1 Ecological Assessment	6-65
6.3.1.6.2 Flora	6-65
6.3.1.6.1 Fauna	6-71
6.3.1.7 Conclusion from Flora & Fauna Assessment	6-82
6.4 Human Environment	6-83
6.4.1 Landuse and Sensitive Receptors	6-83
6.4.1.1 Environmental Sensitive Areas (ESAs)	6-84
6.4.1.2 Compatibility with Surrounding Land	6-90
6.4.2 Socio-Economic Study	6-95
6.4.2.1 Zone of Influence	6-95
6.4.2.2 Methodology	6-96
6.4.2.3 Analysis of Study Findings	6-100

CHAPTER 7: IMPACT ASSESSMENT

7.1	Introduction	7-1
7.2	Project Main Activities	7-1
7.3	Identification and Prediction Assessments of Impact	7-4
7.3.1	Pre-Construction Phase	7-4
7.3.2	Demolition and Construction Phase	7-4
7.3.3	Operation Phase	7-21
7.3.4	Abandonment/ Post Closure Phase (Optional)	7-26
7.4	Matrix Summary of Impact	7-29
7.5	Residual Impacts	7-30
7.6	Socio Economic Evaluation	7-31
7.6.1	Expected Impact by residents, businesses, institutions, tourists and the broader community within the zone of impact (Pre-Construction of Project)	7-31
7.6.2	Expected Impact by residents, businesses, institutions, tourists and the broader community within the zone of impact (Pre-Construction of Project)	7-33
7.6.3	Expected Impact by residents, businesses, institutions, tourists and the broader community within the zone of impact (Pre-Construction of Project)	7-36
7.6.4	Summary of Positive Impacts of Proposed Development	7-37
7.7	Air Quality Assessment During Demolition & Construction Phase	7-38
7.7.1	Emission of Particulate Matter PM10	7-38
7.7.2	Emission from Transportation of Material/Waste on Paved Road	7-39
7.7.2.1	Calculation of Emission Factor (PM10) Without Waste Management	7-41
7.7.2.2	Calculation of Emission Factor (PM10) With Waste Management	7-42
7.7.3	Summary of Emission Rates	7-43
7.7.4	Sensitive and Discrete Receptors	7-44
7.8	Noise Level Assessment	7-45
7.8.1	Noise Level Impact	7-45
7.8.2	Expected Sound Propagation from Point Sources	7-47
7.9	Water Quality Modelling	7-50
7.9.1	Introduction	7-50
7.9.2	Methodology	7-50
7.9.3	Baseline Data Results	7-53
7.9.4	Qual2k Simulation Results	7-56
7.9.4.1	TSS	7-56
7.9.4.2	BOD	7-59
7.9.4.3	COD	7-61
7.9.4.4	NH3-N	7-63
7.9.4.5	Oil and Grease	7-65
7.9.5	Waste Load Allocation (WLA)	7-67
7.9.6	Conclusion	7-67
7.10	Erosion Assessment and Evaluation	7-68
7.10.1	Soil Erosion Assessment and Evaluation on Site	7-68

7.10.2 Soil Loss Estimation with RUSLE	7-70
7.10.3 Estimation of Sediment Yield	7-75
7.10.4 Sizing of Sediment Basin	7-78
7.10.5 Sizing of Temporary Earth Drain	7-78

CHAPTER 8: MITIGATION MEASURES

8.1 Introduction	8-1
8.2 Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2)	8-1
8.3 Mitigation Measures	8-4
8.4 Abandonment Phase	8-33
8.5 Inspection and Maintenance	8-34
8.5.1 General BMPs Inspection and Maintenance	8-34
8.5.2 Slope Protection and Maintenance	8-35
8.5.2.1 Instrumentation and Monitoring	8-35
8.5.2.2 Post Construction Monitoring and Maintenance	8-35

CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1 Introduction	9-1
9.2 Objective of the EMP	9-1
9.3 Scope of the EMP	9-1
9.4 Key Information in the EMP	9-2
9.5 Regulatory Requirements	9-3
9.6 Guided Self-Regulation (GSR) Through Environmental Mainstreaming Tools	9-4
9.6.1 Environmental Policy (EP)	9-4
9.6.2 Environmental Budgeting (EB)	9-4
9.6.3 Environmental Monitoring Committee (EMC)	9-4
9.6.3.1 Project Proponent (PP)	9-5
9.6.3.2 Environmental Consultant (EC)	9-5
9.6.3.3 Environmental Officer (EO)	9-6
9.6.4 Environmental Facility (EF)	9-6
9.6.5 Environmental Competency (EC)	9-7
9.6.6 Environmental Reporting and Communications (ERC)	9-7
9.6.6.1 External Reporting	9-7
9.6.6.2 Internal Reporting	9-8
9.6.6.3 Communication Channels	9-8
9.6.7 Environmental Transparency (ET)	9-8
9.7 Environmental Monitoring Programme	9-9
9.8 Environmental Auditing	9-15
9.9 Abandonment Plan	9-16

CHAPTER 10: CONCLUSION

REFERENCE

10-1
R-1

LIST OF TABLE

TABLE NO.		PAGE
1.1	Registered EIA Study Team	1-3
1.2	Strategy/ Development Framework of NPP-4	1-11
1.3	DPU and DSP related to Proposed Project	1-12
1.4	List of Heritage Buildings in Penang Hil	1-16
2.1	Scoping Notes	2-1
2.2	Potential Significant Impacts	2-2
2.3	Baseline Requirements	2-4
2.4	Baseline Environmental Quality	2-5
2.5	Assessment Standard	2-6
2.6	Sampling Stations	2-7
3.1	Statement of Need	3-3
4.1	Summary of the advantages and disadvantages for 'No Project' Alternative	4-2
4.2	Summary of advantages and disadvantages of 'Yes Project' Alternative	4-3
4.3	Summary of Options	4-5
5.1	Details of Lot Involved	5-2
5.2	Project Development Component	5-6
5.3	Population Equivalent (PE) Estimation	5-13
5.4	Water Demand Estimation	5-14
5.5	Electrical Load Estimation	5-17
5.6	Key Project Activities	5-21
5.7	Estimated Cut and Fill Volume	5-24
5.8	Proposed Project Implementation Schedule	5-29
6.1	Existing Environmental Component Assessed	6-1
6.2	Summary of Boreholes	6-6
6.3	Slope Gradient Classes	6-8
6.4	Construction Suitability Classification of the Site based on CSM Map	6-8
6.5	Geological terrain classification attributes	6-9
6.6	Adopted Design Soil Parameter	6-21
6.7	Summary of Results of Slope Stability Analysis	6-23
6.8	Percentage Frequencies of Occurrence for Concurrent Wind Direction	6-40
6.9	Description of Ambient Air Quality Sampling Location	6-42
6.10	Ambient Air Quality Standard Method	6-42
6.11	New Ambient Malaysia Air Quality Standard	6-42
6.12	Description of Ambient Noise Level Sampling Location	6-45
6.13	Ambient Noise Level Standard Method	6-45
6.14	Recommended Permissible Level (L_{aeq}) by Receiving Land use for New Development	6-45
6.15	Description of Vibration Sampling Locations	6-48
6.16	Recommended Vibration Limits for Human Response and Annoyance from Intermittent Vibrations (Third Schedule)	6-48
6.17	Human Perception of Vibration and Likely Environmental Impact	6-48
6.18	Ground Vibration Monitoring Result	6-49

6.19	Description of Water Sampling Locations	6-50
6.20	Comparison Baseline Data with DOE's Database	6-50
6.21	Water Quality Result Analysis	6-53
6.22	Water Uses Classification	6-54
6.23	Fauna Survey Methods	6-63
6.24	Number of Species Identified	6-66
6.25	Total Flora Species Composition of Proposed Project Site	6-67
6.26	List of Mammals, Reptiles and Heptero fauna Species Observed in Study Area	6-72
6.27	List of Avifauna species observed on site	6-77
6.28	List of Environmentally Sensitive Areas (ESAs) within 5km from the Proposed Project Site	6-89
6.29	Village/Housing/Industrial Areas Within the 3km ZOI	6-98
6.30	Social Profiling of Respondents	6-100
6.31	Social Profiling of Respondents under all 3 categories	6-100
6.32	Resident Understanding to the Proposed Project	6-107
6.33	Residents' Thoughts on the Benefits of the Proposed Project	6-111
6.34	Respondents' Thoughts on Issues in Existing Environment	6-112
7.1	Typical Activities for Construction Related Projects	7-1
7.2	Potential Impacts during Demolition and Construction Phase	7-6
7.3	Typical noise levels generated by construction machinery	7-7
7.4a	Types of Scheduled Waste Expected to be Generated from Demolition Activities	7-15
7.4b	Types of Scheduled Waste Expected to be Generated from Demolition Activities	7-16
7.5	Potential Impacts during Operation Phase	7-22
7.6	Potential Impacts during Abandonment/Post Closure Phase	7-26
7.7	Summary of Potential Impacts	7-29
7.8	Residual Impacts	7-30
7.9	Expected Positive Impacts During Pre-Construction	7-31
7.10	Expected Negative Impacts During Pre-Construction	7-32
7.11	Expected Positive Impacts During Project Construction	7-33
7.12	Expected Negative Impacts During Project Construction	7-34
7.13	Expected Positive Impacts After Project Completed and Operational	7-36
7.14	Expected Negative Impacts After Project Completed and Operational	7-37
7.15	Estimated Material Composition of Demolition Waste	7-42
7.16	Summary of Expected Emission Rates	7-43
7.17	Sixth Schedule: Maximum Permissible Sound Levels (Percentile L10 and Lmax) Of Construction, Maintenance and Demolition Work by Receiving Land use	7-45
7.18	Construction Equipment Noise Emission Levels	7-46
7.19	Predicted Noise Attenuation with Distance for Point Source	7-48
7.20	Summary of Baseline Water Quality Data	7-54
7.21	Project Site Water Discharge Quality Scenario (Construction Phase)	7-55
7.22	Sewage Effluent Quality Scenario (Operation Phase)	7-55
7.23	Qual2k Simulation Scenario	7-55
7.24	Determination of K Factor	7-72

7.25	Determination of LS Factor	7-72
7.26	The Summary of Adopted C Factor and P Factor	7-73
7.27	Soil Loss Tolerance Rates from Erosion Risk Map Malaysia	7-73
7.28	Summary of Soil Loss Assessment for Development Site	7-73
7.29	The Description of Soil Loss Assessment Result	7-74
7.30	Sediment Yield Assessment Result	7-75
7.31	The Description of Sediment Yield Assessment	7-76
7.32	Summary of Sediment Basin Specification	7-78
8.1	Proposed BMPs	8-2
8.2	Prevention Pollution and Mitigation Measures (P2M2s)	8-5
8.3a	List of Scheduled Wastes expected from Demolition Activities	8-19
8.3b	List of Scheduled Wastes at the Construction Site	8-20
8.4	Emergency Response Plan (ERP)	8-27
8.5	Frequency of regular maintenance works	8-35
9.1	Key Information in the EMP	9-2
9.2	Types of Environmental Report and Submission Responsibility	9-7
9.3	Environmental Monitoring Programme Description	9-9
9.4	Environmental Monitoring Programme	9-11
9.5	Environmental Monitoring Sampling Stations	9-15

LIST OF FIGURE

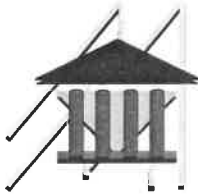
FIGURES NO.		PAGE
1.1	Location Plan	1-7
1.2	Proposed Site and Coordinate	1-8
1.3	Overview of Current Site Condition	1-9
1.4	Zoning of Project Site According to RSNPP 2030	1-14
1.5	Location of historical heritage buildings	1-17
1.6	Developmental Zones on Penang Hill	1-18
1.7	Zoning of Proposed Project Site According to i-plan	1-19
2.1	Landuse within 0-5km radius	2-2
2.2	Environmental Baseline Sampling Point Locations (Air, Noise and Vibration)	2-8
2.3	Environmental Baseline Sampling Point Locations (Water Quality)	2-9
5.1	Project Location	5-1
5.2	3D Perspective Views of Proposed Project	5-5
5.3	PKM Layout Plan	5-7
5.4	Cross sectionals of the Proposed Development	5-8
5.5	Main Structure of Crag Hotel	5-10
5.6	Some of the wooden buildings on the site to be demolished	5-10
5.7	Site Accessibility	5-11
5.8	Water Distribution Plan	5-15
5.9	Electrical Installation Site Plan	5-18
5.10	Layout of Proposed Small Sewage Treatment System (SSTS)	5-19
5.11	Sewerage Plan	5-20
5.12	Route from project site to dumping location	5-24
5.13	Typical Soil Nail Detail	5-26
6.1	Existing Topography at Project Site	6-2
6.2	Demarcation, Spot Levels and Details Survey	6-3
6.3	Surface Morphology Map	6-4
6.4a	Geology of Project site and Penang Island	6-5
6.4b	Summary of Soil Profile	6-7
6.5	Slope Gradient Map	6-12
6.6	Development Suitability Map	6-13
6.7	Terrain Classification Map	6-14
6.8	Erosion Map	6-15
6.9	Physical Constraints Map	6-16
6.10	Engineering Geology Map	6-17
6.11	Geohazard Map	6-18
6.12	Seismic Refraction Layout Plan	6-20
6.13	Seismic Profile L4	6-21
6.14	Slope Layout Plan with Section Lines	6-22
6.15	Section B-B Slope Profile	6-23
6.16	Sample of Slope Stability Analysis (Section B-B)	6-24
6.17	Micropile Foundation at Slope Area	6-25
6.18	Flow Direction from Project Site to the Nearest River	6-28

6.19	Flow Direction Map	6-29
6.20	Existing Drainage System at Project Area based on Survey Plan	6-30
6.21	Penang Water Supply Infrastructure	6-31
6.22	Penang Flood Hot Spot	6-33
6.23	Nearest Meteorological Station to the Project Site	6-34
6.24	Mean Monthly Rainfall	6-35
6.25	Mean Monthly Raindays	6-35
6.26	Mean Annual Rainfall	6-36
6.27	Annual Raindays	6-36
6.28	Mean Monthly 24-hr Temperature	6-37
6.29	Mean Annual Temperature	6-38
6.30	Mean Monthly Relative Humidity	6-38
6.31	Mean Annual Relative Humidity	6-39
6.32	Wind rose	6-40
6.33	Ambient Air Quality Sampling Locations	6-41
6.34a-b	Particulate Matter 2.5 and 10 Monitoring Result	6-43
6.35	Ambient Noise Level Sampling Locations	6-44
6.36	Compliance of Noise Level During Daytime and Night time	6-46
6.37	Vibration Sampling Locations	6-47
6.38	Water Quality Sampling Locations	6-52
6.39	Water Quality Classification	6-54
6.40	Water Quality Index Classification Based on Water Uses	6-54
6.41	Current site condition	6-56
6.42	Overall Biosphere Area with Project Site	6-58
6.43	Some Flora Species Observed at Site	6-70
6.44	Some Terrestrial Fauna Observed at Project Site	6-74
6.45	Some Avifauna Species Observed at Project Site	6-80
6.46	Penang Hill Vampire Crab	6-81
6.47	Environmentally Sensitive Areas (ESA) in Peninsular Malaysia & F.T of Labuan (NPP 4)	6-85
6.48	Environmentally Sensitive Areas in RSNPP 2030 within 5km radius of project site	6-86
6.49	Penang Hill Biosphere Reserve	6-87
6.50	Environmentally Sensitive Areas within 5km radius of Project Site	6-88
6.51	Landuse within 5 km radius of Project Boundary	6-91
6.52	Landuse within 1 km from Project Boundary	6-92
6.53	Landuse within 3 km from Project Boundary	6-93
6.54	Landuse within 3-5 km from Project Boundary	6-94
6.55	Zone of Influence (ZOI) within 2km	6-95
6.56	Methodology Approach	6-96
6.57	Sample size Calculation	6-97
6.58	Photos Captured During the Questionnaire Survey	6-99
7.1	PM10 Dispersion Scenarios	7-44
7.2	Distance from Site to the Sensitive Receptors	7-47
7.3	Noise Impact Scenarios: Mitigated and Unmitigated	7-49
7.4	Water Sampling Point for Water Quality Modelling	7-51
7.5	Schematic Diagram for Qual2k Simulation	7-52

7.6	Total Suspended Solids (TSS) Contamination Level (Earthwork Phase)	7-57
7.7	Total Suspended Solids (TSS) Contamination Level (Operation Phase)	7-58
7.8	Biochemical Oxygen Demand (BOD) Contamination Level (Operation Phase)	7-60
7.9	Chemical Oxygen Demand (COD) Contamination Level (Operation Phase)	7-62
7.10	Ammoniacal Nitrogen (NH ₃ -N) Contamination Level (Operation Phase)	7-64
7.11	Oil & Grease Contamination Level (Operation Phase)	7-66
7.12	Division for Soil Loss Estimation based on Earthwork Phasing	7-69
7.13	Determination of Rainfall Erosivity Factor (R Factor)	7-71
7.14	Anticipated Soil Loss on Site by RUSLE	7-74
7.15	Anticipated Sediment Yield on site by MUSLE	7-75
7.16	Erosion Risk Map	7-77
8.1	Example of scheduled waste storage area	8-21
8.2	Example of scheduled metal drum container	8-21
8.3	Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 2005	8-22
9.1	Monitoring Sampling Point Locations (Air, Noise and Vibration)	9-13
9.2	Monitoring Sampling Point Locations (Water Quality)	9-14

LIST OF APPENDICES

APPENDIX A	A-1: DOE Letter A-2: SIA & TIA waiver letter from MBPP A-3: Geotechnical Report Approval Letter A-4: Water Enactment Involvement Letter A-5: Correspondence Letters from Technical Agencies A5i : MBPP (all subdivisions) A5viii : Fire & Rescue Dept. A5ii : PDT A5ix : JKR A5iii : JPBD A5x : DOE A5iv : TNB A5xi : JMG A5v : PBA A5xii : SKMM A5vi : IWK A5xiii : PTG A5vii : JPS A5xiv : Forestry Dept.
APPENDIX B	B-1: KM Layout Plan
APPENDIX C	C-1: Land Title
APPENDIX D	D-1: Water Distribution Plan D-2: Water Demand Table D-3: Sewerage Plan D-4: Sewerage Report D-5: Electricity Load Details
APPENDIX E	E-1 EW/ESCP/LD-P2M2 Layout and Details E-2 Phasing of Construction Zones E-3 ESCP Hydraulic Report
APPENDIX F	F-1: Demolition Plan F-2: Demolition Method Statement
APPENDIX G	G-1: R&D Layout Plan G-2: Hydraulic Calculation Report (OSD)
APPENDIX H	H-1: Topographical Survey Plan H-2: Certified Plan
APPENDIX I	I-1: SAMM Laboratory Analysis
OTHER REPORT ATTACHMENT (SOFTCOPY)	S-1: Geotechnical Assessment Report S-2: Geotechnical Terrain Mapping Report S-3: Geological Assessment and SI Report S-4: Flora and Fauna Assessment Report



SRI NISUH SDN BHD

(A member of the Med-Bumikar Mara group of companies) (60953 V)

M-01 Menara MBMR, No. 1 Jalan Syed Putra,
58000 Kuala Lumpur, Malaysia
Tel : 603 22733888 | Fax : 603 22733788

PROJECT PROPONENTS'S ENVIRONMENTAL PLEDGE

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR “CADANGAN MEROBOHKAN BANGUNAN KAYU SEDIA ADA DAN PEMBANGUNAN HOTEL (28 BILIK) SERTA KEMUDAHAN BERKAITAN DI ATAS LOT 10000, BANDAR BUKIT BENDERA, DAERAH TIMUR LAUT, PULAU PINANG”

“I hereby declare that the entire EIA Report is the product of the Qualified Person (Senviro Resources) engaged by my company and all the facts stated in the Report and the accompanying information are to the best my knowledge and belief true and correct, and that I have not withheld or distorted any material facts. I agree and I undertake the responsibility to implement all the Pollution Prevention and Mitigation Measures (P2M2s) described in the EIA Report, in the Environmental Management Plan (EMP), and in the LD-P2M2* as proposed by the EIA Consultant. I have allocated sufficient funds for the above purpose.”

Signature : 
Name : WONG WEI KHIN
IC / Passport : 680820-08-5495
Position : DIRECTOR

Official Stamp:
SRI NISUH SDN BHD (60953-V)

(*Note: LD-P2M2 stands for Land Disturbing Pollution Prevention and Mitigation Measures)

DECLARATION FROM EIA STUDY TEAM LEADER

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR “CADANGAN MEROBOHKAN BANGUNAN KAYU SEDIA ADA DAN PEMBANGUNAN HOTEL (28 BILIK) SERTA KEMUDAHAN BERKAITAN DI ATAS LOT 10000, BANDAR BUKIT BENDERA, DAERAH TIMUR LAUT, PULAU PINANG”

“I declare that the entire EIA Report is the product of my own work and the work of my team members who works under my supervision and all the facts stated in the Report and the accompanying information are to the best of my knowledge and belief true and correct and that I have not withheld or distorted any materials facts. I have briefed the Project Proponent on the content of the Report and highlighted to him all the pollution prevention and mitigation measures (P2M2s) described in it, and in the Environmental Management Plan (EMP), and in the LD – P2M2*, and the Project Proponent has agreed to implement them (i.e.P2M2)”

Name : PROF DR. SHANKER KUMAR SINNAKAUDAN
NRIC Number : 730721-06-5387
Designation : EIA CONSULTANT (CEP-CS0372)
Signature :

Company's
stamp :



(*Note: LD-P2M2 stands for Land Disturbing Pollution Prevention and Mitigation Measures)

Environmental Impact Assessment (First Schedule)

“CADANGAN MEROBOHKAN BANGUNAN KAYU SEDIA ADA DAN PEMBANGUNAN HOTEL (28 BILIK) SERTA KEMUDAHAN BERKAITAN DI ATAS LOT 10000, BANDAR BUKIT BENDERA, DAERAH TIMUR LAUT, PULAU PINANG”

PROJECT BACKGROUND

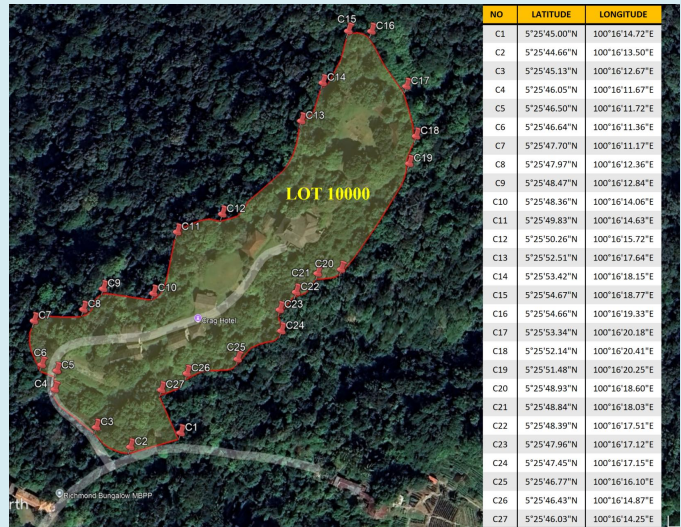
PROJECT OVERVIEW

SRI NISUH SDN. BHD intends to demolish 22 units of existing abandoned dilapidated wooden buildings and redevelop the existing Crag Hotel historic structure into a 28 room hotel and spa with related facilities on a land spanning 7.69 acres (3.112 hectares) located on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang (hereafter referred to as Proposed Project).

LEGAL REQUIREMENT

First Schedule

- Prescribed Activity 13 – Development in Slope Area**
Development of land clearing less than 50% of an area with slope greater than or equal to 25° but less than 35°



ZONING

Penang Structure Plan 2030 (RSNPP 2030)

- The project site is zoned as Forested Area. However, PLANMalaysia Penang has stated that the development is allowed as it is in line with strategies outlined in PHSAP 2016 that has been approved by the state government

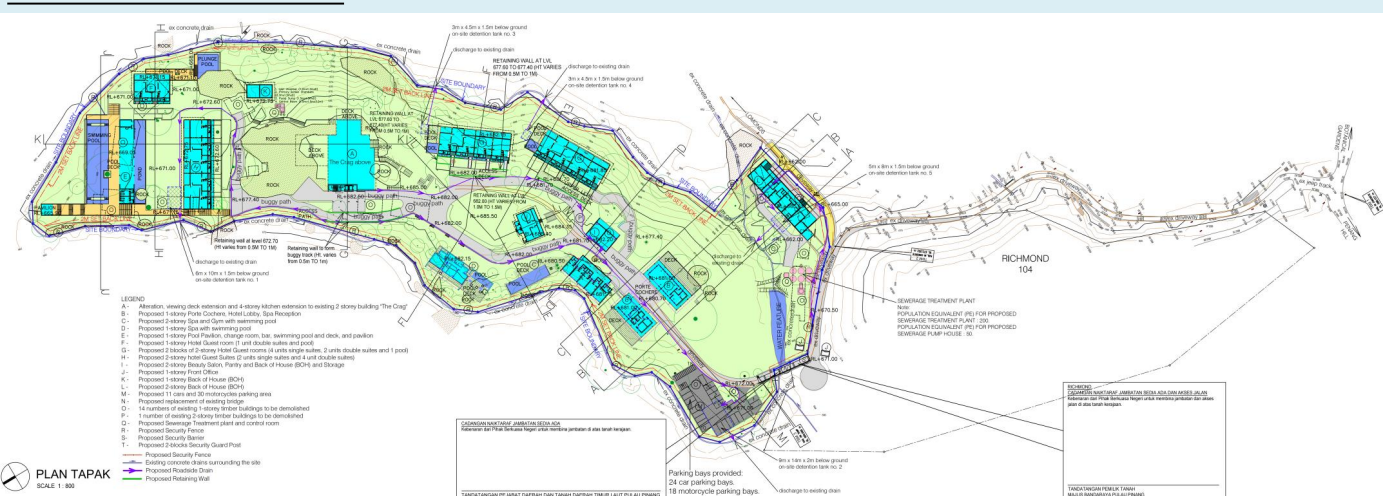
Penang Hill Special Area Plan 2016 (PHSAP 2016)

- The project site is zoned as Tourism Developmental Zone and Heritage Building Site.

PROJECT COMPONENTS

DATA PEMBANGUNAN / DEVELOPMENT DATA		SUBSISTEM PLOT / PLOT RATIO						
Kawasan / Area	Luas / Area	KETERANGAN						
Lot 10000	31.12 ha	1. 0.220						
Zon / Zone		Pelancongan kemasi / Commercial tourism.						
Nisbah plot / Plot ratio		Minimum 1:1						
Kawasan Pengamiran / Plinth Area		Minimum 25% plinth area						
Proposed 11.5% plinth area		Proposed plinth area: 3,581 m ²						
Tempat letak kereta / Parking spaces		Total plot ratio area = open plot area + pool area = 8,226 m ²						
80% total area = 6,580 m ²		1 parking bay per 200 m ² = 33 parking bays.						
20% total area = 1,646 m ²		3 parking bay per 100 m ² = 50 parking bays.						
Total required parking bays		83 car parking bays						
83 motorcycle parking bays		Total required parking bays						
Tempat letak kereta yang disediakan / Parking provided		Car park provided: 38 bays						
Motorcycle park provided: 18 bays								
		PARAM. 1	PARAM. 2	PARAM. 3	PARAM. 4	PARAM. 5	PARAM. 6	PARAM. 7
KETERANGAN		1. 120 m ²	215 m ²	254 m ²	620 m ²	1,215 m ²	-	-
a) PRINDAN, TAMBAHAN DERIVATIF DAN TAMBAHAN DAPUR 4-TINGKAT KEPADA BANGUNAN BERDUA 2-TINGKAT "THE CINO".		-	-	-	-	-	-	-
b) 2-TINGKAT ANJUNG KERETA (PORTE COCHERE), LOBI HOTEL, TEMPAT RESEPSI SPA.		-	-	-	-	-	-	-
c) 2-TINGKAT RUANG SPA, GYMNASIUM DAN KOLAM RENANG.		288 m ²	255 m ²	-	-	-	-	-
d) 1-TINGKAT RUANG SPA, DINI KOLAM RENANG.		-	-	-	-	-	-	-
e) 1-TINGKAT KOLAM PAVILION, BUKU PERSALINAN BAJU, BAR, KOLAM RENANG DAN DEK DAN PAVILION.		-	-	-	-	-	-	-
f) 1-TINGKAT SUITE TETAPAN HOTEL (4 UNIT DOUBLE SUITE DAN 4 KOLAM RENANG).		-	-	-	-	-	-	-
g) 2 BLOK 2-TINGKAT SUITE TETAPAN HOTEL (4 UNIT SINGLE SUITE DAN 2 UNIT DOUBLE SUITE DAN 4 KOLAM RENANG).		882 m ²	882 m ²	-	-	-	-	-
h) 2-TINGKAT SUITE TETAPAN HOTEL (2 UNIT SINGLE SUITE DAN 4 UNIT DOUBLE SUITE).		-	-	-	-	-	-	-
i) 1-TINGKAT SALON/KECANTIKAN (BEAUTY SALON), KAWASAN PEKERJAAN (BACK OF HOUSE) DAN STOK.		139 m ²	110 m ²	-	-	-	-	-
j) 1-TINGKAT PEJABAT DEPAN (FRONT OFFICE).		-	-	-	-	-	-	-
k) 1-TINGKAT KAWASAN PEKERJAAN LAIN (BACK OF HOUSE).		-	-	-	-	-	-	-
l) 2-TINGKAT KAWASAN PEKERJAAN LAIN (BACK OF HOUSE) DENGAN KAWASAN LETAK KERETA ATAS RUMAH.		133 m ²	403 m ²	-	-	-	-	-
m) 2 BLOK 1-TINGKAT RUANG PENGAWAT, KESALAMATAN (SECURITY GUARD POST).		-	-	-	-	-	-	-
Jumlah		1,382 m ²	3,817 m ²	752 m ²	254 m ²	620 m ²	8,841 m ²	1,382 m ²
GADANGAN KAWASAN / PROPOSED AREA: 6,841 m ²		GADANGAN MINIMUM PLOT / PROPOSED PLOT RATIO: 1: 0.220						
GADANGAN KAWASAN PEKERJAAN / PROPOSED PLANT AREA: 3,881 m ² (51.8%)		1,382 m ²	2,189 m ²					

PROJECT LAYOUT



EXECUTIVE SUMMARY

PHYSICO-CHEMICAL ENVIRONMENT

EXISTING ENVIRONMENT	DESCRIPTION																								
TOPOGRAPHY	• Topography : Gentle to steep slopes with a mix of natural formations and modified lands • Highest elevation: 668 m (center) • Lowest elevation: 662m (northwest & southeast) • Slope gradients: Majority of the site (32.07%) consists of steep slopes (>25°–35°), followed closely by gently sloping areas (0°–15°) at 29.21%. 26.96% consists of moderately steep slopes (>15°–25°), with the remaining 11.76% consisting of very steep slopes (>35°–60°).																								
SOIL & GEOLOGY	• Predominantly lies within North Penang Pluton of Late Carboniferous age & is part of Tanjung Bungah Granite. • Soil profile predominantly consists of Silt, Clay and Sand.																								
HYDROLOGY	• The proposed project is located within a dua catchment system, majority of runoff naturally drains towards Sungai Air Terjun catchment, while some flows towards Sungai Tat catchment. • Within the project area, an existing concrete drainage system is present, flowing towards the perimeter of the site boundary then discharging at southern part of the project site. • During construction and operation, the project will alter the natural drainage regime by redirecting all surface runoff towards Sg Air Terjun. There is a risk of increased sediment load and pollutant transport will affect the downstream water intake. However appropriate mitigation measures the potential hydrological impacts can be controlled and adverse effects can be reduced.																								
ENVIRONMENTAL SAMPLING • Air Quality	• Air quality sampling works was carried out at three (3) locations • The results shows that all the tested parameters complied with the permissible level as per New Malaysia Ambient Air Quality Standard (MAAQs 2020) at all sampling stations. 40.0 35.0 30.0 25.0 20.0 15.0 10.0 5.0 0.0 Concentration of PM2.5 (µg/m³) Permissible Level of PM2.5 = 35 µg/m³ <table><thead><tr><th>Monitoring Station</th><th>Baseline Concentration (µg/m³)</th><th>Permissible Level (µg/m³)</th></tr></thead><tbody><tr><td>A1</td><td>9.9</td><td>35</td></tr><tr><td>A2</td><td>4.9</td><td>35</td></tr><tr><td>A3</td><td>7.3</td><td>35</td></tr></tbody></table> BASELINE Permissible Level 120.0 100.0 80.0 60.0 40.0 20.0 0.0 Concentration of PM10 (µg/m³) Permissible Level of PM10 = 100 µg/m³ <table><thead><tr><th>Monitoring Station</th><th>Baseline Concentration (µg/m³)</th><th>Permissible Level (µg/m³)</th></tr></thead><tbody><tr><td>A1</td><td>11.7</td><td>100</td></tr><tr><td>A2</td><td>11.3</td><td>100</td></tr><tr><td>A3</td><td>10.0</td><td>100</td></tr></tbody></table> BASELINE Permissible Level	Monitoring Station	Baseline Concentration (µg/m³)	Permissible Level (µg/m³)	A1	9.9	35	A2	4.9	35	A3	7.3	35	Monitoring Station	Baseline Concentration (µg/m³)	Permissible Level (µg/m³)	A1	11.7	100	A2	11.3	100	A3	10.0	100
Monitoring Station	Baseline Concentration (µg/m³)	Permissible Level (µg/m³)																							
A1	9.9	35																							
A2	4.9	35																							
A3	7.3	35																							
Monitoring Station	Baseline Concentration (µg/m³)	Permissible Level (µg/m³)																							
A1	11.7	100																							
A2	11.3	100																							
A3	10.0	100																							
ENVIRONMENTAL SAMPLING • Noise Level	• Noise level sampling works was carried out at three (3) locations • The results below shows that all the tested parameters complied with the standard guidelines of “Guidelines for Environmental Noise Limits and Control, Third Edition 2019 (Reprint 2021)” 80 70 60 50 40 30 20 10 0 Noise Level (dBA) Maximum Permissible Sound Level for Day Time = 55-70 dBA <table><thead><tr><th>Monitoring Station</th><th>Baseline Noise Level (dBA)</th><th>Permissible Level (dBA)</th></tr></thead><tbody><tr><td>N1</td><td>43.8</td><td>55-70</td></tr><tr><td>N2</td><td>40.6</td><td>55-70</td></tr><tr><td>N3</td><td>52.5</td><td>55-70</td></tr></tbody></table> BASELINE Permissible Level 70 60 50 40 30 20 10 0 Noise Level (dBA) Maximum Permissible Sound Level for Night Time = 55-65 dBA <table><thead><tr><th>Monitoring Station</th><th>Baseline Noise Level (dBA)</th><th>Permissible Level (dBA)</th></tr></thead><tbody><tr><td>N1</td><td>44</td><td>55-65</td></tr><tr><td>N2</td><td>40.3</td><td>55-65</td></tr><tr><td>N3</td><td>54.9</td><td>55-65</td></tr></tbody></table> BASELINE Permissible Level	Monitoring Station	Baseline Noise Level (dBA)	Permissible Level (dBA)	N1	43.8	55-70	N2	40.6	55-70	N3	52.5	55-70	Monitoring Station	Baseline Noise Level (dBA)	Permissible Level (dBA)	N1	44	55-65	N2	40.3	55-65	N3	54.9	55-65
Monitoring Station	Baseline Noise Level (dBA)	Permissible Level (dBA)																							
N1	43.8	55-70																							
N2	40.6	55-70																							
N3	52.5	55-70																							
Monitoring Station	Baseline Noise Level (dBA)	Permissible Level (dBA)																							
N1	44	55-65																							
N2	40.3	55-65																							
N3	54.9	55-65																							

EXECUTIVE SUMMARY

PHYSICO-CHEMICAL ENVIRONMENT

EXISTING ENVIRONMENT	DESCRIPTION																																																																																																																																																																																					
ENVIRONMENTAL SAMPLING Vibration	- Vibration level sampling works was carried out at two (2) locations. - The findings indicate that the existing ground vibration levels at V1 and V2 complied during day and night time. <table><tr><th colspan="4">DAY TIME</th></tr><tr><td colspan="2">Monitoring Station</td><td>V1</td><td>V2</td></tr><tr><td colspan="2">Receiving Land Use Category</td><td>Residential</td><td>Commercial, Business</td></tr><tr><td colspan="2">Recommended Limit</td><td>0.8 mm/s to 1.6 mm/s</td><td>1.6 mm/s</td></tr><tr><td rowspan="5">BASELINE</td><td>Peak Particle Velocity (mm/s)</td><td>0.421</td><td>0.458</td></tr><tr><td>Compliance Status</td><td>Complied</td><td>Complied</td></tr><tr><td>Degree of Perception</td><td>Barely noticeable</td><td>Barely noticeable</td></tr><tr><td>Environmental Impact</td><td>Little</td><td>Little</td></tr><tr><td>Potential Source of Non-Compliance</td><td>-</td><td>-</td></tr><tr><th colspan="4">NIGHT TIME</th></tr><tr><td colspan="2">Monitoring Station</td><td>V1</td><td>V2</td></tr><tr><td colspan="2">Receiving Land Use Category</td><td>Residential</td><td>Commercial, Business</td></tr><tr><td colspan="2">Recommended Limit</td><td>0.4 mm/s</td><td>1.6 mm/s</td></tr><tr><td rowspan="5">BASELINE</td><td>Peak Particle Velocity (mm/s)</td><td>0.381</td><td>0.458</td></tr><tr><td>Compliance Status</td><td>Complied</td><td>Complied</td></tr><tr><td>Degree of Perception</td><td>Barely noticeable</td><td>Barely noticeable</td></tr><tr><td>Environmental Impact</td><td>Little</td><td>Little</td></tr><tr><td>Potential Source of Non-Compliance</td><td>-</td><td>-</td></tr></table>	DAY TIME				Monitoring Station		V1	V2	Receiving Land Use Category		Residential	Commercial, Business	Recommended Limit		0.8 mm/s to 1.6 mm/s	1.6 mm/s	BASELINE	Peak Particle Velocity (mm/s)	0.421	0.458	Compliance Status	Complied	Complied	Degree of Perception	Barely noticeable	Barely noticeable	Environmental Impact	Little	Little	Potential Source of Non-Compliance	-	-	NIGHT TIME				Monitoring Station		V1	V2	Receiving Land Use Category		Residential	Commercial, Business	Recommended Limit		0.4 mm/s	1.6 mm/s	BASELINE	Peak Particle Velocity (mm/s)	0.381	0.458	Compliance Status	Complied	Complied	Degree of Perception	Barely noticeable	Barely noticeable	Environmental Impact	Little	Little	Potential Source of Non-Compliance	-	-																																																																																																																					
DAY TIME																																																																																																																																																																																						
Monitoring Station		V1	V2																																																																																																																																																																																			
Receiving Land Use Category		Residential	Commercial, Business																																																																																																																																																																																			
Recommended Limit		0.8 mm/s to 1.6 mm/s	1.6 mm/s																																																																																																																																																																																			
BASELINE	Peak Particle Velocity (mm/s)	0.421	0.458																																																																																																																																																																																			
	Compliance Status	Complied	Complied																																																																																																																																																																																			
	Degree of Perception	Barely noticeable	Barely noticeable																																																																																																																																																																																			
	Environmental Impact	Little	Little																																																																																																																																																																																			
	Potential Source of Non-Compliance	-	-																																																																																																																																																																																			
NIGHT TIME																																																																																																																																																																																						
Monitoring Station		V1	V2																																																																																																																																																																																			
Receiving Land Use Category		Residential	Commercial, Business																																																																																																																																																																																			
Recommended Limit		0.4 mm/s	1.6 mm/s																																																																																																																																																																																			
BASELINE	Peak Particle Velocity (mm/s)	0.381	0.458																																																																																																																																																																																			
	Compliance Status	Complied	Complied																																																																																																																																																																																			
	Degree of Perception	Barely noticeable	Barely noticeable																																																																																																																																																																																			
	Environmental Impact	Little	Little																																																																																																																																																																																			
	Potential Source of Non-Compliance	-	-																																																																																																																																																																																			
ENVIRONMENTAL SAMPLING Water Quality	- Water quality sampling works was carried out at three (3) locations which are at concrete drain near the project site, upstream and downstream of the Sungai Air Terjun water intake facility. No water discharge was detected at W1 during the sampling period. W2 was compliant and classified as Clean. W3 was found to be slightly polluted, with low DO levels. Field observations indicate that multiple discharge points from surrounding area likely contribute to these observed compliance failures. <table><tr><th rowspan="3">Parameters</th><th rowspan="3">Unit</th><th colspan="9">BASELINE</th></tr><tr><th colspan="3">Concrete Drain</th><th colspan="6">Sungai Air Terjun</th></tr><tr><th colspan="3">W1</th><th colspan="3">W2</th><th colspan="3">W3</th></tr><tr><th></th><th></th><th>Result</th><th>Compliance Limit (Class IIA)</th><th>Compliance Status</th><th>Result</th><th>Compliance Limit (Class IIA)</th><th>Compliance Status</th><th>Result</th><th>Compliance Limit (Class IIA)</th><th>Compliance Status</th></tr><tr><td>pH Value @25C</td><td>unitless</td><td>NWD</td><td>6.5-8.5</td><td>-</td><td>7.3</td><td>6.5-8.5</td><td>Complied</td><td>7.9</td><td>6.5-8.5</td><td>Complied</td></tr><tr><td>BOD - 5 days test @ 20°C</td><td>mg/L</td><td>NWD</td><td>3</td><td>-</td><td>3.0</td><td>3</td><td>Complied</td><td>3.0</td><td>3</td><td>Complied</td></tr><tr><td>COD</td><td>mg/L</td><td>NWD</td><td>25</td><td>-</td><td>13.5</td><td>25</td><td>Complied</td><td>10.4</td><td>25</td><td>Complied</td></tr><tr><td>Total Suspended Solids</td><td>mg/L</td><td>NWD</td><td>50</td><td>-</td><td>ND</td><td>50</td><td>Complied</td><td>ND</td><td>50</td><td>Complied</td></tr><tr><td>Ammonical Nitrogen</td><td>mg/L</td><td>NWD</td><td>0.3</td><td>-</td><td>ND</td><td>0.3</td><td>Complied</td><td>ND</td><td>0.3</td><td>Complied</td></tr><tr><td>Dissolved Oxygen (DO)</td><td>mg/L</td><td>NWD</td><td>5-7</td><td>-</td><td>5.2</td><td>5-7</td><td>Complied</td><td>2.5</td><td>5-7</td><td>Not Complied</td></tr><tr><td>Temperature</td><td>°C</td><td>NWD</td><td>Normal+2oC</td><td>-</td><td>21.5</td><td>Normal+2oC</td><td>Complied</td><td>21.6</td><td>Normal+2oC</td><td>Complied</td></tr><tr><td>Turbidity</td><td>NTU</td><td>NWD</td><td>50</td><td>-</td><td>2.8</td><td>50</td><td>Complied</td><td>2.1</td><td>50</td><td>Complied</td></tr><tr><td>Oil&Grease</td><td>mg/l</td><td>NWD</td><td>-</td><td>-</td><td>ND</td><td>-</td><td>-</td><td>ND</td><td>-</td><td>-</td></tr><tr><td>Escherichia coli</td><td>MPN/100ml</td><td>NWD</td><td>-</td><td>-</td><td>79.0</td><td>-</td><td>-</td><td>9.3</td><td>-</td><td>-</td></tr><tr><td rowspan="3">WATER QUALITY INDEX (WQI)</td><td>SCORE</td><td colspan="3">-</td><td colspan="3">85.81</td><td colspan="3">76.12</td></tr><tr><td>CLASS</td><td colspan="3">-</td><td colspan="3">CLASS II</td><td colspan="3">CLASS III</td></tr><tr><td>STATUS</td><td colspan="3">-</td><td colspan="3">CLEAN</td><td colspan="3">SLIGHTLY POLLUTED</td></tr></table>	Parameters	Unit	BASELINE									Concrete Drain			Sungai Air Terjun						W1			W2			W3					Result	Compliance Limit (Class IIA)	Compliance Status	Result	Compliance Limit (Class IIA)	Compliance Status	Result	Compliance Limit (Class IIA)	Compliance Status	pH Value @25C	unitless	NWD	6.5-8.5	-	7.3	6.5-8.5	Complied	7.9	6.5-8.5	Complied	BOD - 5 days test @ 20°C	mg/L	NWD	3	-	3.0	3	Complied	3.0	3	Complied	COD	mg/L	NWD	25	-	13.5	25	Complied	10.4	25	Complied	Total Suspended Solids	mg/L	NWD	50	-	ND	50	Complied	ND	50	Complied	Ammonical Nitrogen	mg/L	NWD	0.3	-	ND	0.3	Complied	ND	0.3	Complied	Dissolved Oxygen (DO)	mg/L	NWD	5-7	-	5.2	5-7	Complied	2.5	5-7	Not Complied	Temperature	°C	NWD	Normal+2oC	-	21.5	Normal+2oC	Complied	21.6	Normal+2oC	Complied	Turbidity	NTU	NWD	50	-	2.8	50	Complied	2.1	50	Complied	Oil&Grease	mg/l	NWD	-	-	ND	-	-	ND	-	-	Escherichia coli	MPN/100ml	NWD	-	-	79.0	-	-	9.3	-	-	WATER QUALITY INDEX (WQI)	SCORE	-			85.81			76.12			CLASS	-			CLASS II			CLASS III			STATUS	-			CLEAN			SLIGHTLY POLLUTED		
Parameters	Unit			BASELINE																																																																																																																																																																																		
				Concrete Drain			Sungai Air Terjun																																																																																																																																																																															
		W1			W2			W3																																																																																																																																																																														
		Result	Compliance Limit (Class IIA)	Compliance Status	Result	Compliance Limit (Class IIA)	Compliance Status	Result	Compliance Limit (Class IIA)	Compliance Status																																																																																																																																																																												
pH Value @25C	unitless	NWD	6.5-8.5	-	7.3	6.5-8.5	Complied	7.9	6.5-8.5	Complied																																																																																																																																																																												
BOD - 5 days test @ 20°C	mg/L	NWD	3	-	3.0	3	Complied	3.0	3	Complied																																																																																																																																																																												
COD	mg/L	NWD	25	-	13.5	25	Complied	10.4	25	Complied																																																																																																																																																																												
Total Suspended Solids	mg/L	NWD	50	-	ND	50	Complied	ND	50	Complied																																																																																																																																																																												
Ammonical Nitrogen	mg/L	NWD	0.3	-	ND	0.3	Complied	ND	0.3	Complied																																																																																																																																																																												
Dissolved Oxygen (DO)	mg/L	NWD	5-7	-	5.2	5-7	Complied	2.5	5-7	Not Complied																																																																																																																																																																												
Temperature	°C	NWD	Normal+2oC	-	21.5	Normal+2oC	Complied	21.6	Normal+2oC	Complied																																																																																																																																																																												
Turbidity	NTU	NWD	50	-	2.8	50	Complied	2.1	50	Complied																																																																																																																																																																												
Oil&Grease	mg/l	NWD	-	-	ND	-	-	ND	-	-																																																																																																																																																																												
Escherichia coli	MPN/100ml	NWD	-	-	79.0	-	-	9.3	-	-																																																																																																																																																																												
WATER QUALITY INDEX (WQI)	SCORE	-			85.81			76.12																																																																																																																																																																														
	CLASS	-			CLASS II			CLASS III																																																																																																																																																																														
	STATUS	-			CLEAN			SLIGHTLY POLLUTED																																																																																																																																																																														

EXECUTIVE SUMMARY

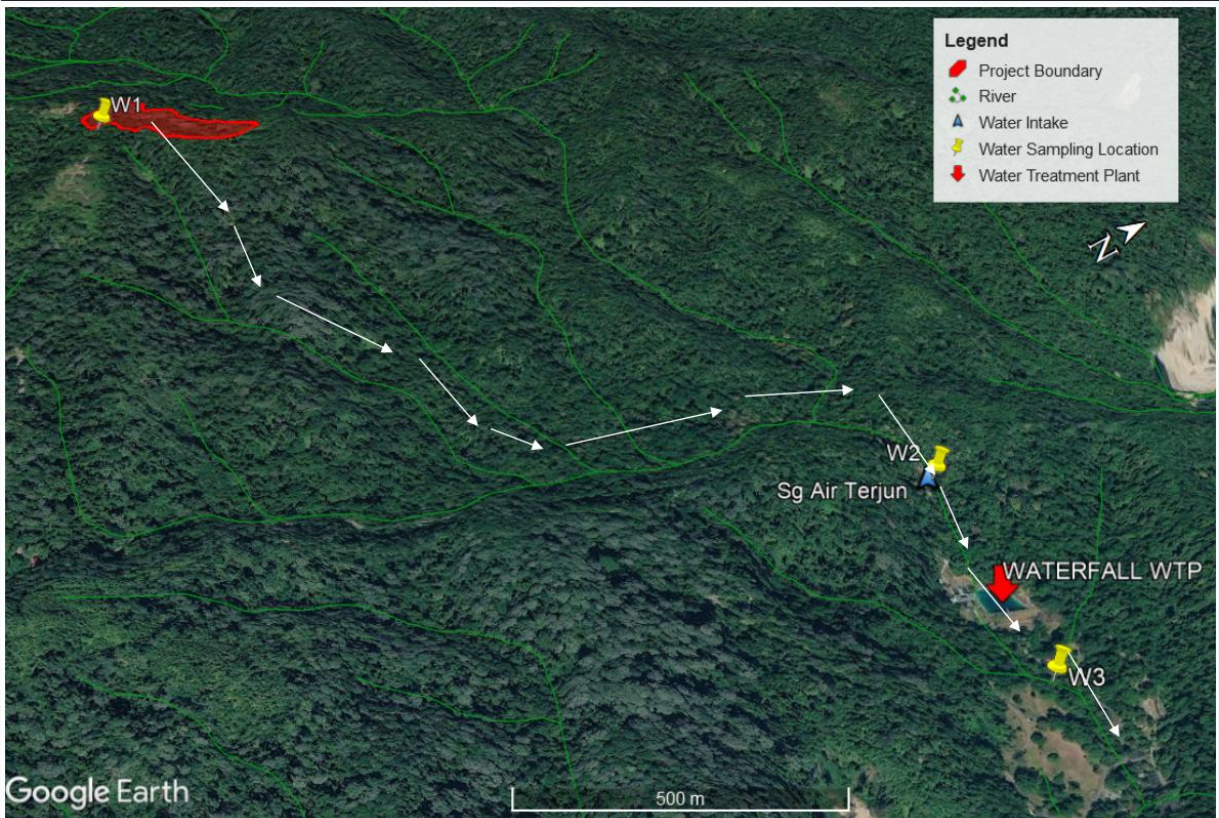
PHYSICO-CHEMICAL ENVIRONMENT

PROPOSED BASELINE SAMPLING LOCATIONS

- AIR QUALITY, NOISE LEVEL & VIBRATION -



- WATER QUALITY -



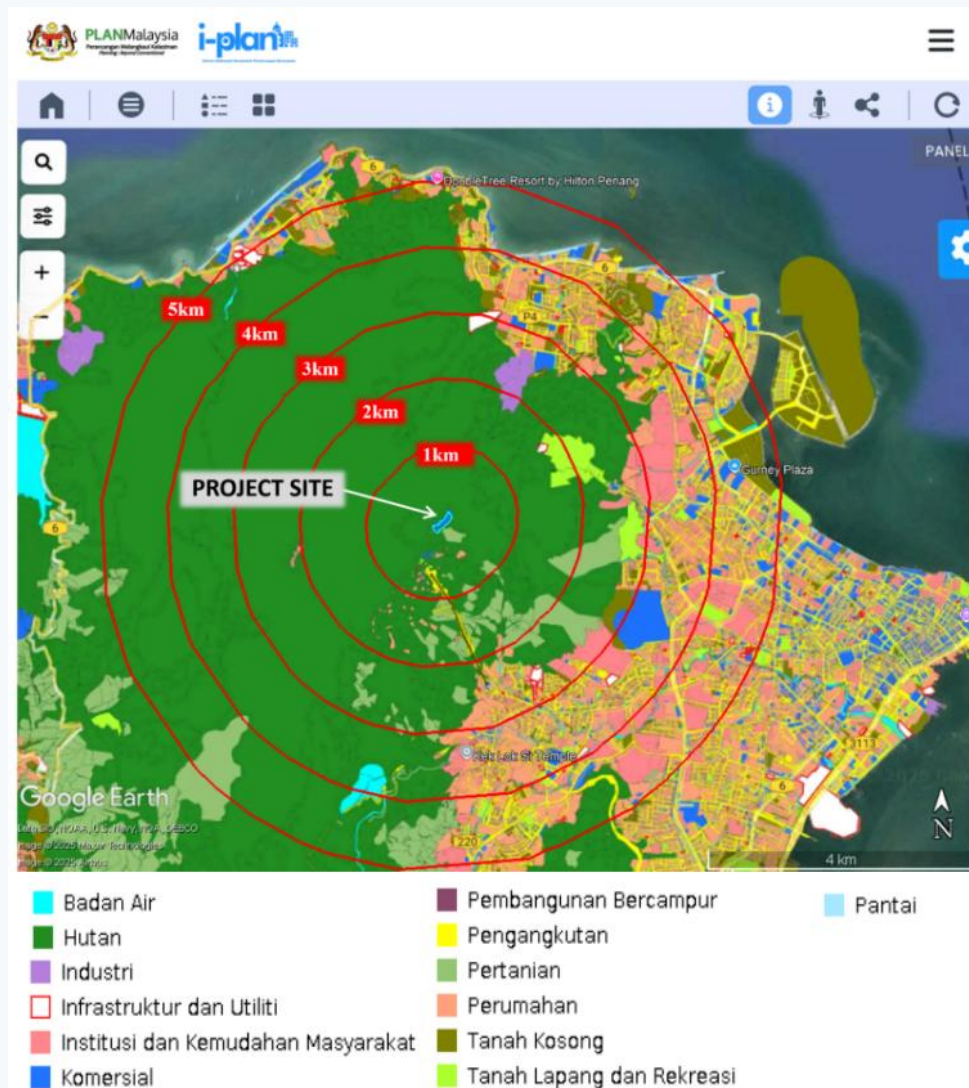
EXECUTIVE SUMMARY

BIOLOGICAL ENVIRONMENT

- The land has previously been disturbed for the construction of existing buildings which are now not in use.
- The flora around the Crag Hotel ruins on Penang Hill is shaped by ecological succession since its abandonment. The majority of the area is rapidly reverting to secondary and hill dipterocarp forest.
- The fauna survey found that 2 Endangered (EN) fauna species (Dusky leaf monkey and Sunda Slow Loris), 1 Critically Endangered (CR) fauna species (Sunda Pangolin) found in the vicinity of the project area. For avifauna species, 1 Near Threatened species (Indochinese Blue Flycatcher) and 4 Totally Protected species are likely to inhabit or pass through the surrounding area.

HUMAN ENVIRONMENT

SURROUNDING LANDUSE WITHIN A RADIUS OF 5KM



SOCIO- ECONOMY

- There is no active human settlement observed within the project site. The site is surrounded by forested lands, scattered settlements and is near to the tourist center of Penang Hilltop.
- In general, the proposed project is expected to bring more benefits to the local community with minimal negative impacts.
- A socio-economic study was conducted within a 3km radius with a total of 362 respondents, ranging from local residents, businesses, institutions, tourists, and the broader community within the zone of impact.
- In general, response to the proposed project is favourable and supportive.

EXECUTIVE SUMMARY

POTENTIAL IMPACT & MITIGATION MEASURES

DEMOLITION & CONSTRUCTION PHASE

POTENTIAL IMPACTS	MITIGATION MEASURES
AIR QUALITY - Dust from vehicle & equipment use - Dust from exposed area - Dust from earthwork activities	- Ensure access and internal roads are kept smooth, well-graded, and clean. - Air pollution control/ dust control (construct of wash through, provide hoarding, water jet spray.) - Machinery & vehicle regularly service and maintained - Ambient air quality impact monitoring to be conducted on periodical basis to assess & monitor the ambient air quality at the project area
NOISE LEVEL & VIBRATION - Noise from equipment & plants - Noise from vehicle movements - Vibration from piling work	- Construction work scheduling during daytime. No works take place at nighttime and on weekends - Employ noise control measures (install of perimeter hoarding, used noise barriers, PPE for workers) - Machinery & vehicle regularly service and maintained - Ambient noise level & vibration limit monitoring to be conducted on periodical basis to assess & monitor the ambient air quality at the project area
WATER QUALITY - Land clearing and earthworks activities; - Untreated sewage discharge; - Uncontrolled surface runoff	- Implementation of LD-P2M2 tools prior to commencement of earthwork - Any surface water runoff discharge from the project site to the offsite area of the project site during the earthwork & construction work shall contain TSS<50mg/L & turbidity<250NTU - Any discharge of wastewater into the watercourses direct or indirectly must be avoided
EROSION & SEDIMENTATION - Soil erosion and sedimentation - Site clearing and earthwork activities - Land disturbing activities on-site;	- The LD-P2M2 tools at the project site shall be constructed before land-disturbing activities - Runoff & stormwater management on site - Erosion and sediment control - Temporary covers of exposed areas - Regular site inspection, maintenance and monitoring of BMPs on-site. - The existing drainage will be retained, & integrated into the drainage design
WASTE MANAGEMENT - Biomass Waste & Unsuitable Material - Overburden Materials - Solid Waste - Sewage - Scheduled Waste - Demolition Waste	- Biomass generated during site clearing needs to be properly managed and dispose off. - The handling and disposal of sewage should be in accordance with Environmental Quality (Sewage) Regulations, 2009. - The handling and disposal of scheduled waste should be in accordance with Environmental Quality (Scheduled Wastes) Regulations 2005. - Recycle and reuse demolition debris whenever possible. Disposal of demolition waste must be at approved landfills.
TRAFFIC - Movement of vehicle passing by via the main access road - Damage to roads from heavy vehicles	- Scheduled heavy vehicle transport during off peak hour periods - Vehicles for carrying building materials, debris and excavated materials should be clean, well maintained and in good running condition - Vehicle speeds should be limited within the project site.
SAFETY AND HEALTH Safety to the construction workers	- Prepare Emergency Response Plan (ERP) in case of emergencies on site - Provide Personal Protective Equipment (PPE) to construction workers
EOCLOGICAL MANAGEMENT Flora & fauna	- Clearly demarcate site-clearing boundaries and no-go areas - Only native flora should be used for landscaping. Flora salvage can be done to remove selected native plants. - Install sturdy, high visibility fencing in active construction zones - Strict no feeding policy among workers. Food waste storage should be secured.
SOCIO-ECONOMIC - Potential job opportunities to the locals - Boosting local economy	- The project proponent should advertise to the surrounding community for encouraging locals to participate in jobs that are suitable to their skill; - The contractor shall make sure the foreign workers recruited have a work permit to enter the construction site
GEOTECHNICAL - Potential geological hazard - Groundwater table effect	Adhere to all the proposed recommendation by geotechnical engineer & accredited checker (ICE)

EXECUTIVE SUMMARY

POTENTIAL IMPACT & MITIGATION MEASURES

OPERATIONAL PHASE

POTENTIAL IMPACTS	MITIGATION MEASURES
AIR QUALITY - Fugitive emissions from mobile vehicles - Minimal impact	- Regularly serviced & maintained the vehicles - Avoid running engines for long periods of time when in a stationary position
NOISE LEVEL & VIBRATION Minimal impact	- Landscaping and natural buffers can help soften the noise from human activities; - Regularly serviced & maintained the vehicles - Avoid running engines for long periods of time when in a stationary position
WATER QUALITY - Surface runoff discharge - Effluent discharge	- Permanent drainage system & OSD tank will be provided to controls water runoff - The treated sewage within the project site shall comply with Environmental Quality (Sewage) Regulation 2009.
EROSION & SEDIMENTATION - No discharges to any open water courses - The exposed area will be permanently stabilized	- Erosion and sedimentation will not be major impacts and no mitigation measures are necessary with the exception of rehabilitation works take place. - Permanent drainage network and on-site detention tank to be installed at-site to capture runoff from the site
WASTE GENERATION - Solid waste/municipal wastes - Sewage	- The waste generated shall be deposited at the approved disposal site. - The sewage discharge from the project site will be channelled to proposed Small Sewage Treatment System (SSTS)
TRAFFIC Minimal impact	Shall abide by local authorities and JKR requirements for traffic management and transportation requirements.
SAFETY & HEALTH Public safety and health with the occupancy of the building.	The design of the proposed project has been formulated to provide for a safe environment for future residents
LAND-USE, LANDSCAPE & VISUAL Aesthetics	Rehabilitation of the site through landscaping and replanting the area
FLORA & FAUNA - Disturbance from light pollution - Potential environmental damage	- Shielded, downward facing warm lighting fixtures which are less disruptive. Motion sensor lighting alongside the peripheral forest areas - Comprehensive education shall be provided to staff and guests, in order to foster responsible tourism practices. - Future research and monitoring can be established to further understand and conserve the ecological dynamics of the area.
SOCIO-ECONOMIC - Employment opportunities - Business opportunities	The project proponent should advertise business opportunities to the surrounding community and encouraging locals to participate in jobs that are suitable to their skills
GEOTECHNICAL - Potential geological hazard - Potential hydrogeology	Adhere to all the proposed recommendation by geotechnical engineer & accredited checker (ICE) based on site condition

EXECUTIVE SUMMARY

IMPACT & COMPLIANCE MONITORING



AIR QUALITY



NOISE LEVEL



WATER QUALITY



VIBRATION

PARAMETER

PM2.5, PM10, SO2,
NO2, O3, CO

Laeq, Lmin, Lmax,
L10, L50, L90

Temperature, pH,
DO, Turbidity,
Conductivity, BOD,
COD, TSS, AN, Oil
& Grease, E.Coli,
Faecal Coliform,
Total Coliform

Peak particles,
velocity, ppv

STANDARD

New Malaysia
Ambient Air Quality
Standard 2020

Guidelines for
Environmental
Noise Limit &
Control, 2019
(Reprint 2021)

National Water Quality
Standards (NWQS) –
Class IIB

Guidelines for
Environmental Vibration
Limits and Control Third
Edition (DOE, 2021)

FREQUENCY

Monthly

Quarterly

Monthly

Quarterly

NO OF
STATIONS

3

3

3

2

PERFORMANCE MONITORING



SEDIMENTATION POND



BMPs in ESCP/LD-P2M2

PARAMETER

TSS
Turbidity

Structural integrity, practicality, functionality
and frequency of maintenance for all P2M2

STANDARD

TSS: 50 mg/L
Turbidity: 250 NTU

-

MONITORING

Monthly
Biweekly
Per rainfall event

Monthly
Biweekly
Per rainfall event

NO OF
STATIONS

Discharge from all sediment basins

All BMPs proposed within the project site

EXECUTIVE SUMMARY

STUDY FINDINGS

- ❖ **SRI NISUH SDN BHD (hereafter referred to as the project proponent) intends to demolish 22 units of existing abandoned dilapidated wooden buildings and redevelop the existing Crag Hotel historic structure into a 28 room hotel and spa with related facilities on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang. This project will entail the development of around 7.69 acres (3.112 hectares) of land area.**
- ❖ **The preliminary existing environmental studies was conducted which include site survey, soil investigations, site geology, geological terrain mapping, geotechnical study, as well as environmental baseline assessment, etc.**
- ❖ **Overall findings shows that the potential impact from the project site to the surrounding areas are expected to be minimal & in the short term period.**
- ❖ **With the assumption that all proposed ESCP/LD-P2M2 components are implemented on site, the impacts could be mitigated accordingly with least amount of impact.**
- ❖ **As such, to ensure that the P2M2s are effective on-site, an Environmental Management Plan with Environmental Auditing & Monitoring Programme are recommended to the project proponent**
- ❖ **Once fully developed, the project will offer a hotel and spa consisting of 28 rooms and related facilities, reminiscent of the origins of Crag Hotel which used to be a health sanatorium.**

“CADANGAN MEROBOKKAN BANGUNAN KAYU SEDIA ADA DAN PEMBANGUNAN HOTEL (28 BILIK) SERTA KEMUDAHAN BERKAITAN DI ATAS LOT 10000, BANDAR BUKIT BENDERA, DAERAH TIMUR LAUT, PULAU PINANG”

TINJAUAN PROJEK

PEMATUHAN

Aktiviti 13: Pembangunan di Kawasan Cerun

	NO	LATITUDE	LONGITUDE
	C1	5°25'45.00"N	100°16'14.72"E
	C2	5°25'44.66"N	100°16'13.50"E
	C3	5°25'45.13"N	100°16'12.67"E
	C4	5°25'46.05"N	100°16'11.67"E
	C5	5°25'46.50"N	100°16'11.72"E
	C6	5°25'46.64"N	100°16'11.36"E
	C7	5°25'47.70"N	100°16'11.17"E
	C8	5°25'47.97"N	100°16'12.36"E
	C9	5°25'48.47"N	100°16'12.84"E
	C10	5°25'48.36"N	100°16'14.06"E
	C11	5°25'49.83"N	100°16'14.63"E
	C12	5°25'50.26"N	100°16'15.72"E
	C13	5°25'52.51"N	100°16'17.64"E
	C14	5°25'53.42"N	100°16'18.15"E
	C15	5°25'54.67"N	100°16'18.77"E
	C16	5°25'54.66"N	100°16'19.33"E
	C17	5°25'53.34"N	100°16'20.18"E
	C18	5°25'52.14"N	100°16'20.41"E
	C19	5°25'51.48"N	100°16'20.25"E
	C20	5°25'48.93"N	100°16'18.60"E
	C21	5°25'48.84"N	100°16'18.03"E
	C22	5°25'48.39"N	100°16'17.51"E
	C23	5°25'47.96"N	100°16'17.12"E
	C24	5°25'47.45"N	100°16'17.15"E
	C25	5°25'46.77"N	100°16'16.10"E
	C26	5°25'46.43"N	100°16'14.87"E
	C27	5°25'46.03"N	100°16'14.25"E

GUNATANAH

Rancangan Struktur Negeri Pulau Pinang 2030 (RSNPP 2030)

- Tapak projek dizonkan sebagai Kawasan Hutan. Walau bagaimanapun, PLANMalaysia Pulau Pinang telah menyatakan bahawa pembangunan tersebut dibenarkan kerana selaras dengan strategi yang digariskan dalam PHSAP 2016 yang telah diluluskan oleh kerajaan negeri.

Rancangan Kawasan Khas Bukit Bendera 2016 (RKKBB 2016)

- Tapak projek terletak di zon **Tapak Bangunan Warisan dan Pembangunan Pelancongan**

KOMPONEN PEMBANGUNAN

[illegible]

SUSUNATUR PROJEK



RINGKASAN EKSEKUTIF

PERSEKITARAN FIZIKAL

PERSEKITARAN SEDIA ADA	PENERANGAN																
Topografi	Topografi: Cerun landai hingga curam dengan gabungan bentuk muka bumi semula jadi dan tanah yang telah diubah suai Ketinggian tertinggi: 668m (tengah). Ketinggian terendah: 662m (barat laut & tenggara). Kecerunan lereng: Majoriti tapak (32.07%) terdiri daripada cerun curam (>25°–35°), diikuti rapat oleh kawasan cerun landai (0°–15°) sebanyak 29.21%. Sebanyak 26.96% terdiri daripada cerun sederhana curam (>15°–25°), manakala baki 11.76% terdiri daripada cerun sangat curam (>35°–60°).																
Tanah & Geologi	- Sebahagian besar kawasan terletak dalam Pluton Utara Pulau Pinang terdiri daripada Late Carboniferous age dan merupakan sebahagian daripada Granit Tanjung Bungah. - Profil tanah kebanyakannya terdiri daripada Lodak, Tanah Liat dan Pasir.																
Hidrologi	- Projek cadangan terletak dalam sistem dua kawasan tadahan, di mana sebahagian besar aliran air larian semula jadi mengalir ke kawasan tadahan Sungai Air Terjun, manakala sebahagiannya mengalir ke kawasan tadahan Sungai Tat. - Di dalam kawasan projek, terdapat sistem saliran konkrit sedia ada yang mengalir ke perimeter sempadan tapak sebelum dilepaskan di bahagian selatan tapak projek. - Semasa fasa pembinaan dan operasi, projek ini akan mengubah rejim saliran semula jadi dengan mengalihkan semua aliran air permukaan ke Sungai Air Terjun. Terdapat risiko peningkatan beban sedimen dan pengangkutan bahan pencemar yang boleh menjejaskan pengambilan air di hilir. Walau bagaimanapun, dengan pelaksanaan langkah-langkah mitigasi yang bersesuaian, potensi impak hidrologi dapat dikawal dan kesan buruk dapat dikurangkan.																
PERSAMPELAN ALAM SEKITAR Kualiti udara	- Kerja-kerja pensampelan kualiti udara telah dijalankan di tiga (3) lokasi - Semua parameter yang diuji mematuhi tahap yang ditetapkan dalam “New Malaysia Ambient Air Quality Standard (MAAQS 2020)” di semua stesen pensampelan. 40.0 35.0 30.0 25.0 20.0 15.0 10.0 5.0 0.0 Concentration of PM2.5 (µg/m³) Permissible Level of PM2.5 = 35 µg/m³ <table><thead><tr><th>Monitoring Station</th><th>BASELINE</th></tr></thead><tbody><tr><td>A1</td><td>9.9</td></tr><tr><td>A2</td><td>4.9</td></tr><tr><td>A3</td><td>7.3</td></tr></tbody></table> Monitoring Station BASELINE Permissible Level 120.0 100.0 80.0 60.0 40.0 20.0 0.0 Concentration of PM10 (µg/m³) Permissible Level of PM10 = 100 µg/m³ <table><thead><tr><th>Monitoring Station</th><th>BASELINE</th></tr></thead><tbody><tr><td>A1</td><td>11.7</td></tr><tr><td>A2</td><td>11.3</td></tr><tr><td>A3</td><td>10.0</td></tr></tbody></table> Monitoring Station BASELINE Permissible Level	Monitoring Station	BASELINE	A1	9.9	A2	4.9	A3	7.3	Monitoring Station	BASELINE	A1	11.7	A2	11.3	A3	10.0
Monitoring Station	BASELINE																
A1	9.9																
A2	4.9																
A3	7.3																
Monitoring Station	BASELINE																
A1	11.7																
A2	11.3																
A3	10.0																
PERSAMPELAN ALAM SEKITAR Tahap Kebisingan	- Kerja-kerja persampelan aras bunyi telah dijalankan di tiga (3) lokasi - Keputusan menunjukkan bahawa semua parameter yang diuji mematuhi tahap yang dibenarkan yang ditetapkan mengikut “Guidelines for Environmental Noise Limits and Control, Third Edition 2019 (Reprint 2021)” di semua stesen pensampelan. 80 70 60 50 40 30 20 10 0 Noise Level (dBA) Maximum Permissible Sound Level for Day Time = 55-70 dBA <table><thead><tr><th>Monitoring Station</th><th>BASELINE</th></tr></thead><tbody><tr><td>N1</td><td>43.8</td></tr><tr><td>N2</td><td>40.6</td></tr><tr><td>N3</td><td>52.5</td></tr></tbody></table> Monitoring Station BASELINE Permissible Level 70 60 50 40 30 20 10 0 Noise Level (dBA) Maximum Permissible Sound Level for Night Time = 55-65 dBA <table><thead><tr><th>Monitoring Station</th><th>BASELINE</th></tr></thead><tbody><tr><td>N1</td><td>44</td></tr><tr><td>N2</td><td>40.3</td></tr><tr><td>N3</td><td>54.9</td></tr></tbody></table> Monitoring Station BASELINE Permissible Level	Monitoring Station	BASELINE	N1	43.8	N2	40.6	N3	52.5	Monitoring Station	BASELINE	N1	44	N2	40.3	N3	54.9
Monitoring Station	BASELINE																
N1	43.8																
N2	40.6																
N3	52.5																
Monitoring Station	BASELINE																
N1	44																
N2	40.3																
N3	54.9																

RINGKASAN EKSEKUTIF

PERSEKITARAN FIZIKAL

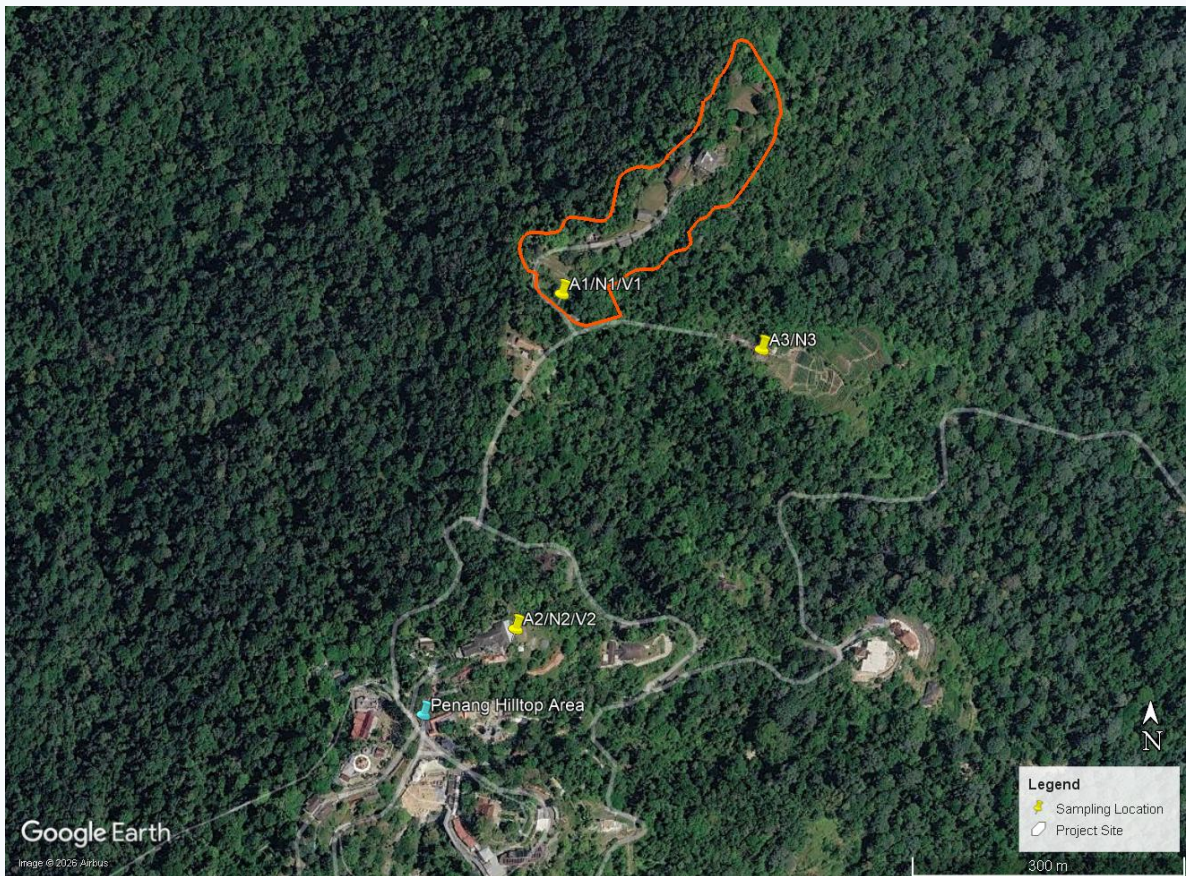
PERSEKITARAN SEDIA ADA	PENERANGAN
PERSAMPELAN ALAM SEKITAR Getaran	

RINGKASAN EKSEKUTIF

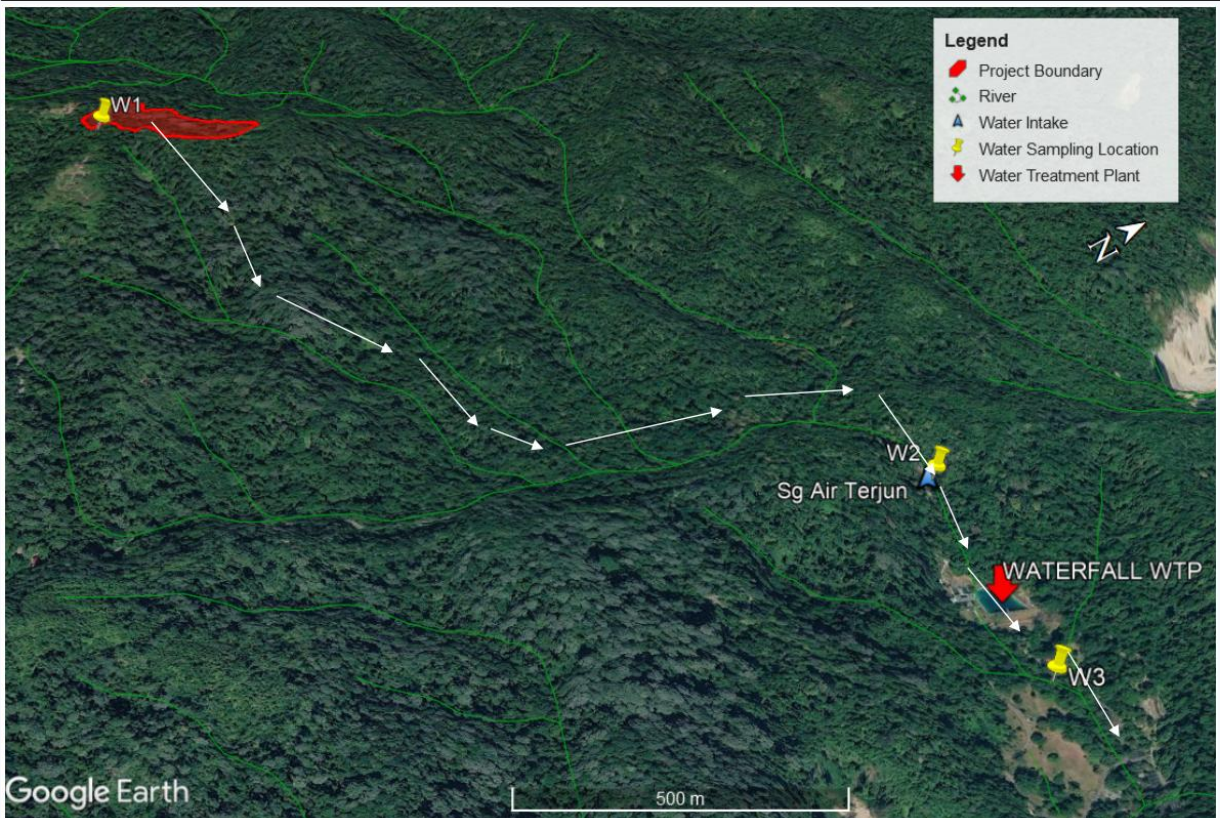
PERSEKITARAN FIZIKAL

CADANGAN LOKASI PERSAMPELAN ASAS

- KUALITI UDARA, TAHAP BUNYI & GETARAN -



- KUALITI AIR -



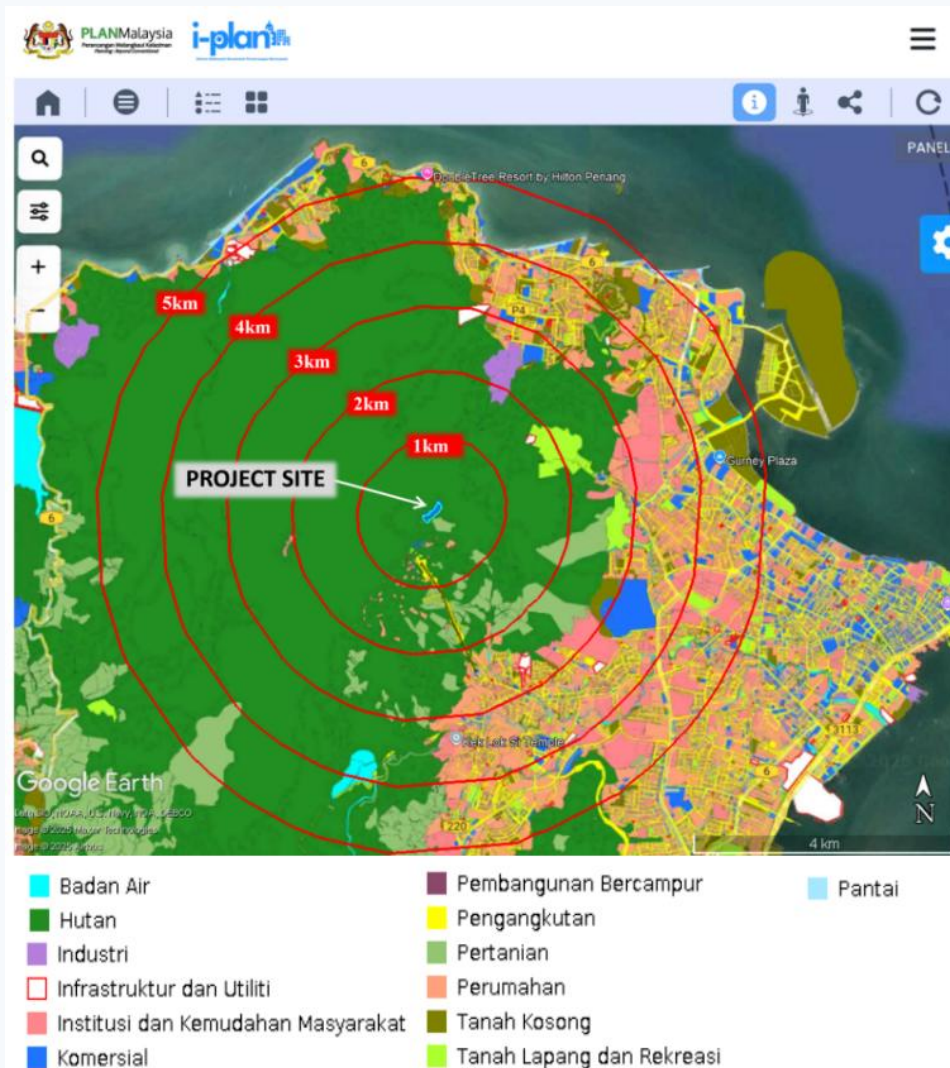
RINGKASAN EKSEKUTIF

PERSEKITARAN BIOLOGI

- Tapak projek sebelum ini telah diganggu akibat pembinaan bangunan sedia ada yang kini tidak lagi digunakan.
- Flora di sekitar runtuhan Hotel Crag di Bukit Bendera terbentuk hasil proses suksesi ekologi selepas kawasan tersebut ditinggalkan. Sebahagian besar kawasan kini sedang mengalami pemulihan semula jadi dengan pembentukan hutan sekunder dan hutan dipterokarpa bukit.
- Kajian fauna mendapati terdapat 2 spesies fauna Terancam (EN), iaitu *Dusky Leaf Monkey* dan *Sunda Slow Loris*, serta 1 spesies fauna Kritikal Terancam (CR), iaitu *Sunda Pangolin*, di sekitar kawasan projek. Bagi spesies avifauna pula, 1 spesies Hampir Terancam (NT), iaitu *Indochinese Blue Flycatcher*, dan 4 spesies lain yang berkategori Dilindungi Sepenuhnya yang berkemungkinan mendiami atau melalui kawasan sekitar projek

PERSEKITARAN MANUSIA

GUNATANAH SEKITAR DALAM LINGKUNGAN 5KM



SOSIO- EKONOMI

- Tiada penempatan manusia aktif diperhatikan di dalam kawasan tapak projek. Tapak ini dikelilingi oleh kawasan berhutan, penempatan berselerak dan terletak berhampiran pusat pelancongan puncak Bukit Bendera.
- Secara amnya, projek cadangan dijangka membawa lebih banyak manfaat kepada komuniti setempat dengan impak negatif yang minimum.
- Satu kajian sosioekonomi telah dijalankan dalam radius 3 km melibatkan seramai 362 responden yang terdiri daripada penduduk tempatan, perniagaan, institusi, pelancong dan komuniti umum dalam zon impak.
- Secara keseluruhannya, maklum balas terhadap projek cadangan adalah positif dan menyokong pelaksanaannya..

RINGKASAN EKSEKUTIF

PENILAIAN KESAN & LANGKAH-LANGKAH MITIGASI

FASA PEMBINAAN

POTENSI IMPAK	LANGKAH-LANGKAH MITIGASI
KUALITI UDARA - Habuk dari penggunaan kenderaan & peralatan - Debu dari kawasan terdedah - Habuk daripada aktiviti kerja tanah	- Memastikan jalan masuk dan jalan di dalam tapak projek bersih dan dalam keadaan yang baik. - Pengawalan pencemaran udara / kawalan debu (pembinaan <i>wash through</i>, <i>hoarding</i>, penggunaan semburan jet air, etc) - Penyelenggaraan berkala untuk kenderaan dan jentera - Pemantauan impak kualiti udara ambien dilakukan secara berkala
TAHAP BUNYI & GETARAN - Bunyi bising dari mesin & jentera - Bunyi bising dari pergerakan kenderaan - Getaran daripada kerja cerucuk	- Penjadualan aktiviti kerja pembinaan dihadkan pada waktu siang. Tiada kerja yang dibenarkan pada waktu malam. - Langkah-langkah kawalan bunyi (seperti membina <i>hoarding</i>, penggunaan PPE untuk pekerja) dijalankan - Penyelenggaraan berkala untuk kenderaan dan jentera - Pemantauan impak bunyi ambien & getaran dilakukan secara berkala
KUALITI AIR - Aktiviti pembersihan tanah & kerja tanah; - Pembuangan kumbahan yang tidak dirawat - Larian air ke permukaan yang tidak terkawal;	- Pelaksanaan LD-P2M2 di tapak projek pada peringkat awal sebelum permulaan kerja tanah - Sebarang pelepasan air permukaan daripada tapak projek semasa kerja tanah dan pembinaan hendaklah mematuhi TSS<50mg/, kekeruhan<250NTU - Sebarang pembuangan air sisa ke dalam laluan air secara langsung atau tidak langsung harus dielakkan
HAKISAN & MENDAPAN - Hakisan tanah & pemendapan - Aktiviti pembersihan tapak & kerja tanah - Aktiviti mengganggu tanah di tapak;	- BMPs di tapak projek hendaklah dibina sebelum pembersihan tapak, kerja tanah dijalankan - Pengurusan air larian & air ribut di tapak - Kawalan hakisan dan sedimen - Penutupan sementara kawasan terdedah - Pemeriksaan tapak secara berkala, penyelenggaraan dan pemantauan BMP di tapak. - Sistem perparitan sedia ada akan dikekalkan dan diintegrasikan ke dalam reka bentuk sistem perparitan
PENGURUSAN SISA - Sisa Biojisim d& Bahan Tidak Sesuai - Bahan-bahan <i>Overburden</i> - Sisa Pepejal/Sisa Binaan - Kumbahan - Sisa Terjadual - Sisa perobohan	- Sisa biojisim yang terhasil semasa kerja-kerja pembersihan tapak perlu diuruskan dengan baik dan dilupuskan dengan sewajarnya - Pengendalian dan pembuangan kumbahan hendaklah mengikut Peraturan Kualiti Alam Sekeliling (Kumbahan), 2009. - Pengendalian & pelupusan sisa terjadual hendaklah mengikut Peraturan Kualiti Alam Sekeliling (Buangan Terjadual) 2005. - Pembuangan sisa perobohan mesti dilakukan di tapak pelupusan yang diluluskan. Kitar semula dan guna semula bahan robohan sebanyak mungkin.
TRAFIK - Peningkatan pergerakan kenderaan yang melalui jalan masuk utama - Kerosakan jalan daripada penggunaan kenderaan berat	- Pergerakan kenderaan berat hendaklah mengikut jadual yang ditetapkan semasa waktu bukan puncak; - Memastikan kenderaan yang membawa bahan pembinaan sentiasa di selenggara dan berada dalam keadaan yang memuaskan; - Menghadkan kelajuan kenderaan dalam kawasan tapak pembinaan;
KESELAMATAN & KESIHATAN Keselamatan pekerja pembinaan	- Perlu mempunyai Pelan Tindakan Kecemasan (ERP) - Setiap pekerja hendaklah dibekalkan kelengkapan PPE
PENGURUSAN EKOLOGI Flora & fauna	- Tandakan dengan jelas sempadan pembersihan tapak dan kawasan larangan - Pemasangan pagar keselamatan yang kukuh yang mudah dilihat di zon pembinaan yang aktif. - Hanya flora asli harus digunakan untuk landskap. Penyelamatan flora boleh dilakukan untuk mengeluarkan tumbuhan asli yang terpilih - Polisi dilarang memberi makan kepada haiwan yang ketat dilaksanakan di antara pekerja. Penyimpanan sisa makanan hendaklah disimpan rapi.
SOSIO-EKONOMI - Peluang pekerjaan untuk penduduk tempatan - Merangsang ekonomi tempatan	- Penggerak projek haruslah mengiklankan kepada komuniti sekitar untuk menggalakkan mereka untuk memanfaatkan peluang pekerjaan baru yang sesuai dengan kemahiran mereka. - Kontraktor akan memastikan pekerja asing yang diupah mempunyai permit kerja untuk memasuki tapak pembinaan
GEOTEKNIKAL - Potensi bencana geologi - Kesan paras air bawah tanah	Patuhi semua cadangan yang dicadangkan oleh jurutera geoteknik dan penyemak bertauliah (ICE)

RINGKASAN EKSEKUTIF

PENILAIAN KESAN & LANGKAH-LANGKAH MITIGASI

FASA PENGOPERASIAN

POTENSI IMPAK	LANGKAH-LANGKAH MITIGASI
KUALITI UDARA - Pelepasan asap daripada kenderaan - Tiada kesan yang ketara	- Menyelenggara kenderaan secara berkala - Elakkan pengoperasian kenderaan dan jentera untuk jangka masa yang lama ketika berada dalam keadaan tetap.
TAHAP BUNYI & GETARAN Tiada kesan yang ketara	- Landskap & pemampasan semulajadi boleh membantu mengurangkan penghasilan bunyi - Menyelenggara kenderaan secara berkala - Elakkan pengoperasian jentera dan kenderaan untuk jangka masa yang lama ketika berada dalam keadaan tetap
KUALITI AIR - Pelepasan air larian permukaan - Pelepasan kumbahan	- Sisa yang dihasilkan hendaklah dilupuskan di tapak pelupusan yang diluluskan. - Kumbahan yang dilepaskan dari tapak projek akan mematuhi Environmental Quality (Sewage) Regulations 2009
HAKISAN & MENDAPAN - Tiada perlepasan ke mana-mana aliran air - Penstabilan kekal terhadap kawasan terdedah	- Kesan hakisan & mendapan dijangka tidak signifikan, dan tiada langkah mitigasi diperlukan kecuali kerja-kerja pemulihan dilaksanakan. - Rangkaian saliran kekal dan tangki penahanan di tapak hendaklah dipasang untuk menangkap air larian dari tapak tersebut.
PENGURUSAN SISA - Sisa pepejal - Sisa kumbahan	- Sisa yang dihasilkan hendaklah dibuang di tapak pelupusan yang diluluskan. - Semua kumbahan yang terhasil akan disalurkan ke loji rawatan <i>Small Sewage Treatment System (SSTS)</i> yang dicadangkan.
TRAFIK - Peningkatan penggunaan kenderaan - Pergerakan kenderaan yang melalui jalan masuk utama	- Patuhi peraturan pihak berkuasa tempatan dan JKR untuk keperluan pengurusan lalu lintas dan pengangkutan - Cadangan yang digariskan dalam Laporan TIA hendaklah dijadikan panduan oleh pihak pemaju projek dan pihak berkuasa bagi memastikan kelancaran rangkaian trafik pada masa hadapan
GUNATANAH, LANDSKAP & ISUAL Aestetik	Pemulihan tapak melalui landskap dan penanaman semula kawasan
PENGURUSAN EKOLOGI Flora & fauna	- Lekapan lampu bercahaya hangat yang terlindung dan menghala ke bawah yang kurang mengganggu. - Pencahayaan sensor gerakan dipasang di kawasan pinggir hutan. - Pendidikan menyeluruh hendaklah diberikan kepada kakitangan dan tetamu bagi memupuk amalan pelancongan yang bertanggungjawab. - Penyelidikan dan pemantauan pada masa hadapan boleh diwujudkan untuk memahami dan memulihara dinamik ekologi kawasan tersebut dengan lebih lanjut.
SOSIO-EKONOMI - Peluang pekerjaan - Peluang perniagaan	Pemaju harus mengiklankan kepada masyarakat sekitar untuk mendorong penduduk tempatan untuk memanfaatkan peluang pekerjaan yang sesuai dengan kemahiran mereka.
GEOTEKNIKAL Potensi bencana geologi	Patuhi semua cadangan yang dicadangkan oleh jurutera geoteknik dan penyemak bertauliah (ICE)

RINGKASAN EKSEKUTIF

PEMANTAUAN IMPAK DAN PEMATUHAN

				
	KUALITI UDARA	KUALITI BUNYI	KUALITI AIR	GETARAN
PARAMETER	PM2.5, PM10, SO2, NO2, O3, CO	Laeq, Lmin, Lmax, L10, L50, L90	Suhu, pH, DO, Turbidity, Conductivity, BOD, COD, TSS, AN, Oil & Grease, E.Coli, Faecal Coliform, Total Coliform	Peak particles, velocity, ppv
PIAWAIAN	New Malaysia Ambient Air Quality Standard 2020	Guidelines for Environmental Noise Limit & Control, 2019 (Reprint 2021)	National Water Quality Standards (NWQS) – Class IIB	Guidelines for Environmental Vibration Limits and Control Third Edition (DOE, 2021)
KEKERAPAN	Setiap bulan	Setiap 3 bulan	Setiap bulan	Setiap 3 bulan
BIL. STESEN	3	3	3	2

PEMANTAUAN PRESTASI

		
	KOLAM MENDAPAN	BMPs - ESCP/LD-P2M2
PARAMETER	TSS Kekeruhan	BMPs yang terdapat dalam ESCP/LD-P2M2
PIAWAIAN	TSS: 50 mg/L Kekeruhan: 250 NTU	-
PEMANTAUAN	Setiap bulan Setiap 2 minggu sekali Selepas <i>rainfall event</i>	Setiap bulan Setiap 2 minggu sekali Selepas <i>rainfall event</i>
BIL. STESEN	Pelepasan keluar dari kolam mendapan	Semua BMP yang dicadangkan di tapak projek

RINGKASAN EKSEKUTIF

RUMUSAN

- ❖ SRI NISUH SDN BHD (selepas ini dirujuk sebagai pihak pemaju projek) bercadang untuk merobohkan 22 unit bangunan kayu sedia ada yang terbiar dan usang serta membangunkan semula struktur bersejarah Crag Hotel menjadi sebuah hotel dan spa 28 bilik berserta kemudahan berkaitan di Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang. Projek ini akan melibatkan pembangunan kawasan tanah seluas kira-kira 7.69 ekar (3.112 hektar).
- ❖ Kajian awal persekitaran sedia ada telah dijalankan, merangkumi tinjauan tapak, penyiasatan tanah, geologi tapak, pemetaan rupa bumi geologi, kajian geoteknikal, serta penilaian asas persekitaran dan lain-lain.
- ❖ Penemuan keseluruhan menunjukkan bahawa kesan yang berpotensi timbul dari tapak projek ke kawasan sekitarnya adalah dalam tahap yang minima dan dalam jangka masa yang pendek
- ❖ Dengan andaian semua komponen yang dicadangkan di dalam LD-P2M2 dilaksanakan di tapak projek, impak alam sekeliling dapat dikurangkan dengan sewajarnya.
- ❖ Oleh itu, untuk memastikan bahawa P2M2 berkesan di tapak, Pelan Pengurusan Alam Sekitar dengan Program Pengauditan dan Pemantauan Alam Sekitar adalah disarankan untuk dilaksanakan oleh penggerak projek
- ❖ Setelah siap sepenuhnya, projek ini akan menawarkan sebuah hotel dan spa yang terdiri daripada 28 bilik serta kemudahan berkaitan, yang mengimbau asal-usul Crag Hotel yang dahulunya merupakan sebuah pusat kesihatan.

CHAPTER 1

PROJECT INTRODUCTION

1.1 PROJECT TITLE

SRI NISUH SDN BHD (hereafter referred to as the project proponent) intends to demolish 22 units of existing abandoned dilapidated wooden buildings and redevelop the existing Crag Hotel historic structure into a 28 room hotel and spa with related facilities on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang (hereafter referred to as the proposed project). This project will entail the development of around 7.69 acres (3.112 hectares) of land area.

Thus, this Environmental Impact Assessment (EIA) report is prepared for the following development: -

**“CADANGAN MEROBOHKAN BANGUNAN KAYU SEDIA ADA DAN
PEMBANGUNAN HOTEL (28 BILIK) SERTA KEMUDAHAN
BERKAITAN DI ATAS LOT 10000, BANDAR BUKIT BENDERA,
DAERAH TIMUR LAUT, PULAU PINANG”**

This assessment is intended to ensure that the proposed project will meet the criteria and requirements set out in the 2016 Environmental Impact Assessment (EIA) Guidelines of the Department of the Environment (DOE).

1.2 PROJECT PROPONENT DETAILS

SRI NISUH SDN BHD is the project proponent of the proposed project. Details pertaining to the project proponent are as follows: -

Company	:	SRI NISUH SDN BHD
Registered Address	:	M-01, MENARA MBMR, 1 JALAN SYED PUTRA, 58000 KUALA LUMPUR.
Director	:	MR. WONG WEI KHIN
Tel	:	03-2273 3888
Fax	:	03-2273 3788

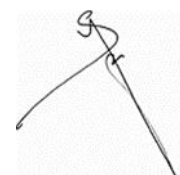
1.3 EIA CONSULTANT DETAILS

SRI NISUH SDN BHD has appointed **SENVIRO RESOURCES** to carry out this Preliminary EIA study. The details of EIA team members are shown in **Table 1.1**. The EIA consultant detail is as follows.

Company	:	SENVIRO RESOURCES (PG0447888-W)
Registered Address	:	No. 8, Lorong Seruling Emas 9, Taman Seruling Emas, 14200, Sungai Bakap, Pulau Pinang
Tel	:	012-5821710/ 012-4029940
Email	:	senviroresources@gmail.com
Contact Person	:	Prof. Dr. Shanker Kumar Sinnakaudan
EIA Consultant	:	CEP-CS0372, CPESC-9233

Any inquiries and correspondence regarding the report can be directed to the EIA Consultant. **Table 1.1** shows the details of EIA team members and their respective roles in this EIA study.

Table 1.1: Registered EIA Study Team

No	Name	Qualification	Registration With DOE				Study Area	Signature
			Category	Registered Area/Field	ID. No.	Registration Expiry Date		
A. TEAM LEADER								
1.	Prof. Dr. Shanker Kumar Sinnakaudan	PhD. GIS & Water Resources Engineering, M. Arts GIS & Hydrological Modelling, B.A. Ed. (Hons) Geography, Education	EIA Consultant	• Air Quality Monitoring & Baseline Assessment • Noise & Vibration Quality Monitoring and Baseline Assessment • Water Quality Monitoring & Baseline Assessment • LD-P2M2 • Soil Erosion and Sedimentation Analysis	• CEP-CS0372 • CPESC9233 • CISEC MY-0358	• 31/05/2028 • 03/01/2027 • 30/06/2027	• Air Quality • Noise & Vibration • Water Quality • Soil Erosion & Sedimentation • Hydrology • LD-P2M2	
B. TEAM MEMBER								
2.	Ts Siti Isma Hani Ismail	MSc. (River & Urban Drainage Management) B.Eng. (Civil Engineering)	EIA Consultant & Subject Specialist (CS)	• LD-P2M2 • Soil Erosion and Sedimentation Analysis • Water Quality Monitoring & Baseline Assessment • Solid Waste Management • Handling & Management of Schedule Waste • Social Impact Assessment (SIA)	• CEP-CS0436 • CISEC • MY-0198	• 31/05/2028	• Waste Management • Socio-economic	
3.	Ts. Mohd Khairul Anwar Bin Ahmad	Bachelor of Landscape Architecture (Hons)	Subject Specialist (SS)	• Flora and Fauna	• CEP-SS0674	• 31/05/2029	• Flora & Fauna Studies • Ecological Studies	

No	Name	Qualification	Registration With DOE				Study Area	Signature
			Category	Registered Area/Field	ID. No.	Registration Expiry Date		
5.	Mohd Rizal Bin Shukor	BSc. (Civil Engineering) MSc. (Civil Engineering)	Subject Specialist (SS)	Hydrology (River Study, Hydrological Modelling)	CEP-SS0568	31/05/2028	- Hydrology - Hydrological Modelling	
6.	Maisarah Binti Abd Ghani	BSc. (Civil Engineering) MSc. (Civil Engineering)	Subject Specialist (SS)	Landuse (Socio-economic study, Land Use planning)	CEP-SS0526	31/05/2028	- Landuse - Socio-economic	

1.4 APPOINTED CONSULTANT'S DETAILS

The following supporting technical consultants have assisted the EIA consultants by providing inputs in the preparation.

i. Planner & Architect

Name	:	CHONG KUM KWAN ARCHITECT
Address	:	3 Jalan Lim Lean Teng, 11600 Penang
Contact Person	:	Dato' Ar Chong Kum Kwan
Tel No.	:	04-2814678
Email	:	chongkumkwan@gmail.com

ii. C&S and Geotechnical Consultant

Name	:	EDP CONSULTING GROUP SDN BHD
Address	:	24-1 Jalan Usj 10/1, 47620 UEP Subang Jaya, Selangor
Contact Person	:	Ir Chan Siew Keat
Tel No.	:	03-56351003
Email	:	edpstreamyx@ledpcon.com

iii. M&E Consultant

Name	:	AG INGENIEUR SDN BHD
Address	:	10, Taman Hijau Tiga, 11600 Pulau Pinang.
Contact Person	:	Ir. Wong Jian Choon
Tel No.	:	04-2815479
Email	:	ag.ingenieur@gmail.com

iv. Land Surveyor

Name	:	JURUKUR KHOO & MAS
Address	:	Midlands Park Centre, 488A-19-02 Jalan Burma, 10350, Penang.
Contact Person	:	LSr. Ernest Khoo Hock Oon
Tel No.	:	04-2268781 / 04-2268782
Email	:	jurukurmas@yahoo.com

v. Professional Geologist

Name	:	STRATEGI GEO ENGINEERING
Address	:	8, Jalan Putra Permai 10/1K, Putra Heights, 47650 Subang Jaya, Selangor
Contact Person	:	P.Geol Hj Zahari bin Muda
Tel No.	:	012-3796964
Email	:	strategigeoengineering@gmail.com

1.5 PROJECT LOCATION

The proposed project intends to develop a hotel with 28 rooms and related facilities, on land spanning 7.69 acres (3.112 hectares) located on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang. The site can be accessed directly via Jeep Track Road, an existing paved road that starts from Jalan Kebun Bunga, or on foot from the Penang Hilltop area (10 minute walk).

Figure 1.1 shows the location plan of the proposed project, whereas **Figure 1.2** shows the project site location and its boundary coordinates. **Figure 1.3** shows the overview of the immediate surroundings of the project area, which are primarily historic bungalows (circled in yellow), the tourist attraction area of Penang Hill, and the Upper Hill Funicular Station (circled in blue).

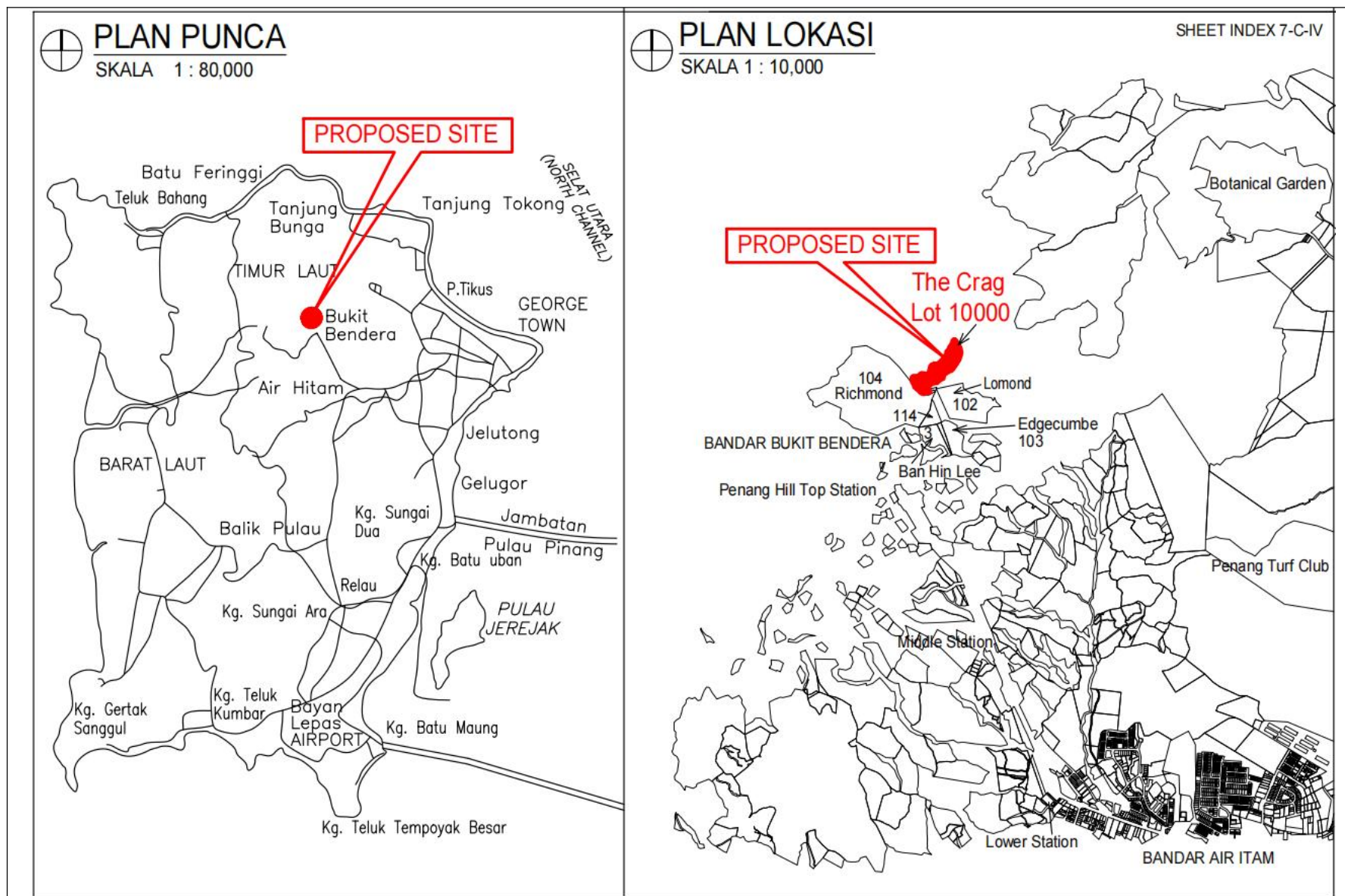


Figure 1.1: Location Plan
Source: Chong Kum Kwan Architect, 2018

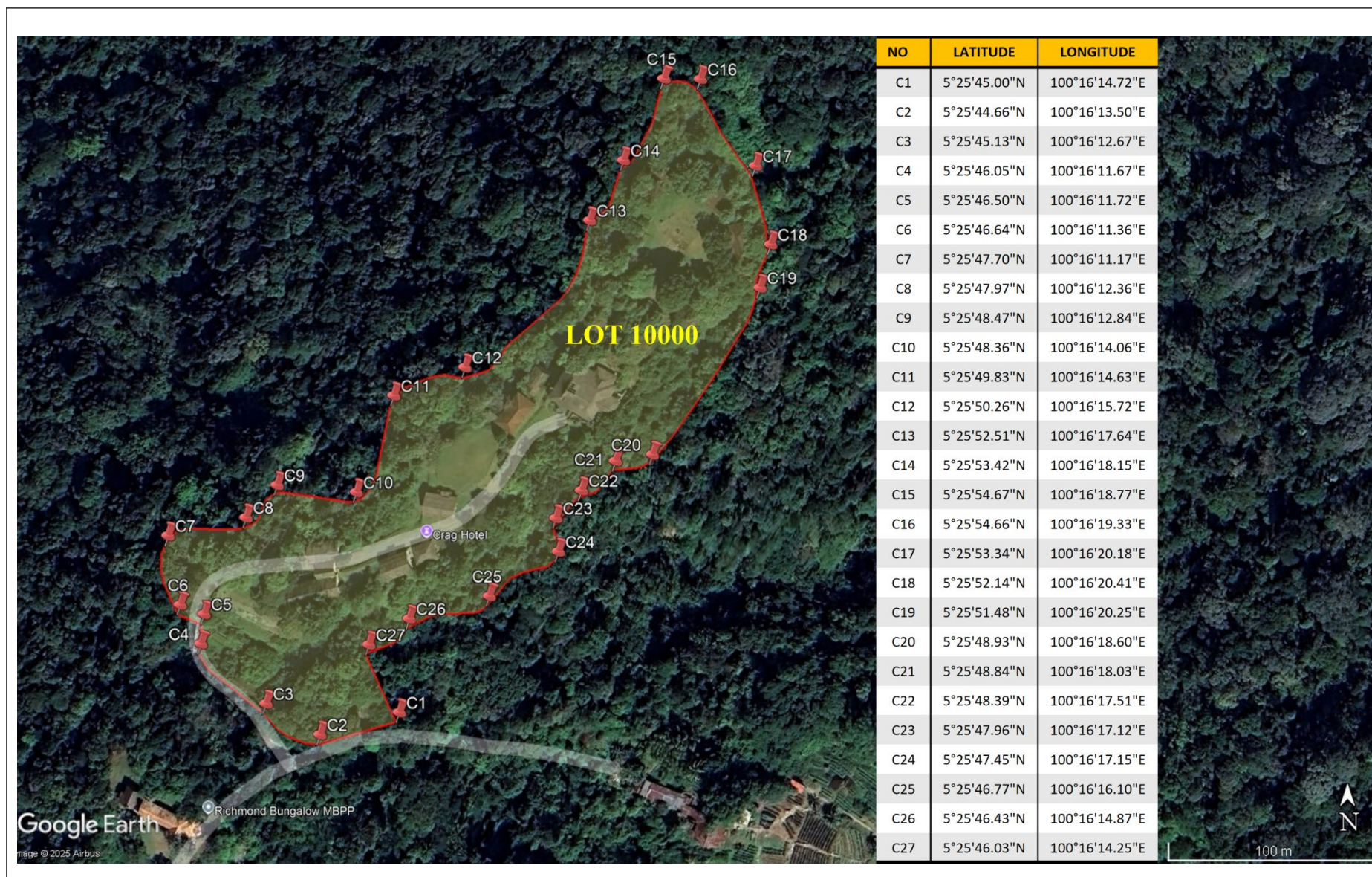


Figure 1.2: Proposed Site and Boundary Coordinates

Source: Updated in Google Earth by Senviro Resources, 2026

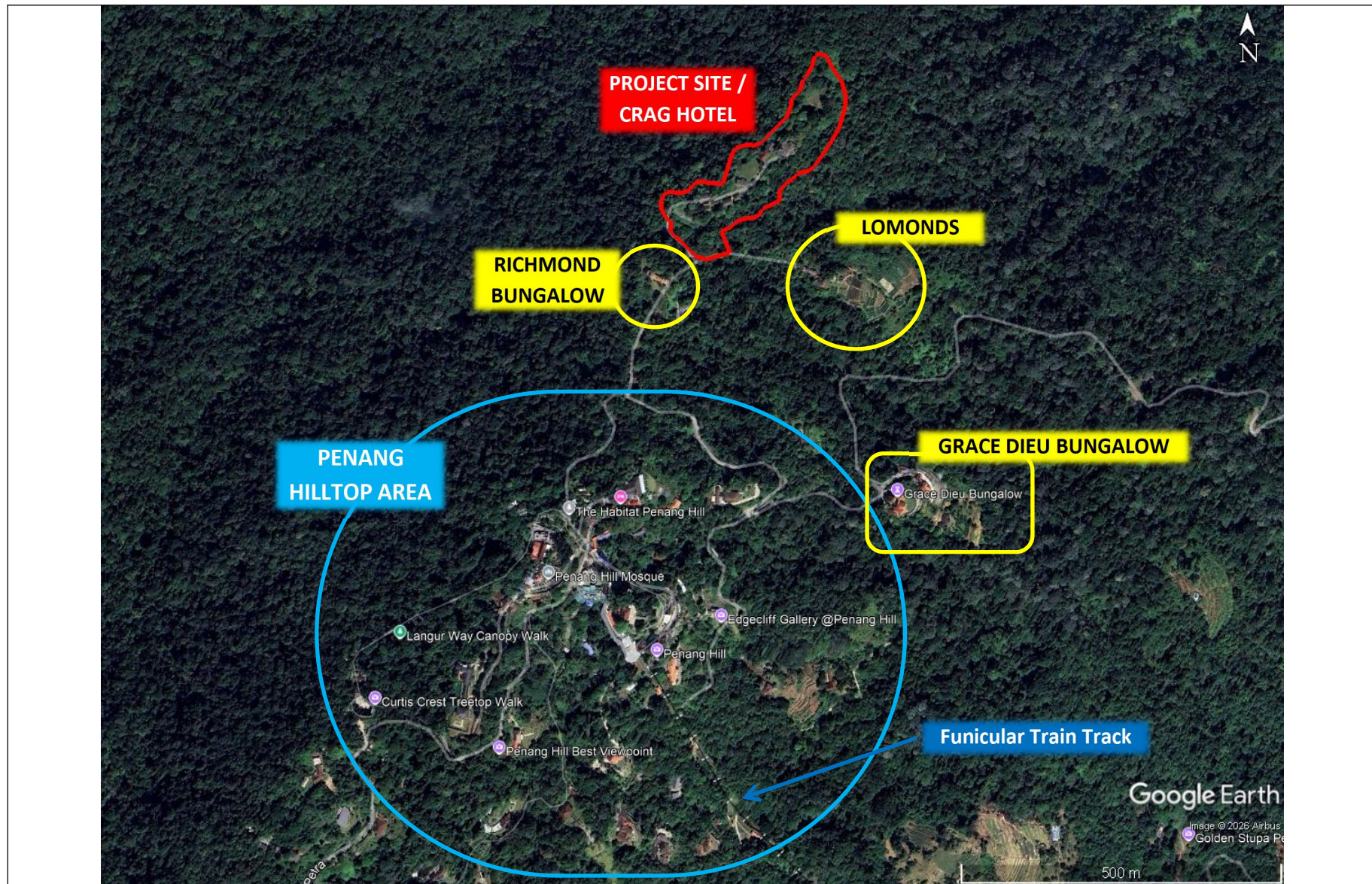


Figure 1.3: Overview of the Immediate Surrounding of the Proposed Project Site

Source: Updated in Google Earth by Senviro Resources, 2026

1.6 LEGAL REQUIREMENTS

The locality of the Project Site falls under the jurisdiction of Majlis Bandaraya Pulau Pinang (MBPP).

1.6.1 Prescribed Activities under the EIA Order

EIA is a statutory requirement for activities prescribed under Section 34A of the Environmental Quality Act (EQA). Section 34A (2) of the Act stipulates that any person intending to carry out any of the prescribed activities shall appoint a qualified person to conduct an EIA study and to submit a report thereof to the Director-General of Environment for prior approval whereby EIA Guidelines requirements under the provision of Section 34A (2C) of the EQA 1974 as follows.

Subsection 34A (2C)

The report shall be in accordance with the guidelines as the Director-General may prescribe and shall contain:

- a) An assessment of the impact such activity will have or is likely to have on the environment; and
- b) The proposed measures shall be undertaken to prevent, reduce or control the adverse impact on the environment.

By referring to Environmental Quality Act (EQA) 1974, Environmental Quality (Prescribed Activities) (EIA) Order 2015 in the Federal Government Gazette dated 28 August 2015, the proposed project is subjected to **Prescribed Activity 13 stated in Schedule 1** as the proposed project involves the development or land clearing less than 50% of an area with slope greater than or equal to 25° but less than 35° of land as shown below: -

13. DEVELOPMENT IN SLOPE AREA:

Development or land clearing less than 50 per cent of an area with slope greater than or equal to 25° but less than 35°.

In compliance with the above requirements, a First Schedule of EIA must be carried out by the project proponent to assess any impact the development would have on the existing project site and its surroundings.

1.6.2 Conformance of Government's Development Plan

1.6.2.1 National Physical Plan 4 (NPP-4)

The emphasis on economic, social, and environmental relations as main components of sustainable development within a holistic ecosystem are reflected in three main thrusts of the NPP-4. The NPP-4 emphasizes sustainable development and planning as a key principle in achieving a resilient and liveable nation for development period up to 2025. The proposed project is compatible with NPP-4 under the following thrusts as shown in **Table 1.2**.

Table 1.2: Strategy/ Development Framework of NPP-4

THRUST 1: BALANCED AND DYNAMIC GROWTH	
<i>DG 2 ENSURING SUSTAINABLE AND COMPETITIVE ECONOMIC GROWTH</i>	
<i>DG 2.4 : Diversify Tourism Products & Coverage as One of the Main Drivers of the National Economy</i>	
<i>DG 2.5A : Ensure adequacy and variety of accommodation facilities</i>	
The proposed development will support highland tourism at Penang Hill by providing adequate facilities, such as accommodations. This can contribute to increasing the length of stay and spending by tourists.	
THRUST 2 : SPATIAL SUSTAINABILITY AND CLIMATE CHANGE RESILIENCE	
<i>SR 1 HOLISTIC LAND USE PLANNING</i>	
<i>SR 1.2 : Prioritise Urban Renewal in Existing Built-Up Areas</i>	
- Urban renewal is necessary to optimize existing infrastructure as land supply becomes increasingly limited. - As Crag Hotel is categorized as a historic building, urban conservation needs to be done to preserve the heritage value while changing the structure that better fits urban and current needs.	
<i>SR 2 SUSTAINABLE MANAGEMENT OF NATURAL, FOOD, AND HERITAGE RESOURCES</i>	
<i>SR 2.6 Strengthen the Preservation, Conservation, and Protection of National Cultural and Natural Heritage Sites</i>	
- Cultural heritage sites include archaeological heritage sites, buildings and monuments/sites with significant cultural heritage value - Crag Hotel is considered a historic heritage site by local plans, hence it should be restored rather than left abandoned.	

Source: National Physical Plan 4 (NPP-4), 2021-2025

The proposed development project greatly supports the aforementioned strategies, mainly by optimizing land use for the rejuvenation of abandoned sites with historic value. Furthermore, the proposed project also has the potential to support tourism activities on Penang Hill by providing accommodations and a new attraction.

1.6.2.2 National Physical Plan 5 (NPP 5)

National Physical Plan 5 (NPP5) which is currently being drafted, will replace NPP4 in the future as Malaysia's primary spatial planning framework to guide land use and physical development from 2026 to 2040 (APUDG, 2025). As of 9 April 2026, during the 50th National Physical Planning Council (NPPC) chaired by Prime Minister Datuk Seri Anwar Ibrahim, it was agreed that further review and coordination of the Draft NPP5 and the Draft Third National Urbanisation Policy (NUP3) be carried out jointly with a state government, including Sabah and the Federal Territory of Labuan, before final adoption (Bernama, 2026). Once the plan is officially finalized, it will be referred to instead of NPP4.

1.6.2.3 Penang Structure Plan (RSNPP 2030)

Penang Structure Plan 2030 (RSNPP 2030) highlights and outlines the main development corridors that focus on housing, commercial, industrial, public facilities, and institutions on the island of Penang. Based on the plan, the project site lies on an area categorized as Forested land as shown in **Figure 1.4**. The proposed site is located on the site of the original Crag Hotel on top of Penang Hill with some abandoned buildings from the time the area was still in active use.

The proposed project is in line with several implementation strategies, mainly *Dasar Pembangunan Utama (DPU) 3.1*, further detailed in **Table 1.3**.

Table 1.3: DPU and DSP related to the Proposed Project

DPU 3.1: <i>“MEMBANGUNKAN KAWASAN PEMBANGUNAN YANG DIKENALPASTI BAGI MEMPERKUKUHKAN PERTUMBUHAN EKONOMI NEGERI PULAU PINANG DI TAHAP ANTARABANGSA”</i>	
<i>DSP 3.1.1: Memperkukuhkan Kedudukan Negeri Pulau Pinang Sebagai Pusat Perdagangan Serantau dan Pelancongan Antarabangsa</i>	
L 3.1.1.2 :	Memperkukuhkan Produk Pelancongan Sedia Ada Di Negeri Pulau Pinang Seperti Legasi Sejarah Dan Warisan Alam Semula Jadi Yang Diintegrasikan Dengan Pembangunan Bandar Moden Bagi Mencapai Kemajuan Ekonomi, Sosial Dan Alam Sekitar Yang Mampan.
<i>DSP 3.1.2: Memperkasakan Industri Pelancongan Sebagai Salah Satu Penggerak Utama Ekonomi Negeri Pulau Pinang</i>	
L 3.1.2.4 :	Menumpukan Pembangunan Pelancongan Kepada Tiga Zon Utama iaitu :- • Zon Pelancongan Pantai; • Zon Warisan Bandar; Dan • Zon Pelancongan Eko Dan Agro.

- L 3.1.2.6 :** Memperkasakan Produk-Produk Pelancongan Agro Dan Eko Melalui Perancangan Dan Program Yang Dapat Menarik Kedatangan Pelancong Yang Lebih Ramai;
- Zon Pelancongan Agro : Pulau Aman, Pulau Gedong, Pulau Betong, Pulau Rimau Dan Pulau Kendi.
 - Zon Pelancongan Eko : Bukit Bendera, Taman Negara Pulau Pinang, Empangan Teluk Bahang, Empangan Ayer Itam, Pulau Jerejak, Empangan Mengkuang, Taman Negeri Bukit Panchor, Taman Rimba Bukit Mertajam, Taman Rimba Teluk Bahang, Hutan Paya Laut Penaga, Hutan Paya Laut Pantai Aceh, Ayer Hitam Dalam, Penaga Dan Kuala Muda.

Source: Penang Structure Plan 2030 (RSNPP 2030)

DPU 3.1 focuses on supporting the **growth of the state economy** on an international level through developing certain identified developmental areas that have potential. Under this strategy, two substrategies (*Dasar Strategik Pelaksanaan*), **DSP 3.1.1** and **DSP 3.1.2** were found to be in line with the proposed development.

Substrategy **DSP 3.1.1** focuses on measures to reinforce the position of the state of Penang as a **hub of international trade and tourism**. Under this, **L 3.1.1.2** aims to **enhance existing tourism spots in Penang** such as historical and natural heritage areas by integrating them with urban developments in order to achieve growth in economy, social and environment in a sustainable manner. This is in line with the proposed project as it aims to revitalise an existing historical building to its original use as a luxury hotel on Penang Hill.

Substrategy **DSP 3.1.2** focuses on **boosting the tourism industry** as a major influence in strengthening the state economy. Under this, **L 3.1.2.4** focuses on developing tourism in three main zones, which are coastal/beach areas, heritage cities and eco/agro tourism. Penang Hill falls under ecotourism zone, which is further elaborated in **L 3.1.2.6** which specifically focused on improving eco and agro tourism zones. The proposed project is able to support both of this measures as it aims to restore the historic Crag Hotel back into its original landuse as a hotel. This development would be able to restore the existing historic building to its original glory and would also attract more tourists to come and explore the nature and history of Penang Hill.

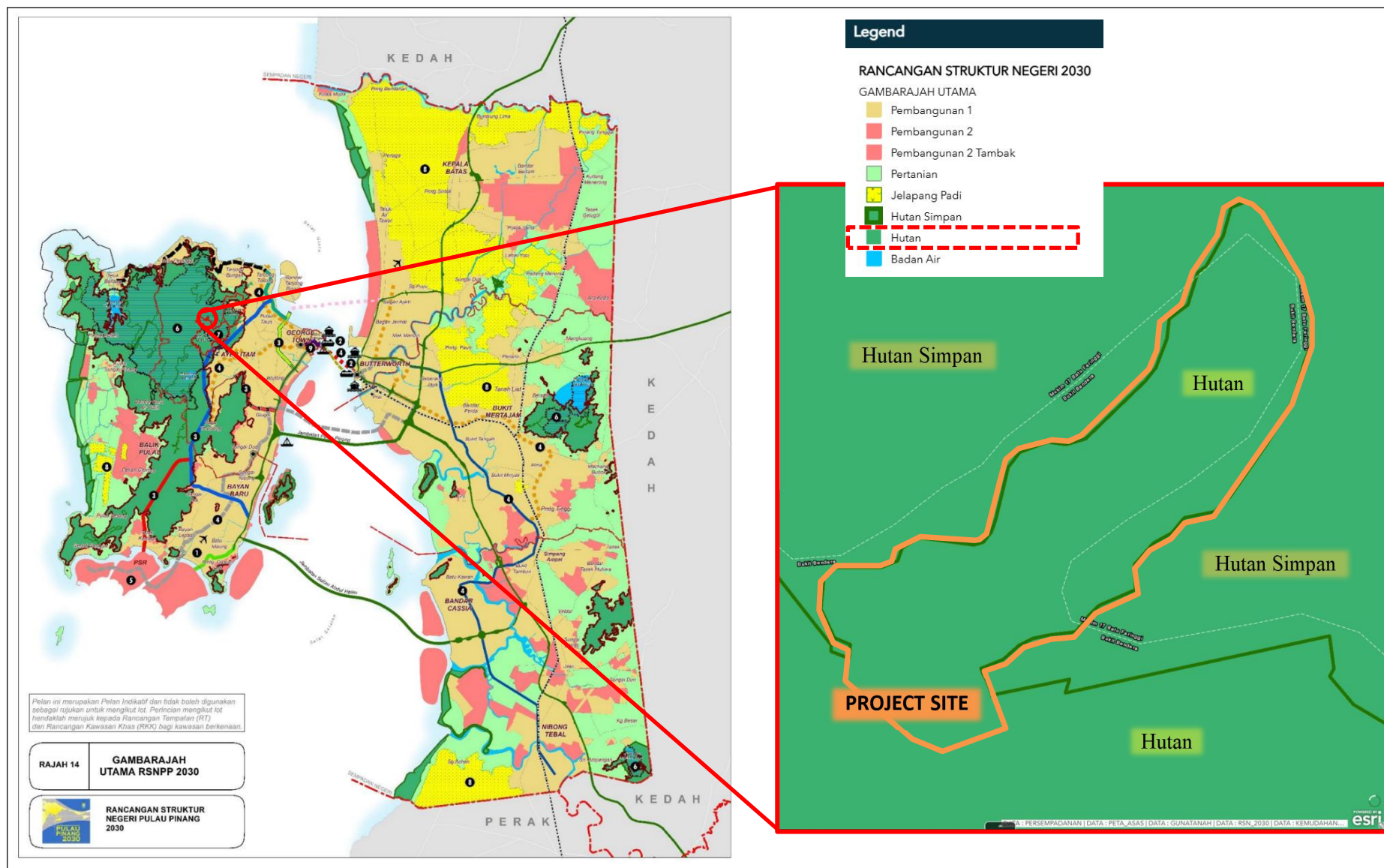


Figure 1.4: Zoning of Project Site According to RSNPP 2030

Source: Gambarajah Utama RSNPP 2030 & Smartplan Penang website, 2026

1.6.2.4 Penang Hill Special Area Plan 2016 (RKK Bukit Bendera 2016)

The **Penang Hill Special Area Plan 2016 (PHSAP 2016)** (gazetted in Sept 2016, No. Warta 664) is an implementation plan that provides a comprehensive direction for the **long-term transformation of Bukit Bendera** from its current state to its envisioned future. This plan contains proposals that serve as formal recommendations or suggestions aimed at achieving specific outcomes, as desired for Bukit Bendera to become a unique tourist destination and a sustainable hill area settlement.

Under this plan, the proposed plan is greatly in line with **Strategic Thrust 2** which aims to preserve the historical heritage of Penang Hill, also known as Bukit Bendera in Malay. Some of the initiatives that are relevant to the project are highlighted below:

TERAS 2: “MEMELIHARA WARISAN KEBUDAYAAN BUKIT BENDERA”	
INISIATIF 4.2.1	Menjaga Bangunan - Bangunan dan Tugu - Tugu Warisan
INISIATIF 4.2.2	Mempromosi Kepentingan Warisan
PELAN TINDAKAN	
ACTION PLAN 2	Pembangunan Pelancongan

Initiative 4.2.1 aims to protect buildings and monuments with historical heritage, as shown in **Figure 1.5**, which displays their locations. **Table 1.4** lists the categories (Category I and Category II) of all the heritage locations. Crag Hotel is listed under **Category II**, which, according to Georgetown World Heritage Incorporated, is defined as “**buildings, objects, and sites of special interest that warrant every effort being made to preserve them.**”

Initiative 4.2.2 aims to promote the importance of heritage areas by highlighting historical heritage aspects such as the architecture and interior design of historical buildings. Apart from developmental strategies, the PHSAP 2016 also aims to establish developmental zones along with action plans. **Figure 1.6** shows the plan for developmental zones on Penang Hill. The proposed project site falls under the tourism developmental zone which will be for low density development that prioritises nature and biodiversity.

Action Plan 2, focusing on tourism development, is mainly centered on developing several historic buildings (The Crag, Richmond, Edgumbe, Lomonds, and Ban Hin Lee) into low-density boutique hotels or holiday villas. Other than that, PHSAP 2016 also greatly supports the development and redevelopment of Crag Hotel back into a hotel and spa.

Table 1.4 List of Heritage Buildings in Penang Hill

No	Nama Bangunan	Kategori Bangunan Warisan
1	Crag Hotel	Kategori II
2	Ngan San	Kategori II
3	Karangan Cot	Kategori II
4	Grace Dieu	Kategori II
5	Edgecliff	Kategori II
6	White House	Kategori II
7	The Nook	Kategori II
8	Eyethrope	Kategori II
9	The Rockies	Kategori II
10	The Cottage	Kategori II
11	Convalescent	Kategori II
12	Tree Top	Kategori II
13	Woodside	Kategori II
14	Ducle damun	Kategori II
15	Fern Hill	Kategori II
16	Hill Side	Kategori II
17	Camville	Kategori II
18	Westspur	Kategori II
19	The Great Wall	Kategori II
20	Arun Rangsi	Kategori II
21	CAP Bungalow	Kategori II
22	Upper Claremont	Kategori II
23	Aloha	Kategori II
24	Rajawali	Kategori II
25	Methodist Centre	Kategori II
26	Buddha Light Vihara	Kategori II
27	Tosari	Kategori II
28	Lausanne	Kategori II
29	Fairmount	Kategori II
30	St. Brelades	Kategori II
31	South View	Kategori II
32	Gate House	Kategori I
33	Bel Retiro	Kategori I
34	Bukit Pinang	Kategori I
35	Brown House	Kategori I
36	Raj Bhavan	Kategori I

Source: Penang Hill Special Area Plan 2016

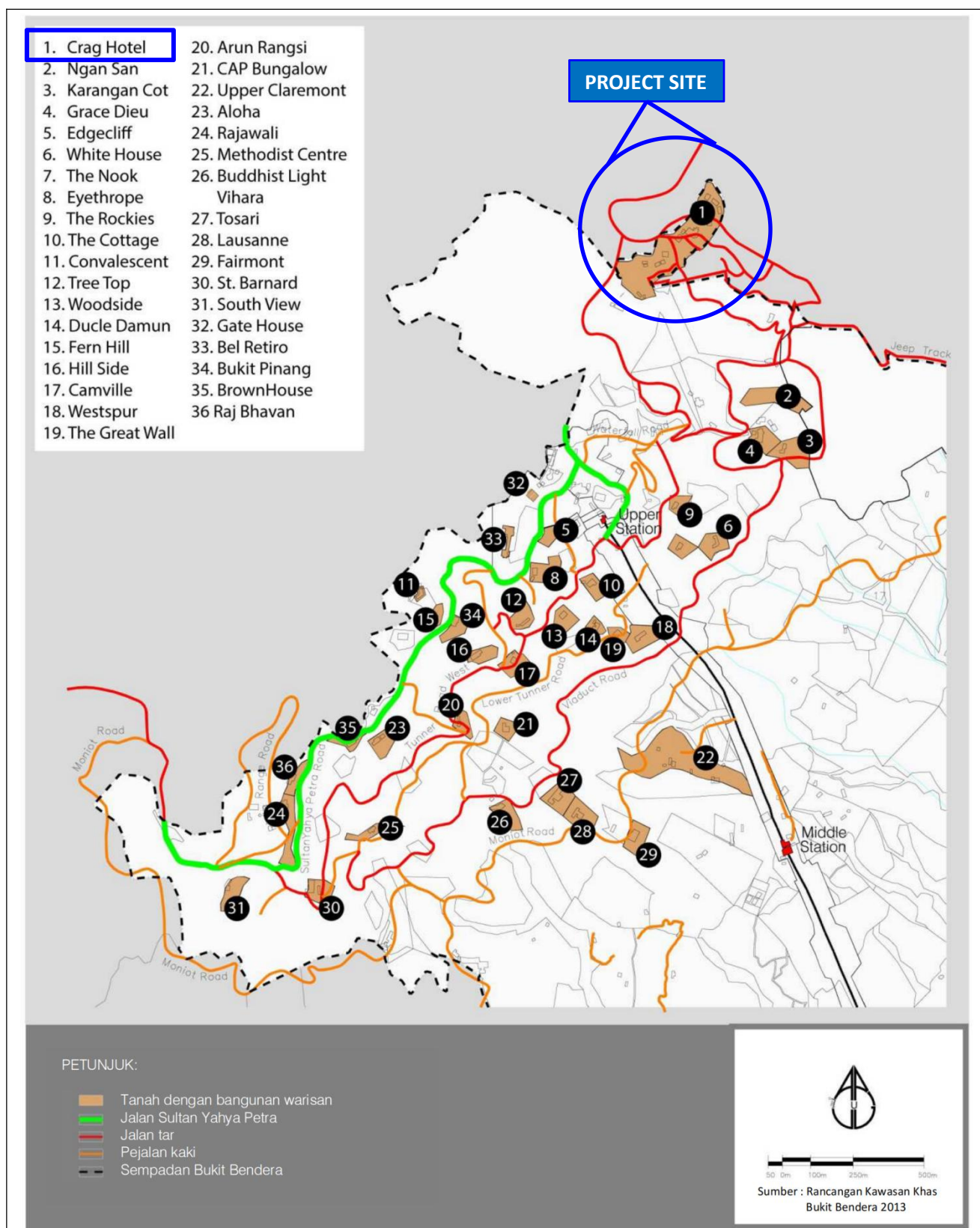


Figure 1.5 Location of historical heritage buildings

Source: Penang Hill Special Area Plan 2016

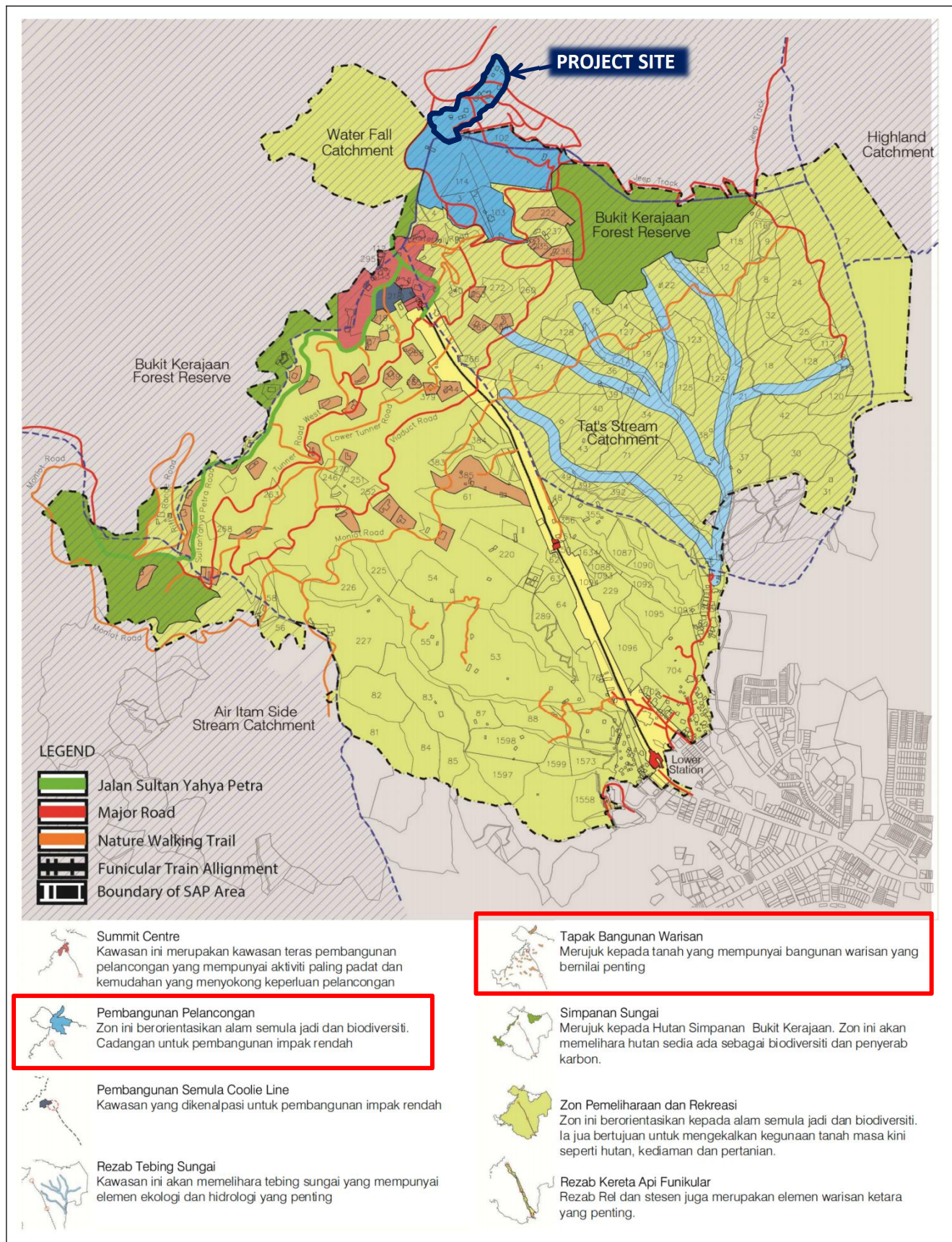


Figure 1.6 Developmental Zones on Penang Hill

Source: Penang Hill Special Area Plan 2016

1.6.3 Landuse

Based on site zoning in RSNPP 2030 (as shown in **Figure 1.4**), the proposed project site is currently located in an area zoned as *Kawasan Hutan* (Forested Area) whereas, iplan website zones the land for commercial use as a hotel, as shown in **Figure 1.7**. According to JPBD, the development is allowed as long as it is in line with the Penang Hill Special Area Plan 2016 (refer to *Appendix A-5iii : Correspondence Letters from Technical Agencies - JPBD letter*).

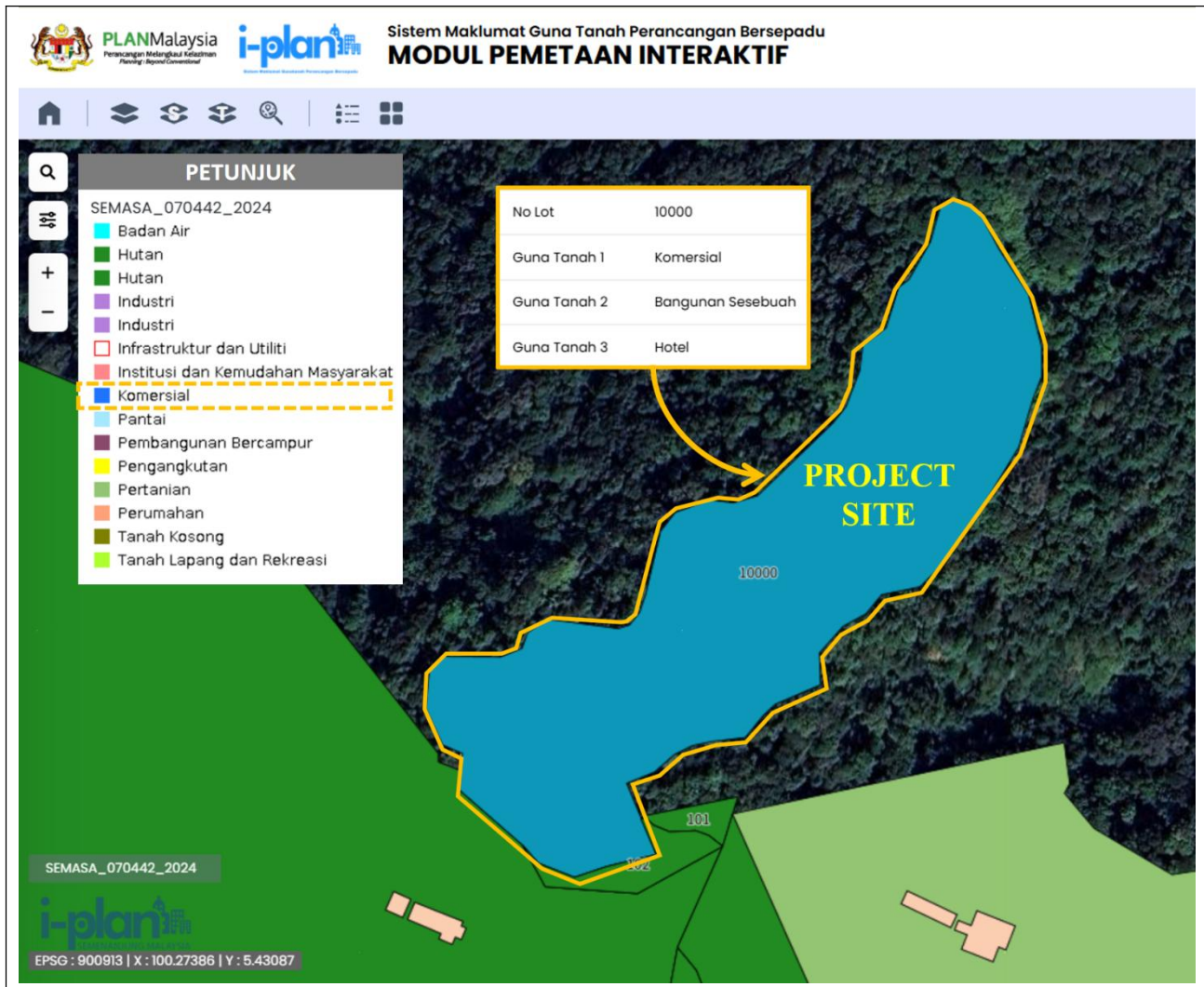


Figure 1.7 Zoning of Proposed Project Site According to i-plan

Source: I-plan website, 2025

CHAPTER 2

SCOPING NOTES

2.1 INTRODUCTION

This chapter provides the Scoping Notes for EIA Report submission under the First Schedule in identifying the potential adverse environmental issues of concern to determine the focus, scope and content of the EIA.

The project was identified to fall under the **Prescribed Activity 13 in Schedule 1, Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015, Environmental Quality Act 1974**. Thus, in compliance with the above requirements, project proponent must conduct an environmental impact assessment to identify any potential impact from the project site towards its surroundings environment.

2.2 SCOPING NOTES

The main summary of the scoping notes for this EIA study as described in **Table 2.1** below.

Table 2.1: Scoping Notes

No.	Scoping Notes
1)	Project Title
	Environmental Impact Assessment (EIA) report is prepared for “ CADANGAN MEROBOKKAN BANGUNAN KAYU SEDIA ADA DAN PEMBANGUNAN HOTEL (28 BILIK) SERTA KEMUDAHAN BERKAITAN DI ATAS LOT 10000, BANDAR BUKIT BENDERA, DAERAH TIMUR LAUT, PULAU PINANG ”
2)	Sensitive Receptors
	The project site currently consists of abandoned existing buildings, including the original Crag Hotel building, located on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang. Overall, the proposed site has a total area of 7.69 acres. The project site is located on the top of Penang Hill, about 850m away from the main tourist area and Upper Hill Rail Station. Within a 5km radius, there are various settlements and residential areas (Figure 2.1).

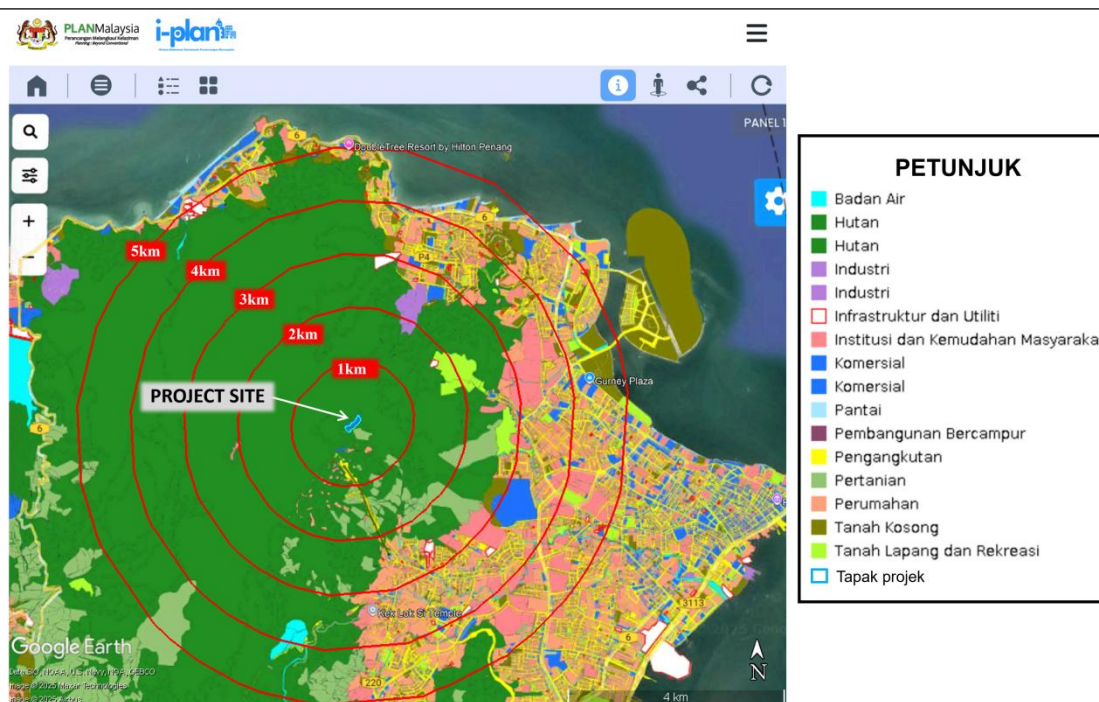


Figure 2.1: Landuse within 0-5km radius

Source: Itownplan website, 2025

3) Significant impacts due to the project or activity identified

- The significant environmental impacts of the proposed project to the existing environment are summarized in **Table 2.2**.

Table 2.2: Potential Significant Impacts

Environmental Aspects	Potential Significant Impacts
Demolition & Construction Phase	
Air Quality	Dust generation from demolition, earthwork, site clearing, construction activities, vehicular movement
Noise Level & Vibration	- Nuisance, annoyance and disturbance to nearby residents from piling works, construction and machineries. - High vibration levels could damage surrounding structures/buildings
Water Quality	- Water pollution due to soil erosion and sedimentation into receiving downstream water body and water body passing through project site - Water pollution due to leakage of oil from equipment and machinery
Erosion & Sedimentation	Soil erosion at the proposed project and sedimentation issues at the receiving water bodies
Waste Generation	Generation of biomass waste, solid waste, scheduled waste, and demolition waste
Traffic	Increase in existing traffic volume.

		● Heavy vehicles accessing public roads
	Safety & Health	● Safety and health of construction workers and public residents. ● Work-related injuries
	Land-Use, Landscape & Visual	● Forested land area changes to developed area
	Flora & Fauna	● Flora and fauna affected by the development from land-clearing activities
	Socio-Economic	● Potential improvement or disruption of local socio-economy ● Increase job opportunities, employment & business ● Conflicts due to the presence of foreign workers ● Increased demand for facilities and utilities
	Operational Phase	
	Air Quality	● Insignificant impact
	Noise Level	● Minimal noise from human activities
	Water Quality	● Potential impact is sewage generation is uncontrolled
	Erosion & Sedimentation	● Insignificant impact as there are no construction activities during the operation phase, and the surface of the ground has been covered by impervious surfaces and buildings.
	Waste Generation	● Generation of solid waste and municipal waste
	Traffic	● Insignificant impact
	Land-Use, Landscape & Visual	● Landscaping will improve overall aesthetics
	Flora & Fauna	● Sensory impact from light and noise pollution
	Socio-Economic	● Increase job opportunities, employment & business ● Increase in land & property values ● Increased demand for facilities and utilities
4)	Impacts which are uncertain as to the impacts but may occur	
	● The list of the potential environmental impacts which are uncertain or could arise and require further investigation includes of: - ❖ The P2M2 will be proposed accordingly for the development and site preparation, operation and maintenance as well as the abandonment and rehabilitation phases for the identified impacts. However, the degree of the unanticipated negative impacts if the ESCP/LD-P2M2 proposal is failed to be implemented on-site is may uncertain and unknown.	
5)	Potential Social Issues	
	● The project development does not involve any relocation and land acquisition. As such, there are no potential social issues for this project development as the project proponent is the land owner.	

- A socio-economic survey was conducted to survey the opinions of the surrounding communities on the proposed project.

6) Any special requirements for the EIA

- The special requirements are including of any baseline survey or study as shown below: -

Table 2.3: Baseline Requirements

Baseline	Requirements
Physico-Chemical Environment	
Topography/ Terrain	▪ <i>Topography and slopes analysis</i>
Soil Geology	▪ <i>Local and regional geology</i>
Soil Investigation	▪ <i>Soil investigation analysis</i>
Geotechnical Analysis	▪ <i>Geotechnical analysis</i>
Climate & Meteorology	▪ <i>Climate and meteorology data</i>
Hydrology	▪ <i>Site survey to verify river system and drainage.</i>
Air Quality	▪ <i>Field sampling and laboratory analysis by SAMM Accredited Laboratory for baseline air quality</i>
Water Quality	▪ <i>Field sampling and laboratory analysis by SAMM Accredited Laboratory for baseline water quality</i>
Noise & Vibration	▪ <i>Field sampling and laboratory analysis by SAMM Accredited Laboratory for baseline noise and vibration</i>
Biological Environment	
Flora & Fauna	▪ <i>Site observations on the existing condition</i> ▪ <i>Flora & fauna assessment</i>
Human Environment	
Landuse	▪ <i>Existing landuse and sensitive receptors</i>
Socio-Economic	▪ <i>Population census of demographic</i> ▪ <i>Socio-economic study within project area</i>

Table 2.4: Baseline Environmental Quality

Baseline environmental quality	Parameters	Recommended Requirements
Air quality	PM_{10} $PM_{2.5}$ Nitrogen Dioxide Sulfur Dioxide Carbon Monoxide Ozone	- Parameters to be sampled are dependent on-site conditions. - One time sampling at minimum two (2) stations (upwind and downwind); - Project boundary and nearest receptors For this project, three (3) sampling locations are proposed at project boundary and nearest receptors.
Water quality	pH. Biochemical Oxygen Demand (BOD) Chemical Oxygen Demand (COD) Total Suspended Solid (TSS) Ammoniacal Nitrogen (AN) Dissolved Oxygen (DO) Conductivity Turbidity Oil & Grease Fecal Coliform (Multiple Tube Method) Total Coliform (Multiple Tube Method) Escherichia Coli (Multiple Tube Method)	- One-time composite sampling. - Upstream and downstream of major rivers and streams within the ZOI. - For this project, three (3) sampling locations are proposed at the final discharge point of the site, upstream and downstream of Sungai Air Terjun.
Noise level	L_{Aeq} , L_{Max} , L_{Min} , L_{10} , L_{50} , L_{90}	- Parameters to be sampled are dependent on on-site conditions. - One time sampling (24-hrs for day time and night time) - Project boundary and nearest receptors - For this project, three (3) sampling locations are proposed at the project boundary and nearest receptors
Vibration	<i>Peak Particles Velocity (ppv)</i>	- Parameters to be sampled are dependent on on-site conditions. - One time sampling (1-hr for day time and night time)

- Project boundary and nearest receptors
- For this project, two (2) sampling locations are proposed at the project boundary and nearest receptors.

Table 2.5: Assessment Standard

Significant Impact	Evaluation Criteria	Reference
Air Quality	• Ambient air quality standards	• Malaysia Ambient Air Quality Standards (MAAQS)
Noise & Vibration	• Noise level limits • Vibration limit	• The Guidelines for Environmental Noise Limits and Control Third Edition 2019 (Reprint 2021) • Guidelines for Environmental Vibration Limits and Control Third Edition (DOE, 2021)
Water Quality	• Water quality • Water Quality Index (WQI)	• National Water Quality Standards for Malaysia (NWQSM).
Erosion and Sedimentation	• Soil Loss and Sediment Yield Evaluation	• Guidelines for Erosion and Sediment Control in Malaysia (DID, 2010) • Malaysia Standard- Urban Stormwater Management (MS 2526-1:14, MS 2526-2:14, MS 2526-3:14, MS 2526-12:14) (SIRIM, 2014) • Urban Storm Water Management Manual for Malaysia (MSMA 2nd Edition) (DID, 2012)
Waste Management	• Biomass waste • Schedule waste • Sewage	• Environmental Quality (Prescribed Activities) (Open Burning) Order, 2000 • Guidelines For Packaging, Labelling and Storage of Scheduled Waste in Malaysia • Environmental Quality (Scheduled Waste) Regulations 2005 • Environmental Quality (Sewage) Regulations 2009

Table 2.6: Sampling Stations

Station	Coordinate		Location
	Latitude	Longitude	
A1/N1/V1	5°25'45.38"N	100°16'12.47"E	Near Richmond Bungalow (within project boundary)
A2/N2/V2	5°25'33.45"N	100°16'10.82"E	Near Bellevue Hotel (south of project site)
A3/N3	5°25'43.39"N	100°16'19.62"E	Near agricultural land (southeast of project site)
W1	5°25'45.21"N	100°16'15.27"E	At concrete drain near final discharge point from project site
W2	5°26'25.77"N	100°16'57.22"E	Upstream of Sungai Air Terjun (upstream of water intake)
W3	5°26'24.94"N	100°17'12.08"E	Downstream of Sungai Air Terjun (downstream of water intake)

Note: *A – Air Quality*
 N – Noise Level
 V – Vibration
 W – Water Quality
 M – Marine Water Quality

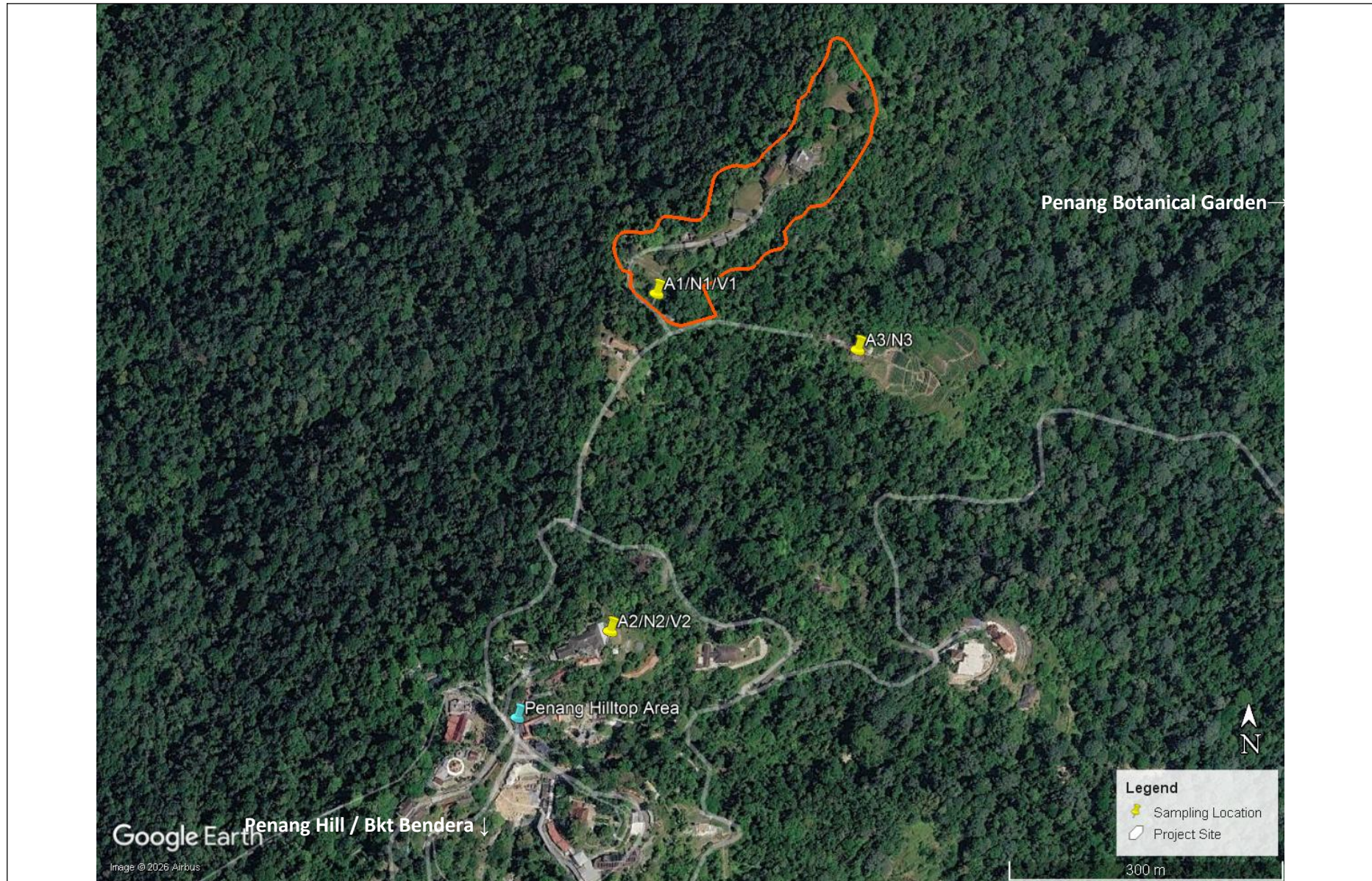


Figure 2.2: Environmental Baseline Sampling Point Locations (Air, Noise and Vibration)

Source: Updated in Google Earth by Senviro Resources, 2026

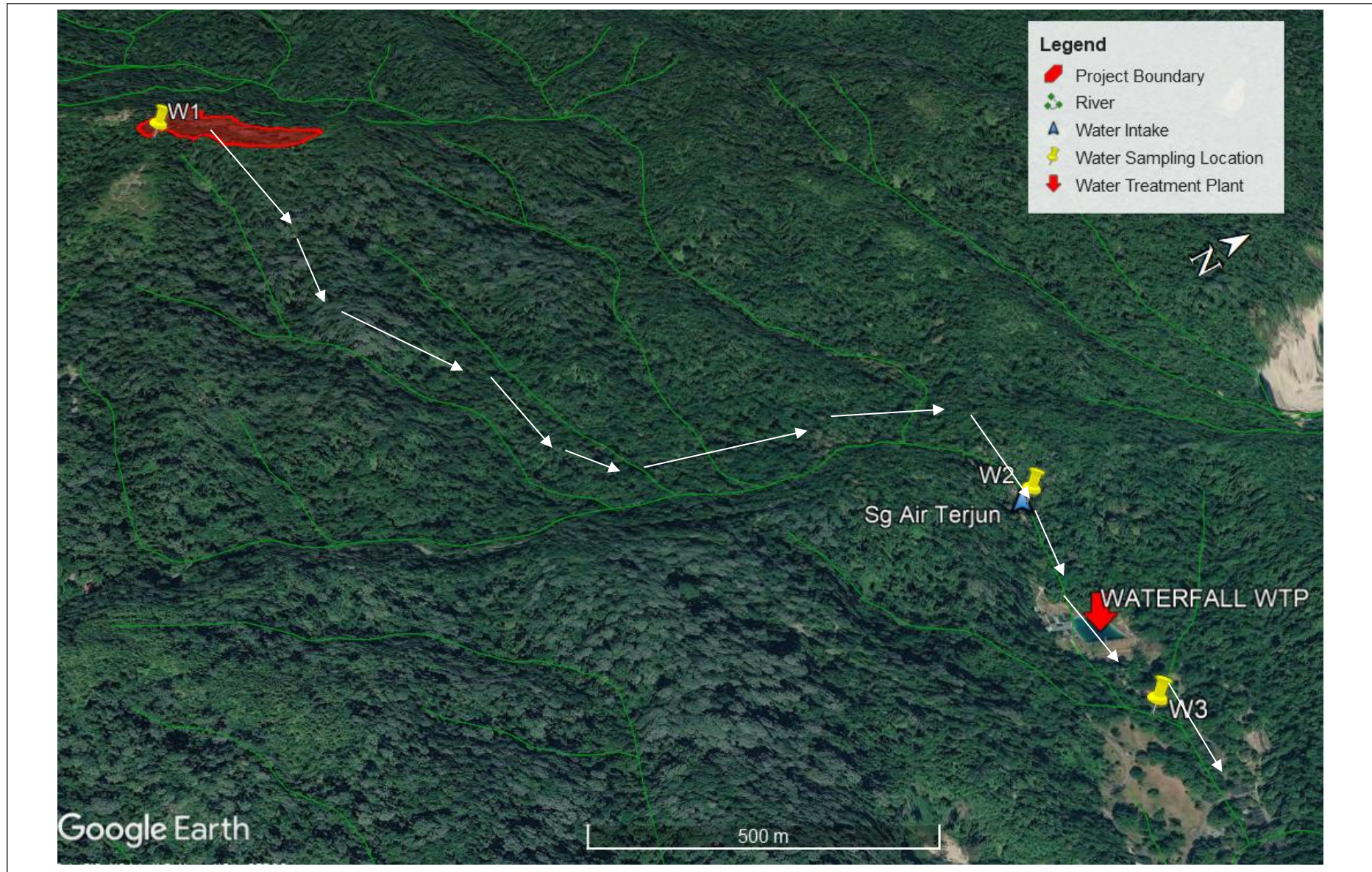


Figure 2.3: Environmental Baseline Sampling Point Locations (Water Quality)

Source: Updated in Google Earth by Senviro Resources, 2026

CHAPTER 3

STATEMENT OF NEED

3.1 INTRODUCTION

Crag Hotel was originally built in the 1850s as a private residence (Sim, 2022). Later on in the 1880s, the property was turned into a health retreat complete with sanatorium facilities, popular among civilian officials. In the early 1900s, the property was purchased by the Sarkies brothers, famed hoteliers who established the Eastern & Oriental Hotel in Georgetown and Raffles Hotel in Singapore (Jia-Ju, 2022). Under them, the Crag Hotel became a popular destination among the Straits Settlements, receiving famous personalities from around the world.

However according to the Penang Monthly article by Sim (2022), the hotel was running at a partial loss after World War I, which prompted the Sarkies Brother to sell it to the colonial government. Following the Japanese occupation, the Crag Hotel fully ceased its operations and sat abandoned for some time. In the 1950s, the property was leased by Uplands Schools and converted into the International School of Penang. In 1977, the school relocated to Georgetown. Since then, the Crag Hotel has remained unoccupied and abandoned, as noted by an article by Jia-Ju on TheSmartLocal website in 2022.

The proposed project aims to revitalize and preserve the historical Crag Hotel by restoring it to its original identity as a health retreat. The proposed hotel development will be centered around the existing main structure, with 28 rooms complete with related facilities, along with a spa.

3.2 STATEMENT OF NEED OF PROPOSED PROJECT

According to Penang Hill Special Area Plan 2016 (PHSAP 2016), Penang Hill is unique with its own cultural heritage. In the past, the hills were often frequented by British colonists due to its cool nature. Due to this, there are many historic buildings and monuments from the colonial era scattered across the top and the slopes of Penang Hill. The plan also points out that there are multiple historic buildings that are still in good condition and have the potential to be restored to support heritage tourism.

In order to support this, the state government has identified several historic buildings that have potential to be restored and redeveloped. Steps for the restoration process have also been highlighted in the plan.

Crag Hotel is one of the identified properties, listed as having the potential to be redeveloped into a low-density boutique hotel with a spa or therapy center, restoring it back to its origins as a health retreat centre.

Other than the historical preservation aspect, this proposed project will also create a new opportunity for visitors to stay and experience the tranquil nature of Penang Hill. Currently there are very few residences on top of Penang Hill, with only Bellevue Hotel located near to the main tourist centre with the rest being scattered private bungalows.

Hence this project will also be a way to boost the tourism industry at Penang Hill, which is also in line with PHSAP 2016 plan's objectives.

3.3 THE NEEDS OF THE PROPOSED PROJECT

- The proposed project is located on the original Crag Hotel site, which is within the Penang Hilltop area, surrounded mainly by historical buildings, dense forests and facilities that support tourism such as foodcourt, shops and a gallery.
- Based on the RSNPP 2030, the land is zoned as forested land. However, according to iplan website, the land is zoned for commercial and hotel use, which is in line with the history of Crag Hotel and RKKBB 2016. Accordingly, the proposed hotel development is consistent with both the surrounding land use and the planning intent for the area.
- The low rise and low density hotel have been designed to complement and enhance the uniqueness of Penang Hill which is known for its rich natural and historical heritage.
- The proposed development also aims to restore Crag Hotel to its original state as a luxurious hotel that also doubles as a health retreat. Furthermore, this will also provide a new lodging spot on Penang Hill, diversifying the available options.
- This proposed project will also eventually increase the land value of the nearby area through the development of this project (hotel with a spa) and help to create spin-off economic activities (such as job opportunities) and new development opportunities, which are essential to the economic development of the region and state.
- Further elaboration on the rationale for the need for the proposed project is stated in **Table 3.1**.

Table 3.1 Statement of Need

Strategic Location & High Accessibility	• Accessible via Jeep Road or via funicular train track. • Close vicinity to neighbourhoods such as Air Itam • Efficient communication system surrounding to and from the proposed project site.
Landuse Optimization	• The commercial component of the development will enhance economic value by creating new jobs and business opportunities. • The project will optimize land use by redeveloping an area currently occupied by secondary forest and dense undergrowth. • The proposed project will also restore the currently abandoned Crag Hotel buildings. The project aims to maximize the utilization of existing infrastructure as well by incorporating as much as possible into the new design. • The proposed project is intended to meet the strategies in PHSAP 2016 to further develop Penang Hill. • The development is expected to indirectly increase the property value of the surrounding areas. • It is compatible with the zoning and land-use classification under the Penang Structure Plan 2030 (RSNPP 2030) and the Penang Hill Special Area Plan 2016 (PHSAP 2016).
Other Supporting Matters	• Expands the employment market ranging from labourers (i.e., construction phase) to the hospitality and tourism industry (i.e., operational phase of the hotel and spa) • Contributes to state and national revenue through license issuance and tax collection. • Provides adequate and diversified lodging options at the hilltop.
Environmental Considerations	• From an ecological perspective, the existing biodiversity of flora and fauna within the site will experience minor impacts, as the current vegetation needs to be cleared during the construction stage. Nevertheless, the implementation of a well-planned landscaping program can help preserve the area as a green hub. • The proposed development incorporates the creation of green areas, buffer zones, and landscaped spaces, which not only promote healthy living but also helps mitigate potential urban pollution (such as air, noise, and water pollution).

CHAPTER 4

PROJECT OPTIONS AND ALTERNATIVES

In this chapter, the options available for the project will be discussed with consideration of future economic, technical, and environmental conditions. Several considerations need to be made in order to select the most suitable options for the development and proposed area. Factors such as compatibility with the surrounding land use, significant impact to the environment, economic and social benefits in terms of employment, contribution to the economy of the area and social impacts and relevance to government policies and development strategies for the area are among those considered when selecting options.

4.1 SITE SUITABILITY ASSESSMENT (SSA) AND CONSIDERATION IN PROJECT ALTERNATIVES AND OPTIONS

The Site Suitability Assessment (SSA) considers alternative options to the proposed concept and finalized layout. The recommendations of consideration in project alternatives and options are as follows: -

4.1.1 SSA for Revitalisation of Historical Heritage Buildings

- Penang is well known for its heritage values, and Penang Hill is no different. Penang Hill especially has a unique natural and historical heritage that has become its identity.
- As part of this, the state government has aimed to restore historical buildings and monuments found on the hill in order to preserve the heritage of the area through the gazetting of Penang Hill Special Area Plan 2016 (PHSAP 2016). Crag Hotel is one of the structures identified to be restored in the plan.
- The project proponent aims to restore the existing structures of Crag Hotel by turning it back into a luxurious hotel with 28 rooms, an adjacent spa, and other related facilities.

4.1.2 Project Sitting/ Site Options

- The proposed site involves 7.69 acres of development on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang.
- A survey of the site and surrounding development shows that the proposed site potentially can be developed as a hotel and spa.
- For the physical landform, the site is generally a forested, hilly area with existing structures and buildings of Crag Hotel.
- The areas surrounding the Project Site within a 5km radius are predominantly developed as local towns, with some nearby tourist attractions. The immediate surroundings of the project site are fairly unpopulated. As such, this proposed site is compatible with the existing land use.
- The development is closest to Air Itam town, which houses mainly local residents. According to iplan website, the existing land is currently zoned as commercial and for hotel uses.

- In selecting the best option for the project sitting, the following criteria were taken into consideration: -
 - a) Compatibility with the Government's development policies and strategy for future uses;
 - b) Environmental impacts of the intended development to the surrounding area;
 - c) Maintenance and enhancement of long-term productivity;
 - d) The irreversible and irretrievable commitment of resources; and
 - e) Suitability of land use.

4.1.3 Project Options and Alternatives

4.1.3.1 The 'No Project' Alternative

- The selection of the '**No Project**' alternative would mean discontinuing project designs and resulting in the site being retained in its existing form. **Table 4.1** shows the advantages and disadvantages of this alternative.
- The '**No Project**' option is normally considered when there is a need to preserve the environment of a particular area. Under the '**No Project**' option, no further development will be carried out within the existing Project site. The land will be left under its present conditions which is forested undeveloped land.

Table 4.1: Summary of the advantages and disadvantages for '**No Project**' Alternative

Advantages	Disadvantages
• No development at all hence there will not be any significant environmental impact on the surrounding/existing area; • No physical changes of the existing site conditions; • No physical, biological or socio-economic changes are expected to occur to the present environment; • Uneconomical usage of the land areas.	• No development on the study area leads to no new job opportunities for the locals surrounding the proposed project; • This area is left in its present condition without any site improvement. • The site remains at its status quo which is presently forested land with abandoned buildings which may not bring economic return. • No physical, biological or socio-economic changes are expected to occur to the present environment and this scenario would not contribute to any positive development on the surrounding environment; • Prevents the restoration of abandoned historic buildings that contain high heritage value and might be able to attract more tourists/visitors.

4.1.3.2 The ‘Yes Project’ Alternative

- The selection of the **‘Yes Project’** alternative would mean the continuation of the project designs. This option was considered the most viable, as described in **Table 4.2**.

Table 4.2: Summary of advantages and disadvantages of **‘Yes Project’** Alternative

Advantages	Disadvantages
• The proposed project aims to restore existing historic buildings • Based on the present landuse within and in the vicinity of the proposed site, the location of the project site is ideal for a hotel and spa. • The proposed project also aims to boost the tourism industry in the area • The position of the site is strategically located and accessible by Jeep Track Road or by the funicular train. • This proposed project is in line with local state plans in improving and establishing Penang Hill as a unique hilltop tourist destination. • The proposed project will have significant positive impacts on creating temporary and permanent job opportunities during the construction and operational phases. • The proposed project will increase economic growth and generate revenue through additional goods and services required in the construction and hospitality industry. • The proposed project offers an opportunity for visitors to learn more about the history of Penang Hill.	• The proposed project will have some short-term environmental impact. • The construction phase could cause some minimal social impacts, but the surrounding community and the larger region will benefit from the proposed project in the long term. • The existing site will remain as abandoned buildings on forested land with no economic contribution.

4.1.4 Layout Options

- There is no selection of the **‘Layout Option’** alternative in this study. The finalized development layout plan is based on various consultation sessions and input from all relevant Technical Departments to ensure that this development will give the minimum negative impact and maximum positive impact to the surrounding environment. The detailed layout plan also can be referred to in **Appendix B – PKM Layout Plan**.

4.1.5 Operations Options

- Once fully developed, the proposed project will will operate mainly as a hotel with 28 rooms, a spa and related amenities.

4.2 SUMMARY

This project has the ability to boost the tourism industry in Penang Hill which is in line with the needs stated in the Penang Structure Plan 2030 (RSNPP 2030). The proposed project is also in line with the Penang Hill Special Area Plan 2016 (PHSAP 2016) which greatly supports restoring historic buildings to boost the tourism industry as well. Based on the above, the **‘Yes Project’** Option is recommended for this project. If this project is a success, the value of the area can be fully utilized while being able to fulfill strategies listed in local plans. **Table 4.3** shows the summary of the options of the proposed project.

Table 4.3: Summary of Options

Item	‘Yes Project Option’	‘No Project Option’
ADVANTAGES		
Landuse compatibility	• Aligns with the government's development policies and strategies for future land use.	• The site remains as abandoned buildings in a forested area. It will not realise the policies and strategy of the Government needs.
Environmental impact	• Selected layout design options minimise cutting works and associated impacts. • Adoption of the environmental sustainability concept. • Paving and landscaping of exposed areas reduce soil erosion and improve aesthetics.	• No environmental impact since the land remains untouched, maintaining its current ecological state.
Socio-economic	• Restoration of existing historic buildings by developing into a hotel with 28 rooms, spa and related amenities • Enhances local infrastructure and connectivity. • Stimulates the construction industry in Air Itam. • Creates opportunities for	• No socio-economic benefits as the land remains undeveloped. • No economic activities generated for the local population or authorities.

	supporting businesses that provide goods and services to residents and visitors.	
DISADVANTAGES		
Landuse	Potential inefficient land use if not properly planned and executed.	The land remains as a forested area with abandoned buildings without any development potential being realized.
Environmental impact	Construction activities may temporarily affect environmental quality if preventive, mitigation, monitoring, and control measures are not implemented.	The environment remains unchanged, with no disturbances to the current ecosystem.

4.3 CONCLUSION AND EVALUATION

The ‘**Yes Project**’ Alternative was found to be the most reliable and appropriate option for this development due to the following reasons;

- Develops the areas in line with Government policies outlined in the National Physical Plan 4 (NPP-4), Penang Structure Plan (RSNPP 2030) and Penang Hill Special Area Plan (PHSAP2016);
- The proposed development will restore Crag Hotel to its former status as a luxurious hotel, complete with 28 rooms, a spa, and related facilities.

Hence, it can be concluded that the development would bring maximum benefits, primarily to the local community and the state government, by potentially boosting the tourism industry. As such, the proposed project to be undertaken by **SRI NISUH SDN BHD** should be given due consideration for its implementation.

CHAPTER 5

PROJECT DESCRIPTION

5.1 PROJECT LOCATION

The proposed project site is located on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang with the total land area being 7.69 acres (3.112 hectares). It is located on the top of Penang Hill, beside Richmond Bungalow and 850m away from the main commercial and tourist attraction area of Upper Hill Station. The site currently consists of dilapidated, unoccupied historical buildings. **Figure 5.1** shows the location of the proposed development.



Figure 5.1: Project Location

Source: Updated in Google Earth by Senviro Resources, 2026

5.2 SITE OWNERSHIP, SIZE, ZONING AND LAND USE

Table 5.1 shows the details of Lot 10000 with a total area of 7.69 acres (3.112 hectares) whereby a copy of the land title is attached in *Appendix C – Land Title* for reference. The landowner is the Penang State Government who has leased the land for 99 years for the development and operation of a hotel. The proposed project will be developed by Sri Nisuh Sdn Bhd.

Table 5.1: Details of Lot Involved

	Details
Lot	Lot 10000
Location	Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang.
Registered Land Owner	Penang State Government
Land Area	3.112 Ha
Ownership No.	PN9324
Land Use Category	Bangunan
Terms	a) Pajakan Negeri b) Tanah yang diperihalkan diatas adalah dipegang untuk selama tempoh tahun di atas oleh tuan punya pada masa namanya disebut dalam rekod ketuanpunyaan di bawah, tertakluk kepada peruntukan-peruntukan Kanun Tanah Negara, kepada kategori yang dinyatakan di atas dan kepada syarat-syarat nyata dan sekatan-sekatan kepentingan yang dinyatakan di bawah, sebagai balasan bagi pembayaran cukai tahunan yang sewajarnya.
Restriction	Tanah yang diberimilik ini hendaklah digunakan untuk tujuan pembangunan hotel dan aktiviti pelancongan sahaja

Source: Land Title Lot 10000 attached in Appendix C

5.3 PROJECT CONCEPT AND DEVELOPMENT COMPONENTS

5.3.1 Planning Permission Application

The application for Planning Permission for the proposed project (**MBPP/OSC/PM3700/18/(LB)/102708-1**) has been submitted to MBPP and has received feedback and technical input from the relevant departments. In addition, the proposal has been presented to the Penang Hill Committee, as the project site falls within the Penang Hill Special Area Plan 2016, and the necessary considerations and requirements have been duly noted for compliance.

To date, all technical compliance requirements have been fulfilled, including the geotechnical report, which was approved on **30th January 2020 (Letter Ref No: PKR.PP.(165)R/30/80/1 Jld.43, refer to *Appendix A-3: Geotechnical Approval Letter*)**. At present, the only outstanding requirement is the submission and approval of the Environmental Impact Assessment (EIA) report. Upon approval of the EIA report, together with the required supporting documents, the proposed project will be tabled for final approval by the relevant authorities.

5.3.2 Project Concept

The Crag Hotel site is located on a ridgeline area covering 3.112 hectares (7.69 acres) at one of the highest peaks of Penang Hill. The property was originally operated in the 19th century as a British hill station with a lodging house known as the Crag Hotel, built on a large granite outcrop. In the 1920s, the building was significantly reconstructed using reinforced concrete, and substantially expanded and modernised.

Over time, additional buildings were added to the Crag Hotel area, which are now in various states of disrepair or near collapse. These smaller buildings were used as school facilities for Uplands School during and after the Malayan Emergency.

Through this proposed project, the property will return to its original use — a luxurious hotel and spa — centred around the historic Crag Hotel building, which will be restored. Twenty-eight luxury guest rooms, each approximately 75 square metres, will be constructed along the eastern and western flanks of the site, in single-storey buildings overlooking Georgetown and the Straits of Malacca.

To the north, a two-storey guesthouse will be added facing the hotel pool in a secluded area. Additional hotel facilities will be built on a gentle slope within the development area. The main public spaces will consist of a large restaurant and function room, bar, lounge, and viewing deck, which will be added to the restored Crag Hotel building to serve as both a visual and functional centrepiece of the development. The restoration will aim to be as authentic to the original 1920s architectural style as possible, with later additions removed.

The hotel is accessible via a public road beside the adjacent Richmond estate. Hotel guests will be guided along a village road through mature forest and hanging vegetation to reach the

resort and enjoy the site's natural beauty. This village road leads to a small river bridge at the entrance to the development area. The bridge will be rebuilt to allow access for small vehicles and essential services.

From this point, the existing access road leads up to the hotel and spa buildings, which are situated on the old structural platform on both sides of the hotel entrance portico. Existing grassy slopes, rocky hills, trees, and established vegetation will be preserved in this area to maintain the site's historical ambience, low population density, and to celebrate its natural beauty and tranquillity.

Currently, access to the hotel building is limited to small vehicles or on foot, and conventional vehicles will be redirected to parking facilities located below the hotel. Two new arrival pavilions will be built — one serving as the hotel's main arrival lobby, and the other as a reception area for the other rooms and the spa. The extensive spa facilities, located below the arrival pavilions, will include treatment rooms, a gym, pilates and yoga spaces, and a swimming pool. The spa will cater to both hotel guests and day visitors from Georgetown.

An existing small guesthouse that opens onto the garden area in the middle of the site, located between the hotel arrival buildings and the Crag Hotel, will be retained and repurposed as the hotel's front office.

The architecture of the new hotel buildings will largely be prefabricated due to the site's topographic challenges and unavoidable construction access constraints. The typical new residential buildings will each house four guest suites, suspended on stilts along the site's slopes to minimise the development's footprint.

The roofs are expected to be made of coated metal that will weather naturally over time. Dark-toned engineered wood panels will be used for the exterior cladding of the new buildings, allowing them to visually blend with the site's existing vegetation.

Inside, the guest suites and public spaces will be built primarily using light-toned wood panels, creating a tranquil ambience. Large verandas will extend the spatial experience of the rooms, offering views of the sea, Georgetown and the surrounding forest.

Figure 5.2 shows some 3D perspective views of the proposed project. The breakdown and details of the project component are presented in **Table 5.2**. The KM Layout Plan is shown in **Figure 5.3**, while Figure 5.4 shows the cross sectionals (refer *Appendix B - KM Layout Plan*).

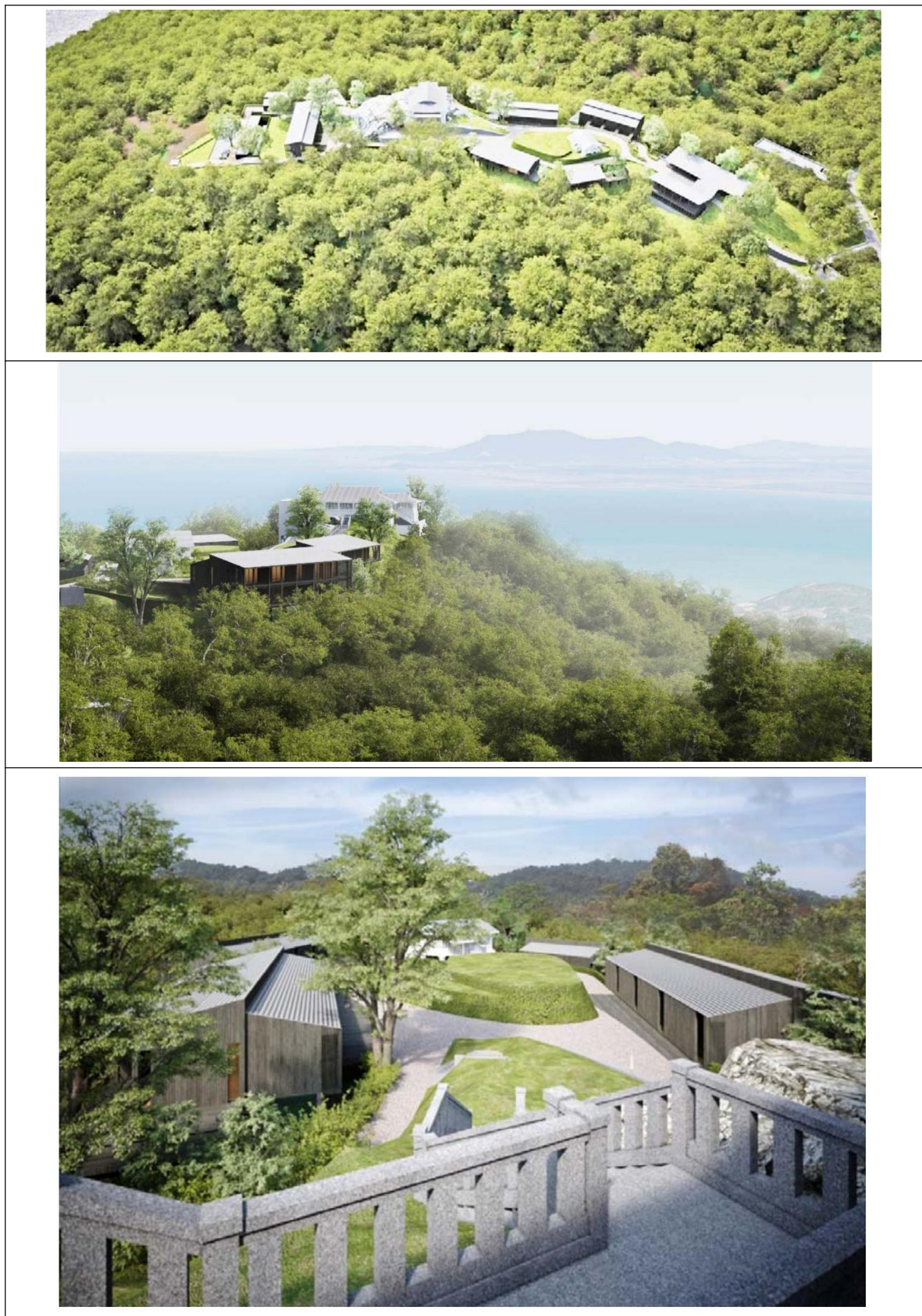


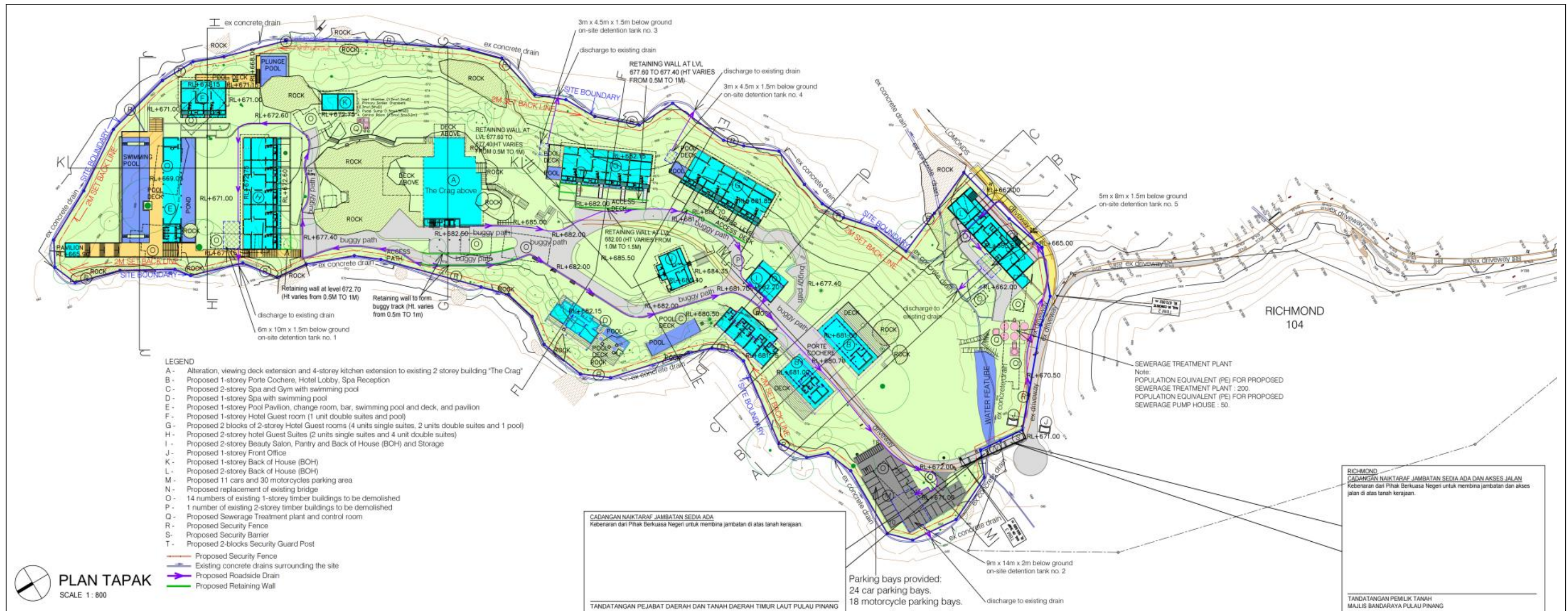
Figure 5.2: 3D Perspective Views of Proposed Project

Source: LCP Report by Chong Kum Kwan Architect, 2018

Table 5.2: Project Development Components

DATA PEMBANGUNAN / DEVELOPMENT DATA					NISBAH PLOT / PLOT RATIO							
Kawasan / Area					KETERANGAN							
Lot	hektar	m ²	acre	ft ²	PARAS -1	PARAS 1	PARAS 2	PARAS 3	PARAS 4	JUMLAH	DEK RENANG & KOLAM RENANG	
10000	3.112	31,120	7.690	334,972.9								
Zon / Zone					a) PINDAAN, TAMBAHAN DEK PANDANGAN DAN TAMBAHAN DAPUR 4-TINGKAT KEPADA BANGUNAN SEDIADA 2 TINGKAT "THE CRAG".							
Pelancongan komersil / Commercial tourism.					-	120 m ²	215 m ²	254 m ²	626 m ²	1,215 m ²		-
Nisbah plot / Plot ratio					b) 2-TINGKAT ANJUNG KERETA (PORTE COCHERE), LOBI HOTEL, TEMPAT RESEPSI SPA.							
Maximum allowable: 1 : 1					-	518 m ²	-	-	-	518 m ²		-
Proposed plot ratio: 1 : 0.220					c) 2-TINGKAT RUMAH SPA, GIMNASIUM DAN KOLAM RENANG.							
					268 m ²	256 m ²	-	-	-	524 m ²		244 m ²
Kawasan Penempatan / Plinth Area					d) 1-TINGKAT RUMAH SPA DAN KOLAM RENANG.							
Allowable 30% plinth area.					-	207 m ²	-	-	-	207 m ²		125 m ²
Allowable plinth area: 9,336 m ²					e) 1-TINGKAT KOLAM PAVILION, BILIK PERSALINAN BAJU, BAR, KOLAM RENANG DAN DEK DAN PAVILLION.							
Proposed 11.5% plinth area.					-	341 m ²	-	-	-	341 m ²		668 m ²
Proposed plinth area: 3,581 m ²					f) 1-TINGKAT SUITE TETAMU HOTEL (1 UNIT DOUBLE SUITE DAN KOLAM).							
					-	236 m ²	-	-	-	236 m ²		206 m ²
Tempat letak kereta diperlukan / Parking required					g) 2 BLOK 2-TINGKAT SUITE TETAMU HOTEL (4 UNIT SINGLE SUITE DAN 2 UNIT DOUBLE SUITE DAN 1 KOLAM RENANG).							
Total plot ratio area + open pool deck area + pool area = 8,226 m ²					862 m ²	862 m ²	-	-	-	1,724 m ²		142 m ²
80% total area = 6,580 m ²					h) 2-TINGKAT SUITE TETAMU HOTEL (2 UNIT SINGLE SUITE DAN 4 UNIT DOUBLE SUITE).							
1 parking bay per 200 m ² = 33 parking bays.					-	537 m ²	537 m ²	-	-	1,074 m ²		-
20% total area = 1,646 m ²					i) 1-TINGKAT SALON KECANTIKAN (BEAUTY SALON), KAWASAN PEKERJAAN LAIN (BACK OF HOUSE) DAN STOR.							
3 parking bay per 100 m ² = 50 parking bays.					129 m ²	110 m ²	-	-	-	239 m ²		-
Total required parking bays					j) 1-TINGKAT PEJABAT DEPAN (FRONT OFFICE).							
83 car parking bays.					-	134 m ²	-	-	-	134 m ²		-
83 motorcycle parking bays.					k) 1-TINGKAT KAWASAN PEKERJAAN LAIN (BACK OF HOUSE).							
					-	76 m ²	-	-	-	76 m ²		-
Tempat letak kereta yang disediakan / Parking provided					l) 2-TINGKAT KAWASAN PEKERJAAN LAIN (BACK OF HOUSE) DENGAN KAWASAN LETAK KERETA ATAS BUMBUNG.							
Car park provided: 39 bays					133 m ³	400 m ²	-	-	-	533 m ²		-
Motorcycle park provided: 18 bays					t) 2 BLOK 1-TINGKAT RUMAH PENGAWAL KESELAMATAN (SECURITY GUARD POST).							
					-	20 m ²	-	-	-	20 m ²		-
					JUMLAH							
					1,392 m ²	3,817 m ²	752 m ²	254 m ²	626 m ²	6,841 m ²		1,385 m ²
CADANGAN KAWASAN / PROPOSED AREA: 6,841 m ²												
CADANGAN NISBAH PLOT / PROPOSED PLOT RATIO: 1 : 0.220												
CADANGAN KAWASAN PENEMBATAN / PROPOSED PLINTH AREA: 3,581 m ² (11.5%)					1,392 m ²	2,189 m ²						

Source: Chong Kum Kwan Architect, 2018



refer Appendix B for full details

Figure 5.3 PKM Layout Plan
Source: Chong Kum Kwan Architect, 2018

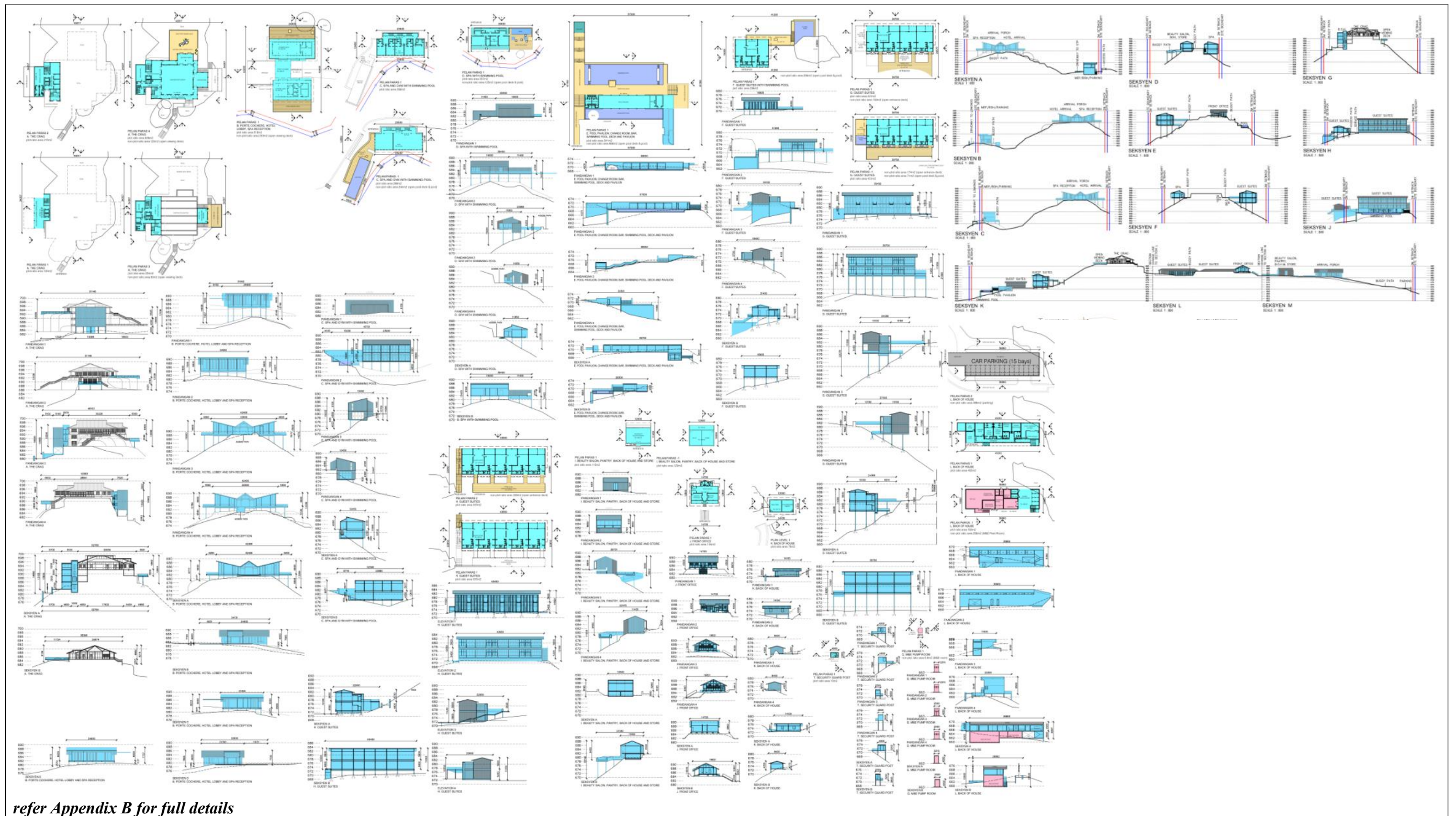


Figure 5.4 Cross sectionals of the Proposed Development
Source: Chong Kum Kwan Architect, 2018

5.3.3 Heritage Preservation in Project Concept

The concept for the proposed project is developed with the protection of Outstanding Universal Value (OUV) of the Crag Hotel in mind. Although the Crag Hotel itself is not located within the main Georgetown Heritage Zone, OUV principles should still be considered in design, as the property does have historic value.

In order to protect and conserve OUV value, an adaptive reuse strategy with heritage conservation principles will be implemented in the project concept and design. Adaptive reuse is the process in which existing buildings are reused in either a different or similar capacity to their original purpose and are often undertaken in buildings at the end of their lifespan (UBE, 2024). This strategy is highly beneficial and sustainable as it allows the revitalisation of historical buildings while saving valuable resources. Furthermore, under this method, heritage elements such as the building's facade, integrity, materials, and structure are maintained with minimal renovations.

This is also reflected in the proposed project concept, as the overall development will complement and revolve around the historic Crag Hotel (shown in **Figure 5.5**), which will be maintained except for some minimal renovations. All conservation works will adhere to best practices, with interventions designed to be minimal, reversible (where feasible), and non-intrusive to the original structure and fabric. The proposed ancillary additions, such as the viewing deck and kitchen extension, will be carefully scaled and positioned to avoid adverse physical and visual impacts on the primary heritage asset. Other than that, other factors such as building height of new structures will be limited as per regulations in Penang Hill Special Area Plan 2016, in order to ensure that the visual corridor of the area is not obstructed.

Some of the additional wooden buildings on the land will be demolished, but that is mainly due to their dilapidated and structurally unsafe conditions, with negligible heritage significance. Their removal is necessary to mitigate safety risks and to facilitate a more coherent, controlled, and context-responsive site layout. The demolition activities will be done through a manual demolition system which will only be minimally disruptive. Materials from demolition works will be reused as much as possible. Moreover, the proposed development prioritizes the retention of the existing building footprint to the greatest extent practicable. Any extensions or new works will be minimized in scale and confined within defined development zones to reduce land disturbance, vegetation clearance, and potential environmental impacts. Some of the structures to be demolished are shown in **Figure 5.6**.

Thus, it can be summarized that the design of the proposed development prioritizes the retention and restoration of the main heritage structure while introducing minimal and controlled ancillary additions. The design approach ensures the preservation of the Outstanding Universal Value (OUV), authenticity, and integrity of the existing structure.



Figure 5.5 Main Structure of Crag Hotel



Figure 5.6 Some of the wooden buildings on the site to be demolished

5.4 ACCESSIBILITY

The proposed development is situated on top of Penang Hill, located 850m away from the Upper Hill Station area and 2.5km away from Air Itam which is the closest town. As this proposed development is situated on top of Penang Hill, there are two main ways to reach the hilltop, either by funicular train or by driving up Jeep Track Road (paved road that's 5km long). Both paths are shown in **Figure 5.7** and further discussed below.



Figure 5.7: Site Accessibility

Map & Path Source: Google Earth & updated by Senviro Resources, 2026

Photo Sources (from top, clockwise): alwyn-lau on medium.com(2023), penang-traveltips.com (2011) & @mypenanghill on Instagram (2021)

i. Jeep Track Road

Jeep Track Road is the only paved road that leads up to the top, with the entrance of the route located near Penang Botanical Garden. However only residents, business operators and contractors of Penang Hill are allowed to drive vehicles up the hill. Visitors can book private jeep services to go up the 5km long route, while any other vehicles have to get permits from the Public Works Department of Penang (Jabatan Kerja Raya Pulau Pinang) and Penang Hill Corporation (PHC). As this is the only paved road leading to the top of Penang Hill, construction vehicles will be utilizing this road as well.

ii. Funicular train

A 5 minutes funicular train ride is the main method of transport for visitors and the general public up to the top of Penang Hill. From the Upper Station, the proposed development is a 10 minute walk away. This method is only for those going on foot.

It is expected that the visitors, guests, and staff will mainly use the funicular train or private jeep services to access the proposed development once in operation.

iii. Cable Car (currently under construction)

Currently, a cable car line connecting Penang Hill and Penang Botanical Garden is in development, slated for completion by 2027. Once in operation, the cable car will provide an alternate method for visitors, guests, and staff to access Penang Hilltop, alongside the existing funicular rail system. From the Hill Station, the proposed development is a 10 minute walk away.

5.5 INFRASTRUCTURE AND UTILITY DEMAND

5.5.1 Utility Demand

The provision of infrastructure and utilities is necessary for the overall project to ensure that the facility can accommodate future development needs. It is a necessity and responsibility of various parties such as Federal and State agencies. For this proposed project, some of the estimations of utilities demand for the entire development as follows: -

i. Population Equivalent (PE)

It is estimated that the total population equivalent (PE) for the proposed project once fully developed is about **199 PE** as shown in **Table 5.3**. The calculation of total estimated PE is based on Malaysian Sewerage Industry Guidelines Volume IV by Suruhanjaya Perkhidmatan Air Negara (SPAN) as per Malaysian Standards 1228 (MS1228).

Table 5.3: Population Equivalent (PE) Estimation

No	Type of Establishment – Commercial	Unit	Quantity	PE/unit	Total PE
1	Block A– THE CRAG	m2	1215	0.03	36.45
2	Block B– Hotel Lobby & Spa	m2	518	0.03	15.54
3	Block C– Spa House, Gym & Swimming Pool	m2	768	0.03	23.04
4	Block D– Spa House & Swimming Pool	m2	332	0.03	9.96
5	Block E– Pavillion & Swimming Pool	m2	1009	0.03	30.27
6	Block I– Salon & Stor	m2	239	0.03	7.17
7	Block J– Office	m2	134	0.03	4.02
8	Block K– Commercial	m2	76	0.03	2.28
7	Block J– Commercial	m2	533	0.03	15.99
No	Type of Establishment – Hotel Room	Unit	Quantity	PE/unit	Total PE
1	Block F– 1 Unit Double Suite	Room	1	4	4
2	Block G1– 4 Unit Single Suites & 2 Unit Double Suites	Room	6	4	24
3	Block H– 4 Unit Single Suites & 2 Unit Double Suites	Room	6	4	24
4	Block T– 1 Unit Security Guard Post	Room	10	0.20	2
Total :					199
PE CALCULATION BASED ON TABLE 3.1 OF MSIG 2025					
VOL. 1					

Source: EDP Consulting Group, 2026

ii. Water Demand

The water demand is calculated based on the average maximum demand per unit per day. The estimated water consumption for the proposed project is expected to accommodate the use of visitors, hotel residents and staff that will be on site once operation begins. The average daily water demand for this proposed project is as illustrated in **Table 5.4**. The overall total daily water demand estimated is about **67,790 litres/day**.

Water is proposed to be tapped off from the existing supply main at Jalan Tunku Yahya Petra, with a connection to the site laid under PBAPP's supervision. The water distribution system is shown in **Figure 5.8** and further details can be referred to in **Appendix D (Water Distribution Plan & Details)**.

Table 5.4: Water Demand Estimation

Development Type	Current Proposed KM Submission					
	Unit	Area (m2)	Water Demand (Gallon/Day)	Demand per day/ Area/unit	Total Estimated Water Demand (Gallon Per Day)	Total Estimated Water Demand (Lpd)
Commercial						
Block A - Pindaan, Tambahan Dek Pandangan Dan Tambahan Dapur 4 Tingkat Kepada Bangunan Sediada 2 Tingkat "The Crag"		1215	220/100m2	1000/100m2	2673	12,150
Block B - 2 Tingkat Anjung Kereta (Porte Cochere), Lobi Hotel, Tempat Resepsi SPA		518	220/100m2	1000/100m2	1139.6	5,180
Block C - 2 Tingkat Rumah SPA, Gimnasium Dan Kolam Renang		768	220/100m2	1000/100m2	1689.6	7,680
Block D - 1 Tingkat Rumah SPA Dan Kolam Renang		332	220/100m2	1000/100m2	730.4	3,320
Block E - 1 Tingkat Kolam Pavilion, Bilik Persalinan Baju, Bar, Kolam Renang Dan Dek Dan Pavilion		1,009	220/100m2	1000/100m2	2219.8	10,090
Block I - 1 Tingkat Salon Kecantikan (Beauty Salon), Kawasan Pekerjaan Lain (Back of House) Dan Stor		239	220/100m2	1000/100m2	525.8	2,390
Block J - 1 Tingkat Pejabat Depan (Front Office)		134	220/100m2	1000/100m2	294.8	1,340
Block K - 1 Tingkat Kawasan Pekerjaan Lain (Back Of House)		76	220/100m2	1000/100m2	167.2	760
Block L - 2 Tingkat Kawasan Pekerjaan Lain (Back Of House) Dengan Kawasan Letak Kereta Atas Bumbung		533	220/100m2	1000/100m2	1172.6	5,330
Sub Total		4,824			10,613	48,240
Hotel Room						
Block F - 1 Tingkat Suite Tetamu Hotel (1 Unit Double Suite Dan Kolam)	1	442	330/room	1500/room	330	1,500
Block G - 2 Blok 2 Tingkat Suite Tetamu Hotel (4 Unit Single Suite Dan 2 Unit Double Suite Dan 1 Kolam Renang)	6	1,866	330/room	1500/room	1980	9,000
Block H - 2 Tingkat Suite Tetamu Hotel (2Unit Single Suite Dan 4 Unit Double Suite)	6	1,074	330/room	1500/room	1980	9,000
Block T - 2 Blok 1 Tingkat Rumah Pengawal Keselamatan (Security Guard Post)	1	20	11/person	50/person	11	50
		3,402			4301	19,550
Total	14	8,226			14,914	67,790
Total Water Demand = 67,790 Litre Per Day (LPD) 0.78 Litre Per Second (LPS) 67.79 m3/day						

Source: EDP Consulting Group, 2026

iii. Electricity Demand

The estimated maximum demand of the electrical load is based on the use of electrical load and diversity factors for the overall development proposals in the area. The total estimation of the maximum electrical demand for the proposed project is about **450 kW** as tabulated in **Table 5.5**.

Based on the total electricity demand as shown in **Table 5.5**, the project development will have one (1) Single Chamber substaion to cater to the load requirements (refer **Appendix D-5: Electricity Load Details** for further details). The proposed location for the electrical substation for the site is shown in **Figure 5.9**.

Table 5.5: Electrical Load Estimation

No. Rujukan Ulasan TNB Keatas Pelan Bangunan:

Tarikh Bekalan Diperlu:

LAMPIRAN:

No Projek: AG-1052

Permohonan Kebenaran Merancang Untuk, (A) Merobokkan 21 Unit 1-Tingkat dan 1 Unit 2-Tingkat Bangunan Kayu Sediada, (B) Cadangan Pembangunan Hotel (28 Bilik) yang Terdiri daripada :

- 1) Pindaan, Tambahan Dek Pandangan dan Tambahan Dapur 4-Tingkat kepada Bangunan Sediada 2-Tingkat "The Crag"
- 2) Mendirikan 3 Blok 2-Tingkat Ruang Kemudahan Hotel dan Tempat Letak Kereta
- 3) Mendirikan 5 Blok 1-Tingkat Pejabat Pentadbiran dan Ruang Kemudahan Hotel
- 4) Mendirikan 1 Blok 1-Tingkat Hotel 2 Bilik (1 Bilik Double Suites dan 1 Kolam Renang)
- 5) Mendirikan 3 Blok 2-Tingkat Hotel 26 Bilik (10 Bilik Single Suite, 8 Bilik Double Suites dan 1 Kolam Renang)
- 6) Menaiktaraf Jambatan Sedia Ada
- 7) Loji Rawatan Kumbahan

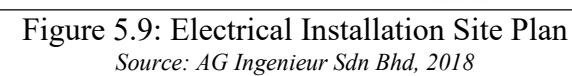
DI atas Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang. Untuk Tetuan Sri Nisuh Sdn. Bhd.



	JENIS BANGUNAN	BILANGAN PENGGUNA	KWKM SEPENGGUNA	KWKM JUMLAH	LOAD FACTOR %	BEBAN BERSAMBUNG SEPENGGUNA KW	BEBAN SAMBUNG JUMLAH KW	TARIF	JENIS & BIL. JANGKA
1	Pindaan, Tambahan Dek Pandangan dan Tambahan Dapur 4-Tingkat kepada Bangunan Sediada 2-Tingkat "The Crag"	1	200	200	0.7	286	286	B	800A 3 Fasa (U/G) (1 CT jangka)
2	3 Blok 2-Tingkat Ruang Kemudahan Hotel		30	30	0.7	43	43		
3	5 Blok 1-Tingkat Pejabat Pentadbiran dan Ruang Kemudahan Hotel		40	40	0.7	57	57		
4	1 Blok 1-Tingkat Hotel 2 Bilik		5	10	0.7	7	14		
5	3 Blok 2-Tingkat Hotel 26 Bilik		5	130	0.7	7	186		
6	Loji Rawatan Kumbahan		40	40	0.7	57	57		
	JUMLAH BESAR	1		450			643		

Refer Appendix D for further details

Source: AG Ingenieur Sdn Bhd, 2018



5.5.2 Sewage Treatment Plant

The overall total population equivalent (PE) for the proposed project is **199 PE**. Sewage from the development will be conveyed via the internal sewer reticulation system and connected to the proposed Small Sewerage Treatment System (SSTS) which is shown in **Figure 5.10**. A pump sump will also be allocated for buildings A, E, F, H and K (refer to **Figure 5.11** and *Appendix D-3: Sewerage Plan*).

The proposed SSTS and the internal system will not be handed over to Indah Water Konsortium Sdn. Bhd and instead will be managed privately. The calculation of the total estimated PE is based on Malaysian Sewerage Industry Guidelines by Suruhanjaya Perkhidmatan Air Negara (SPAN) as per Malaysian Standards 1228 (MS1228).

The final effluent from the proposed SSTS will be discharged into an existing concrete drain, which will eventually discharge into the Ayer Terjun River. A copy of the sewerage layout plan and the design report are attached in *Appendix D-3 (Sewerage Plan)*.

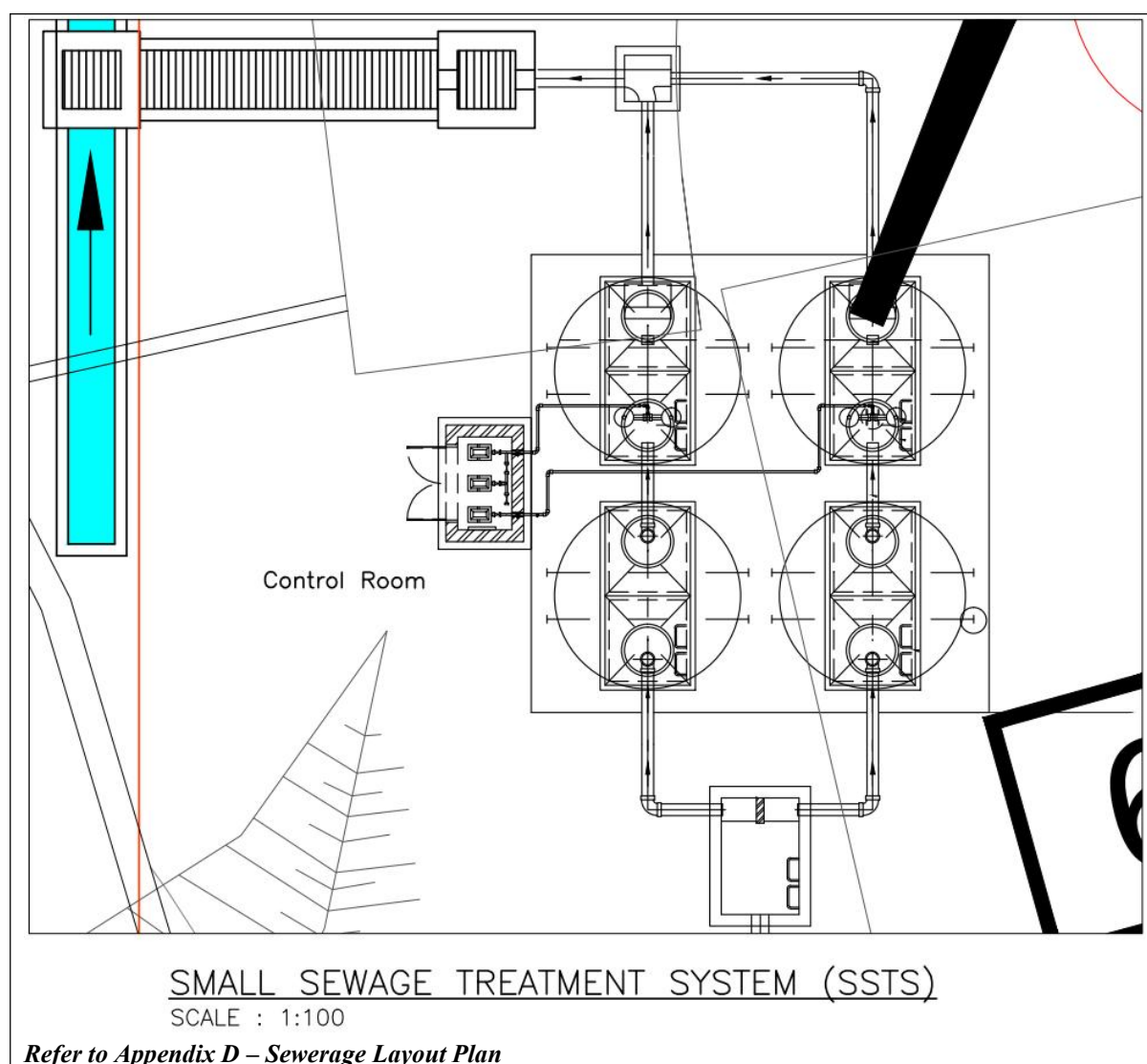
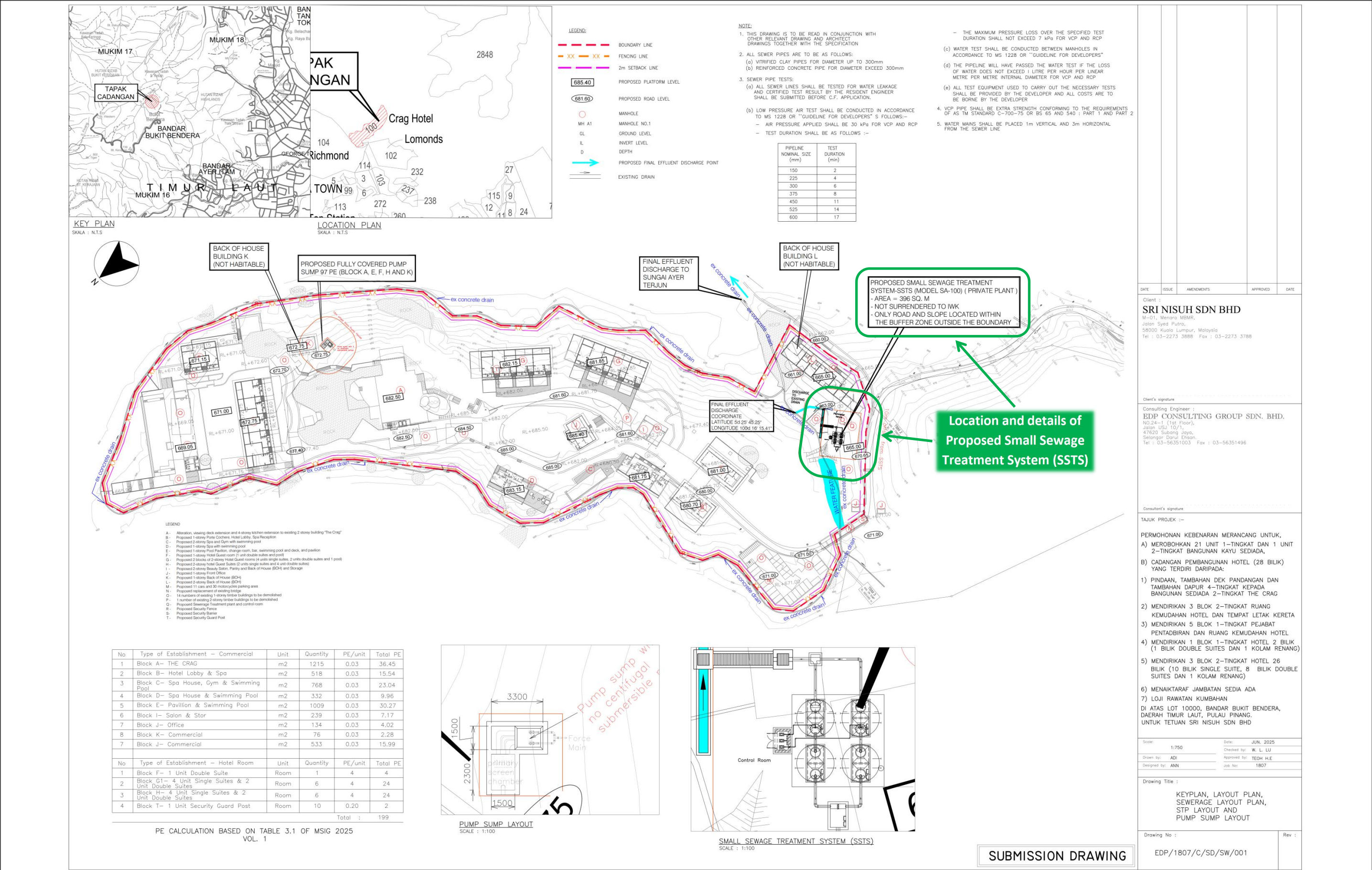


Figure 5.10 Layout of Proposed Small Sewerage Treatment System (SSTS)

Source: EDP Consulting Group, 2026



Refer Appendix D for further details

Figure 5.11 Sewerage Plan
Source: EDP Consulting Group, 2026

5.5.3 Solid Waste Management

Solid waste disposal is a process comprising storage, collection, transportation, and landfilling of typically solid or semi-solid materials resulting from human activities that are useless, unwanted, or hazardous. Any disruption or deficiency in the solid waste disposal operations mentioned above can result in either a total or partial disruption of the service. Thus, careful planning is essential to manage waste handling and disposal effectively, ensuring both human and environmental safety.

The population equivalent (PE) estimation for the proposed project is about **199 PE**. The amount of solid waste generated by the proposed project is estimated by the defined number of PE. Thus, based on the total PE calculation, it is estimated that the solid waste would amount to **199 kg/day** at a assumed waste rate of **1kg/capita/day** (Saeed et. al., 2009) whereby the calculation as follows: -

$$\begin{aligned}
 \text{Solid waste generation} &= PE \times \text{waste rate} \\
 &= 199 \times 1 \text{ kg/capita/day} \\
 &= 199 \text{ kg/day}
 \end{aligned}$$

Based on the total PE calculation, the estimated solid waste would amount to **199 kg/day** at a production rate of 1 kg/person/day. This solid waste should be appropriately managed to prevent any undesired problems. The Project site falls under the administration of Majlis Bandaraya Pulau Pinang (MBPP). The collection and disposal services would be under the purview of MBPP or even the private contractor which has been appointed by the city council that will be disposed of at the approved disposal site (Pulau Burung Sanitary Landfill).

5.6 PROJECT ACTIVITIES

The typical project activities involved throughout the phase of project development can be summarized/ divided into a few phases of project development, i.e., pre-construction phase, construction phase, operation phase and abandonment phase, as elaborated in **Table 5.6**.

Table 5.6: Key Project Activities

Development Phase	Project Activities
Pre-Construction Phase	
Project Planning and Management	• Desk study, feasibility analysis; • Appointment and supervision of the Consultants' team and Contractor; • Layout proposal and site suitability. • Liaison with statutory authorities for approval; • Preparation of detailed engineering design for the development plan, development layout, earthwork plan, Erosion and Sediment Control Plan (ESCP)

	• Permit to start work.
Site survey	• Commissioning of surveys by licensed surveying firm; • Vegetation clearing for survey works (if in need); • The analysis is done by the surveyor and further planning and advice to the site for construction preparation and development; • The details of Cassini, longitude and latitude for each boundary of the development area are established and attached in the survey plan (Refer to <i>Appendix H-1: Topographical Survey Plan</i>).
Soil investigation Geological survey	• Soil investigations was conducted on the site to provide specific sub-surface information about soil conditions and associated physical and chemical characteristics. The SI work involved soil drilling and analysis of soil samples
Environmental baseline study	• Main activities for an environmental baseline study for the existing environment, including air quality, water quality, noise and vibration level shall be conducted by an accredited laboratory scheme. • For this proposed project, MYCO2 (PG) Sdn Bhd has been appointed to conduct the environmental baseline study. The details of laboratory results and analysis are attached in <i>Appendix I – SAMM Laboratory Result & Analysis</i>.
Demolition Phase	
Mobilisation on-site	• Mobilisation of construction machinery, plant, and equipment to the project site. • Mobilisation of construction workers – Employ workers to carry out construction work with skilled workers.
Site preparation, demolition works and removal of debris	• Preparation and construction of all the BMP's, e.g., wash-through, hoarding, etc. as per EW/ESCP/LD-P2M2 Plan (Refer to <i>Appendix E</i>) and Demolition Method Statement (refer <i>Appendix F</i>). • The demolition works will be carried out in 5 phases, involving 22 units of abandoned timber structures, with the produced debris estimated to be 2209 m³. Detailed information on the Demolition Work Plan and Program can be referred to in <i>Appendix F</i>. • The demolition debris will be stockpiled at the designated area before being segregated. Demolition waste that can be recycled and reused will be repurposed. • Any unuseable material will be disposed of at the approved

	landfill sites that accept construction/demolition waste, which in this case will be Pulau Burung Landfill, located 64 km away.
Construction Phase	
Temporary occupation at the site	- Estimated that more than 100 professionals, technical staff, and site workers will be working on-site and off-site depending on the phases of project implementation. - Foreign workers may be employed when there are insufficient local workers to work on the project.
Mobilization on-site	- Mobilization of construction machinery, plant, and equipment to the project site. - Mobilization of construction workers – Employ workers to carry out construction work with skilled, semi-skilled and unskilled workers. The labour requirements are estimated at 50-100 workforce.
Construction of temporary access road, buildings, site facilities establishment	- Construction of a temporary internal access road to the project site. - Involves earth excavation, moving, backfilling, and leveling during the construction of the temporary access road. - Construct site offices, toilets, stockpile areas, storage facilities, etc. - Establish utilities and infrastructure: power supply, water supply, drainage, and sewage systems, etc. - Provide temporary treatment systems, e.g., septic tanks for toilets and waste collection areas.
Site clearance	- Demolition of existing structures consisting of 21 single-storey units and 1 unit of 2-storey wooden buildings. - Removal of the existing vegetation within the project site - The project site shall be cleared of trees and bushes and the overburden stripped off to the areas where excavation and backfilling works are necessary, or to the areas where the buildings are located. - Mobilisation of the site and equipment for site clearing works.
Earthwork, site formation and excavation	- Preparation and construction of all the BMP's, e.g., wash-through, sediment ponds, temporary earth drains, etc. as per ESCP/LD-P2M2 Plan (Refer to <i>Appendix E</i>). - The earthworks cut and fill will only be carried out in the

southern part of the site, whereby the estimated volume for earthwork activities is shown in **Table 5.7**. Detailed information on the Earthwork Design and the ESCP/LD-P2M2 throughout the construction can be found in **Appendix E**.

Table 5.7: Estimated Cut and Fill Volume

Phase	Estimated Cut Volume (m ³)	Estimated Fill Volume (m ³)	Net Cut Volume (m ³)
Total	1800 m³	1395 m³	405 m³

Source: EDP Consulting Group, 2026

- The **excess earth** will be stockpiled at the designated area and **reused as topsoil for landscaping**.
- **If the need for disposal arises**, then the excess earth will be **disposed of at the approved disposal area**, which will be Pulau Burung Landfill (located 64km away). The path from the site to the landfill is shown in **Figure 5.12**.



Figure 5.12 Route from project site to dumping location

- All materials used in embankments and as filling elsewhere shall be compacted as soon as practicable after deposition.

Construction of buildings and structures	• Renovation of the existing ‘Crag Hotel’ building • Construction of hotel rooms, spa and related facilities after completion of earthworks activities. • Import of construction materials to the site.
Civil and structural works	• Construction of temporary drainage system. • Construction of water reticulation work and facilities.
Mechanical and electrical works	• Installation of electrical cabling and piping system for water and sewage
Road and other infrastructure facilities	• Construction of temporary access road and other infrastructure facilities.
Operation Phase	
Occupation	• Occupancy of the building
Repair and Maintenance	• General preventive maintenance shall be carried out throughout the building's operation
Abandonment Phase	
Site restoration and rehabilitation	• The abandonment phase is referred to as the event whereby the proposed Project is withdrawn or halted. • It involves the permanent withdrawal of all personnel, equipment, halting operations and dismantling all above and below ground structures, facilities, and buildings.

5.7 GENERAL CONSTRUCTION METHOD STATEMENT BASED ON GEOTECHNICAL REPORT

5.7.1 Method Statement for Soil Nailing

Soil nailing length shall be determined by the slope stability analysis, and a pullout test shall be conducted to verify the soil nail capacity. The soil nail mainly consists of T32 rebar; nail length of 15.0m with a working load of 120kN/nail. The typical soil nail details are shown in Figure 5.13.

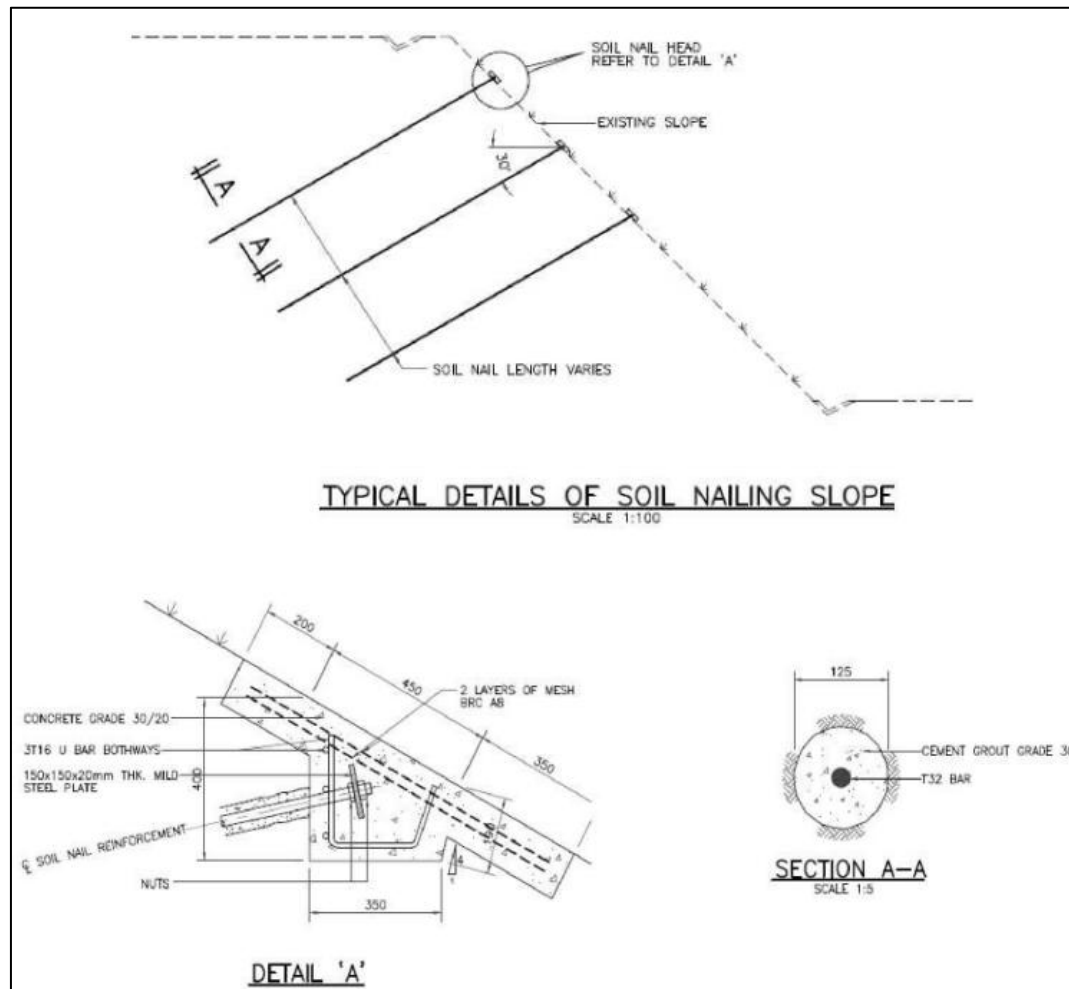


Figure 5.13 Typical Soil Nail Detail

5.7.2 Earthworks

Earthwork construction mainly will consists of leveling of platform, access road, slope strengthening and building foundation construction works. If retaining wall is to be used, a low wall with height not exceeding 1.5m shall be adopted.

5.7.3 Temporary and Permanent Slope Protection

The proposed development do not require major fill or cut on the existing terrain. The original vegetation will be maintained. Temporary staging might be required for the installation of micropile on hill slope. No major earthwork protection is required since the construction of pilecap and footing is on flat ground. As mentioned in the previous section 3.4, slope especially at building area shall be permanently stabilized by soil – nailed system.

5.8 METHOD STATEMENT FOR DEMOLITION WORKS

This method statement describes the method of demolition works for the redevelopment of Crag Hotel located at Penang Hill.

5.8.1 Scope of Works

There are 21 units of 1 storey and 1 unit of 2 storey abandoned timber structure houses on existing land which need to be completely demolished before starting the new development.

Basically, the construction works of the development are classified under 5 zones (refer to the attached Demolition Plan). Zone 2 will be the 1st zone to begin the demolition activity. Roof covering and trusses will be dismantle & remove before proceeding to the frame and wall elements. Floor slab / timber board and Footing / Brick Piller will be the last element to remove.

5.8.2 Methodology

Generally, **Manual Demolition System** will be used in this project. Electric tools and gas-powered chainsaws are the main tools to be used. The sequence of demolition have to be started from most top of building or structure and coming down to the bottom.

- Roof covering will be the first item to be removed, followed by battens, rafter and bracing. Timber roof beams, columns, and wall boards will be the next to be removed upon completion of the roof dismantling work.
- Timber floor joints will only be removed after the dismantling of timber floorboards. All brick stumps or footings will be hacked and broken into crumbles to be reused.
- Temporary propping (scaffolding) and netting are to be used for unsafe or unsecured structures, especially timber elements that have been attacked by termites, and will be inspected regularly to ensure safety and no falling object occurs during the operation.

- All debris and un-used material will be clear and take-away from site by using RORO Bin (registered under MBPP).
- All timbers and boards with acceptable condition will keep at site for re-use purpose (to use for formworking, propping, temporary store, temporary working platform and etc.)All crumbled bricks or concrete material will be re-used for making temporary construction access.

5.8.3 Safety

All works will be planned and undertaken in accordance with the Project Safety Plan. All activities will be undertaken with safety in mind ensuring that Personal Protective Equipments are being used at all times.

5.9 PROJECT TIMELINE

Table 5.8 shows the proposed implementation schedule for the proposed project which is expected to be developed over a period of three (3) years. The duration and timeframe may differ if certain vital and emerging issues and information required are not fulfilled.

However, it should be noted that the schedule is tentative based on current project planning, and it could be adjusted based on prevailing conditions in order to reduce any potential significant adverse impact on the environment.

Table 5.8: Proposed Project Implementation Schedule

ITEM	DESCRIPTION	YEAR 2027												YEAR 2028												YEAR 2029											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A	TEMPORARY WORKS & FACILITIES																																				
1	Sediment Fence																																				
2	Sediment Basin (Silt Trap)																																				
3	Temporary Earth Drain & Check Dam																																				
4	Temporary Gate & Construction Road																																				
B	DEMOLITION AND CLEARING WORKS																																				
1	ZONE 1																																				
2	ZONE 2																																				
3	ZONE 3																																				
4	ZONE 4																																				
4	ZONE 5																																				
C	EARTHWORK																																				
1	ZONE 1																																				
D	BUILDING WORKS																																				
1	ZONE 2																																				
2	ZONE 3																																				
3	ZONE 4																																				
4	ZONE 5																																				
5	ZONE 1																																				
D	EXTERNAL INFRA & LANDSCAPE WORKS																																				
1	ZONE 2																																				
2	ZONE 3																																				
3	ZONE 4																																				
4	ZONE 5																																				
5	ZONE 1																																				
F	FINAL CLEARING & CLEANING																																				

Source: Sri Nisuh Sdn Bhd, 2026

CHAPTER 6

EXISTING ENVIRONMENT

6.1 INTRODUCTION

This chapter outlines the existing environment within and surrounding the project site covering an area of 0-5 km radius from the proposed development site boundary to form the baseline to the project. It will further elaborate on various aspects including the physical-chemical, biological and human environment in the vicinity of the proposed development site. The information serves as the background or baseline data on various aspects of subject matters in connection with the proposed development. The existing environmental data presented in the following subsection are derived from both primary and secondary sources via specific field survey and supplemented by the secondary data from the relevant published sources. The components of the existing environmental sector study and their respective methods are summarized in **Table 6.1**. The findings of the current environment in this chapter will assess the project's impact during development and implementation, as well as measure any changes in environmental quality due to project activities

Table 6.1 Existing Environmental Component Assessed

CATEGORY	EXISTING ENVIRONMENT	SOURCE	EXTENT
Physico-Chemical Environment	Topography & Terrain Classification	Field survey Secondary data	Project site Study area
	Soil and Geology	Field survey Secondary data	Project site Study area
	Soil Investigation Analysis	Soil Investigation Report	Project site
	Geotechnical Analysis	Geotechnical Report	Project site
	Hydrology	Field survey Secondary data	Study area
	Meteorology and Climate	Secondary data	Study area
	Environmental Baselines	Field sampling and laboratory testing	Environmental sensitive receptors
Biological Environment	Flora and Fauna	Field verification Secondary data	Study area
Human Environment	Landuse	Secondary data	Study area
	Socio-economic	Secondary data	Study area
	Traffic	Primary data	Study area
	Public facilities	Secondary data	Study area
	Infrastructure and utilities	Secondary data	Study area

6.2 PHYSICO-CHEMICAL ENVIRONMENT

6.2.1 Topography and Terrain Classification

The topography and terrain of the proposed project area, which has historically been primary forest as shown in **Figure 6.1**. This was extracted from Topomap MY 502A: Sheet FH12 & FH21, 1st edition (JUPEM, 2013). The proposed project site is characterized by an undulating terrain comprising both natural and man-made slopes. It includes several existing, dilapidated buildings from previous developments and is surrounded by dense vegetation dominated by mature trees. The site is situated along existing side slopes and foot slopes, shaped by past earthworks. Man-made terraces are anticipated in the southwestern part of the site.

Overall, the site morphology consists of gentle to steep slopes, a mix of natural formations and modified land. Elevation ranges from 662 m to 668 m above sea level, with the lowest points located in the northwest and southeast, and the highest elevation found near the centre of the site as shown in Survey Plan (**Figure 6.2**, and attached in *Appendix H -Topographical Survey Plan*) and Surface Morphology Map (**Figure 6.3**).

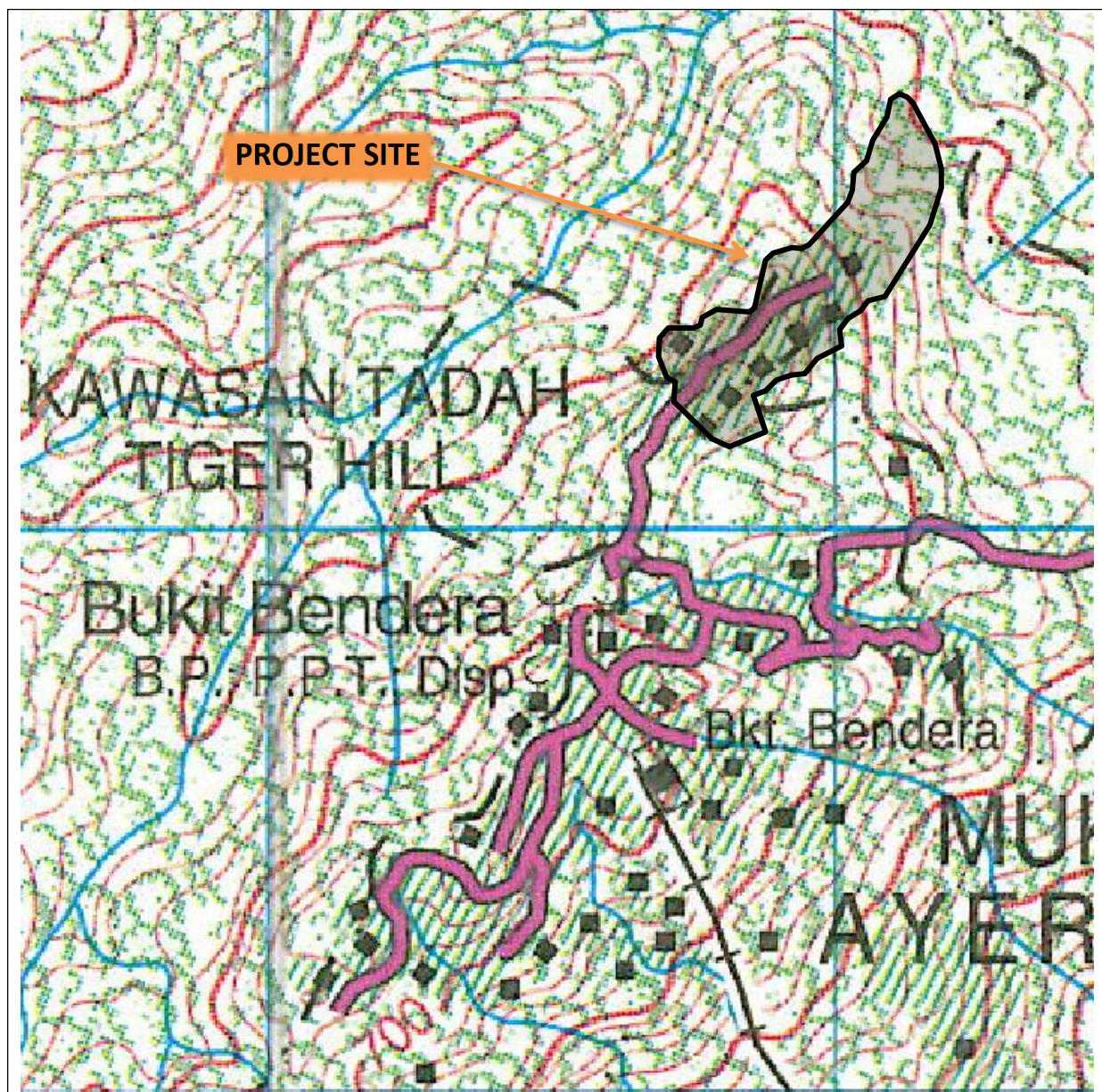


Figure 6.1 Existing Topography at Project Site

Source: Topomap MY 502A: Sheet FH12 & FH21, 1st edition (JUPEM, 2013)

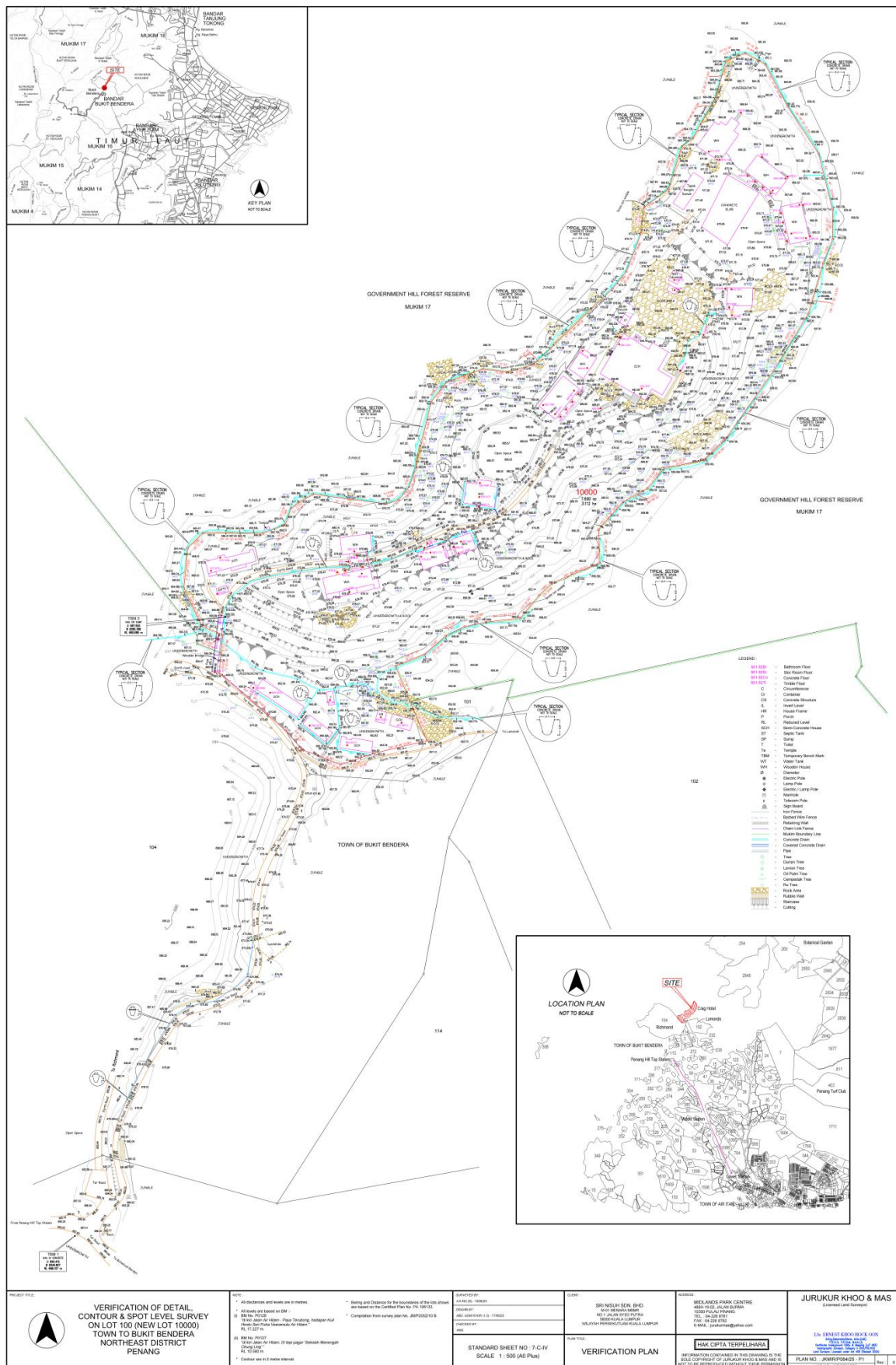


Figure 6.2 Demarcation, Spot Levels and Details Survey

Source: Jurukur Khoo & Mas, 2025

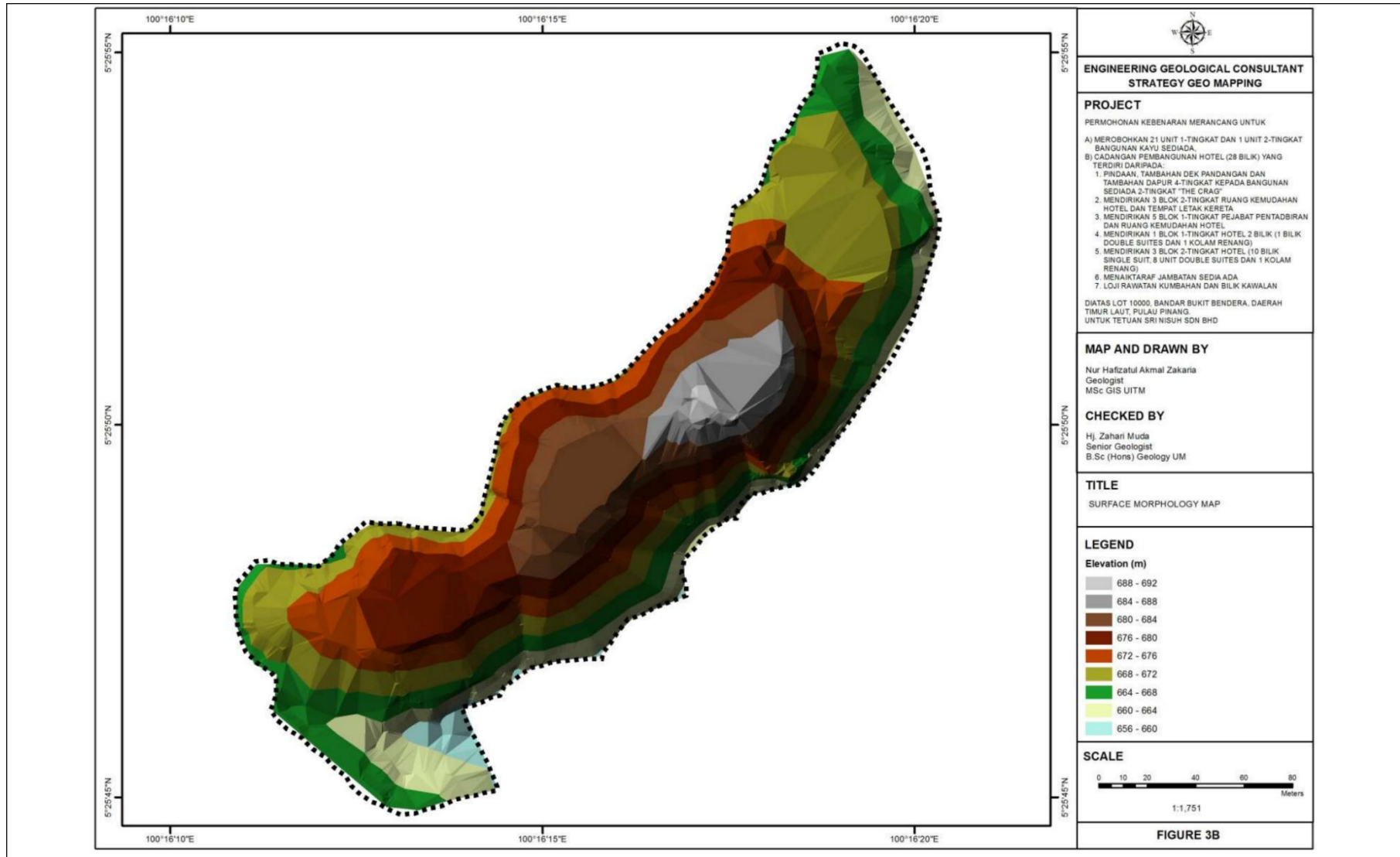


Figure 6.3 Surface Morphology Map
Source: Geological Assessment Report by Strategy Geo Mapping , 2025

6.2.2 Soil and Geology

6.2.2.1 Site Geology

Most of Penang Island is underlain by granitic igneous rocks, which are categorized into two main plutons: the North Penang Pluton (composed of alkali feldspar, orthoclase, and intermediate microcline) and the South Penang Pluton (mainly microcline), as described by Ahmad et al. (2006).

The project site lies within the **North Penang Pluton of Late Carboniferous age** and is classified as part of the **Tanjung Bungah Granite (Figure 6.4a)**. The granite is medium to coarse-grained, rich in biotite, with dominant orthoclase and minor microcline. The site is also classified under acid intrusive rocks (undifferentiated). Granite outcrops and boulders are visible around the site and near-surface materials mainly consist of residual soils derived from weathered granite, typically medium to gravelly sand.

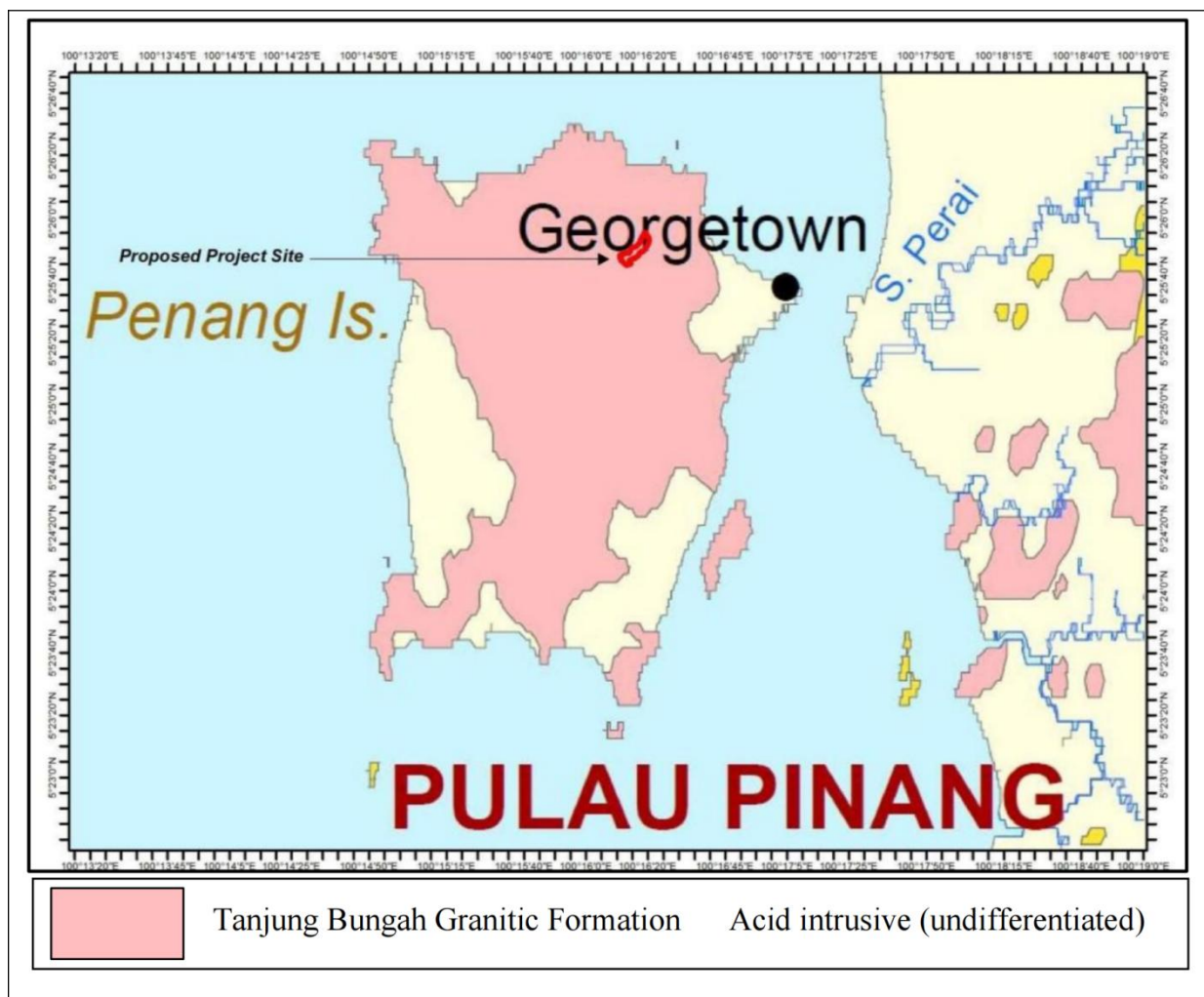


Figure 6.4a Geology of Project site and Penang Island
Source: Geological Assessment Report by Strategy Geo Mapping, 2025

6.2.2.2 Soil Profile based on SI Report

A total of eight (8) boreholes were drilled in the proposed area. The borehole drilling was conducted by Pacific Geosciences Sdn Bhd during the period from 1st March to 11th March 2014. The boreholes were terminated upon reaching maximum termination depth ranging from 6.00m to 37.00m. The borehole findings are summarized in **Table 6.2** and shown in **Figure 6.4b**.

Table 6.2 Summary of boreholes

Borehole	Type of Overlying Soil	Thickness of Overlying Soil/Sand (m)	Depth of Granite Rock or Hard Layer (m)	Depth of Groundwater
BH 1	Silt, clay and sand	1.5	-	29.35
BH 2	Silt, clay and sand	1.5	27.5 - 30.5	-
BH 3	Silt, clay and sand	1.5	11.5 - 13.5, 18.0 - 21.0	-
BH 4	Silt, clay and sand	1.5	34.0 - 37.0	< 30m
BH 5	Silt, clay and sand	1.5	18.45 - 22.00	< 30m
BH 6	Silt and Sand	1.5	8.0 - 11.0	-
BH 7	Silt and Sand	1.5	0.5 - 4.5, 21.0 - 24.0	< 30m
BH 8	Sand and Clay	1.5	3.0 -6.0	-

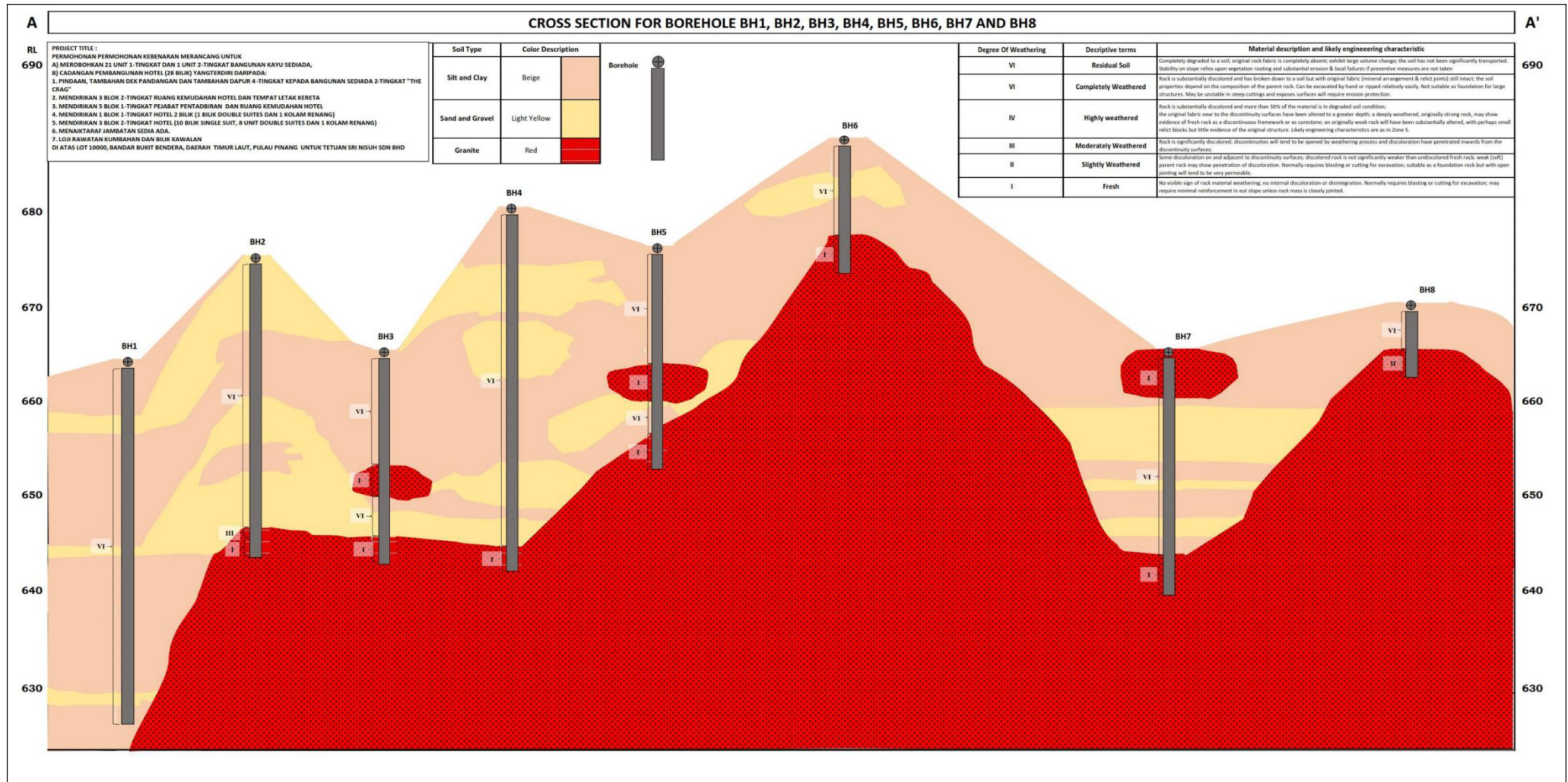
Source: Geo Assessment Report by Strategi Geo Engineering. 2025

i. Soil Profile

All eight boreholes (BH1, BH2, BH3, BH4, BH5, BH6, BH7 and BH8) show a little consistent profile, with brownish, reddish and yellowish of silt, sand, and clay as the overlying soil, having a uniform thickness of 1.5 meters across all boreholes. Beneath this layer, the hard layer was encountered until the termination depth of each borehole except for BH1.

ii. Groundwater Conditions

The groundwater table (GWT) was encountered in four boreholes which is BH1, BH4, BH5 and BH7, indicating the presence of groundwater within the subsurface profile. The hard layers were only encountered at deeper depths, suggesting that the upper soil layers may be unstable or weak.



6.2.3 Geological Terrain Mapping

The Geological Terrain Mapping Report was conducted by Strategi Geo Mapping. The full report is attached in *Softcopy Attachments: Geological Terrain Mapping Report*. The summary of the report is discussed below.

6.2.3.1 Slope Gradient Map

Table 6.3 shows the slope gradient classes at the proposed site. **Figure 6.5** show the slope gradient map of the proposed development. Majority of site has a slope gradient that is lesser than 35° .

Table 6.3: Slope Gradient Classes

Slope Gradient	Percentage (%)	Description
$0^{\circ} - 15^{\circ}$	29.21	Gently to moderately sloping
$15^{\circ} - 25^{\circ}$	26.96	Moderately steep
$25^{\circ} - 35^{\circ}$	32.07	Steep
$>35^{\circ}$	11.76	Very Steep

6.2.3.2 Construction Suitability Map

The development suitability classification is shown in **Table 6.4** below, with the development suitability map is given in **Figure 6.5**.

Class I areas are highly suitable for construction and cover 28.81% of the project site. Followed by Class II areas which cover 27.60% of the site, Class III covers 31.83% of the site and Class IV covers 11.76% of the site.

Table 6.4: Construction Suitability Classification of the Site based on CSM Map

Development Suitability	Percentage (%)	Description
Class I	28.81	Suitable for development
Class II	27.60	Suitable for development
Class III	31.83	Low suitability for development (detailed geotechnical and geological studies required)
Class IV	11.76	Very low suitability for development (detailed geotechnical and geological studies required)

6.2.3.3 Geological Terrain Classification Map

The terrain classification map of the site has been shown in **Figure 6.7** and the terrain attributes and their suitability for development are listed in **Table 6.5**.

Table 6.6: Geological terrain classification attributes (JMG, 2021)

SUDUT CERUN		TERAIN		BAHAN GEOLOGI DAN GUNA TANAH			HAKISAN DAN KETIDAKSTABILAN			
0° - 5°	1	Puncak bukit/Permatang		A	Batu	a	Tiada hakisan ketara		0	
>5° - 15°	2	Terain semula jadi	Cerun sisi	Lurus	B	Tanah	b	Hakisan lembar	rendah	1
>15° - 25°	3			Cekung	C	Batu dan tanah	c		sedehana	2
>25° - 35°	4			Cembung	D	batu kapur	i		tinggi	3
>35° - 60°	5		Cerun kaki	Lurus	E	Bahan geologi sensitif	batuan BIM	m	rendah	4
>60°	6			Cekung	F	gambut	n	Hakisan nil	sedehana	5
				Cembung	G	lapisan lembut/longgar	o	tinggi	6	
	Terain potongan	Cerun sisi	Lurus	H	syis bergrafit	p	Hakisan galur	rendah	7	
			Cekung	J	Bekas kuari	q		sedehana	8	
			Cembung	K	Bekas lombong	r		tinggi	9	
		Cerun kaki	Lurus	L	Tapak pelupusan	s	Amblesan		a	
			Cekung	M	Tebus guna	t	Tanah runtuh; panjang atau lebar melebihi 3m	baharu	b	
			Cembung	N		u	relika	c		
	Terain tambakan	Cerun sisi	Lurus	O	Jasad air	kolam	u	Ketidakstabilan sungai/laut	cenuram	d
			Cekung	P		saliran buatan	v		pantai	e
			Cembung	Q		saliran semula jadi	w		tebing	f
		Cerun kaki	Lurus	R	takungan air	x				
			Cekung	S						
			Cembung	T						
	Teres	Cerun sisi	Lurus	U						
			Cekung	V						
			Cembung	W						
		Cerun kaki	Lurus	X						
			Cekung	Y						
			Cembung	Z						
Lembah saliran				1						
Tanah pamah				2						
Dataran banjir				3						
Dataran pantai				4						
Paya				5						
Zon litoral				6						
Platform potongan ombak				7						

6.2.3.4 Erosion Map

Figure 6.8 shows the erosion map within the project site. **No severe erosion** was found as the slope on situ that surrounds the site have been dominated by dense vegetation which plays an important role in preventing soil erosion. Trees are known to reduce the effect of erosive forces using their root systems and foliage, helping to stabilize the soil around them and holding it all in place.

6.2.3.5 Physical Constraints Map

The Physical Constraints Map is shown in Figure 6.9. Majority of the site was found to contain disturbed slopes consisting of soil and rock.

6.2.3.6 Engineering Geology Map

The engineering geological map shown in Figure 6.10 displays the broad distribution of geological materials based on their engineering characteristics and also the engineering geological constraints.

6.2.3.7 Geohazard Map

The Geohazard Map (Figure 6.11) shows that the landslide risk score of the project is **less than 25**, which is between **Low risk to Moderate risk**. About 56.17% of the project area located in Low risk zone and 43.83% located in Moderate risk zone.

The summary of landslide risk is presented as follow:

Rating	Total Score	Percentage (%)	Area (Ha)
LOW risk	<12.5	56.17	1.748
MODERATE risk	12.5 - 25.0	43.83	1.364
HIGH risk	26.0 - 35.0	-	
VERY HIGH risk	>35.0	-	

6.2.3.8 Conclusion and Recommendations from GTM Report

- The proposed site is characterised by an undulating hilly area and is surrounded by dense vegetation dominated by trees. This site is not virgin ground as evidenced by existing buildings from past developments and a few existing man made slope due to previous earthwork.
- Based on attributes from the Terrain Classification Map, a Construction Suitability Map is produced. The construction suitability map shows that 28.81% of the proposed project site are Class I (insitu terrain <15°), 27.60% Class II (insitu terrain 15°–25°), 31.83% Class III (insitu terrain 25°–35°) and remaining 11.76% Class IV (insitu terrain >35°).
- As such, Classes I and II are suitable for development and should not encounter much geotechnical problems, whereas Class III is not suitable due to high to extreme geotechnical limitation and Class IV is probably unsuitable because of its extreme geotechnical limitation.
- In terms of engineering costs for development, land under Class I will probably be having low development costs, Class II normal, Class III high and Class IV very high. One of the reasons is that Classes I and II will require only normal site investigations, whereas Class III and Class IV will require detailed site investigations
- Based on Terrain Classification Map and its derivative thematic maps such as Erosion Map, Geohazard Map and Construction Suitability Map, this site is suitable for future development with detailed geotechnical study in the land under Class III and Class IV.
- Proposed development in this area will indicate minimum cut and fill to achieve the final platform level. According to Geotechnical Report provided by Client, minimum earth cutting would be carried out and the original terrain and much of the vegetation are kept intact to maintain the green natural environment. In addition, where structure or access road need to traverse along the slope, they would be on elevated structure. The slope would be studied and measures adopted to ensure that it would be geotechnically stable.
- According to Construction Suitability Map with Proposed Building Layout (Figure 11), it can be seen that some of the buildings or structures sits partly on Class IV zone. However only light weight buildings (single storey, only a few 2 storey) will be built in this proposed project site and the buildings are design to be supported on a steel structure on slope supported by micro pile foundation system. Furthermore, soil nailing would be used to strengthen the slope as required.

- In general, the Class I and II area, is suitable to develop with minimal cut and fill, whereas the Class III and Class IV need to special attention on geotechnical aspect to avoid any geological hazards during or after construction. The geotechnical characters of each Class should be studied in details before carry out any cut and fill activitie

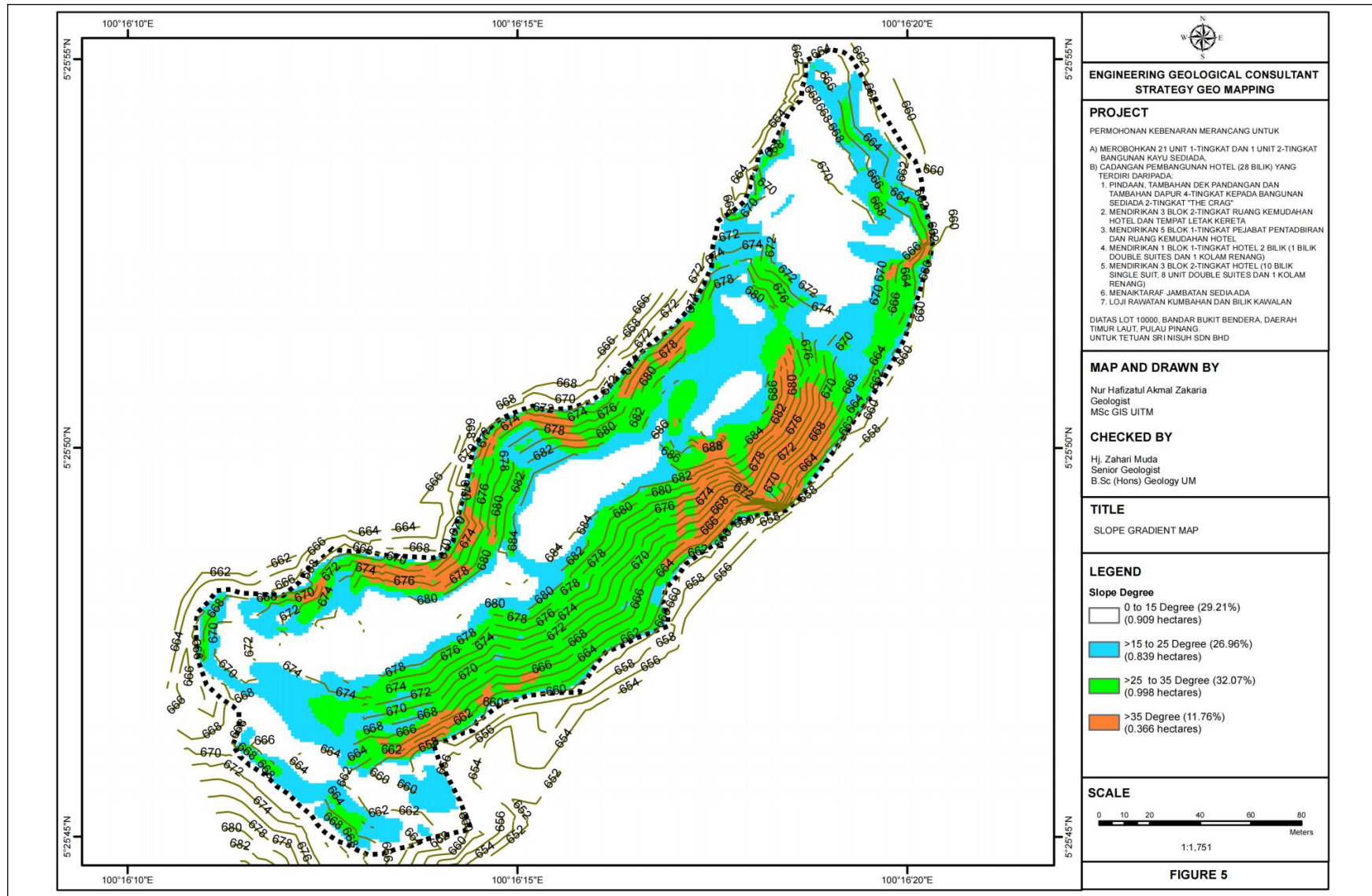


Figure 6.5: Slope Gradient Map
Source: GTM Report by Strategy Geo Mapping, 2019

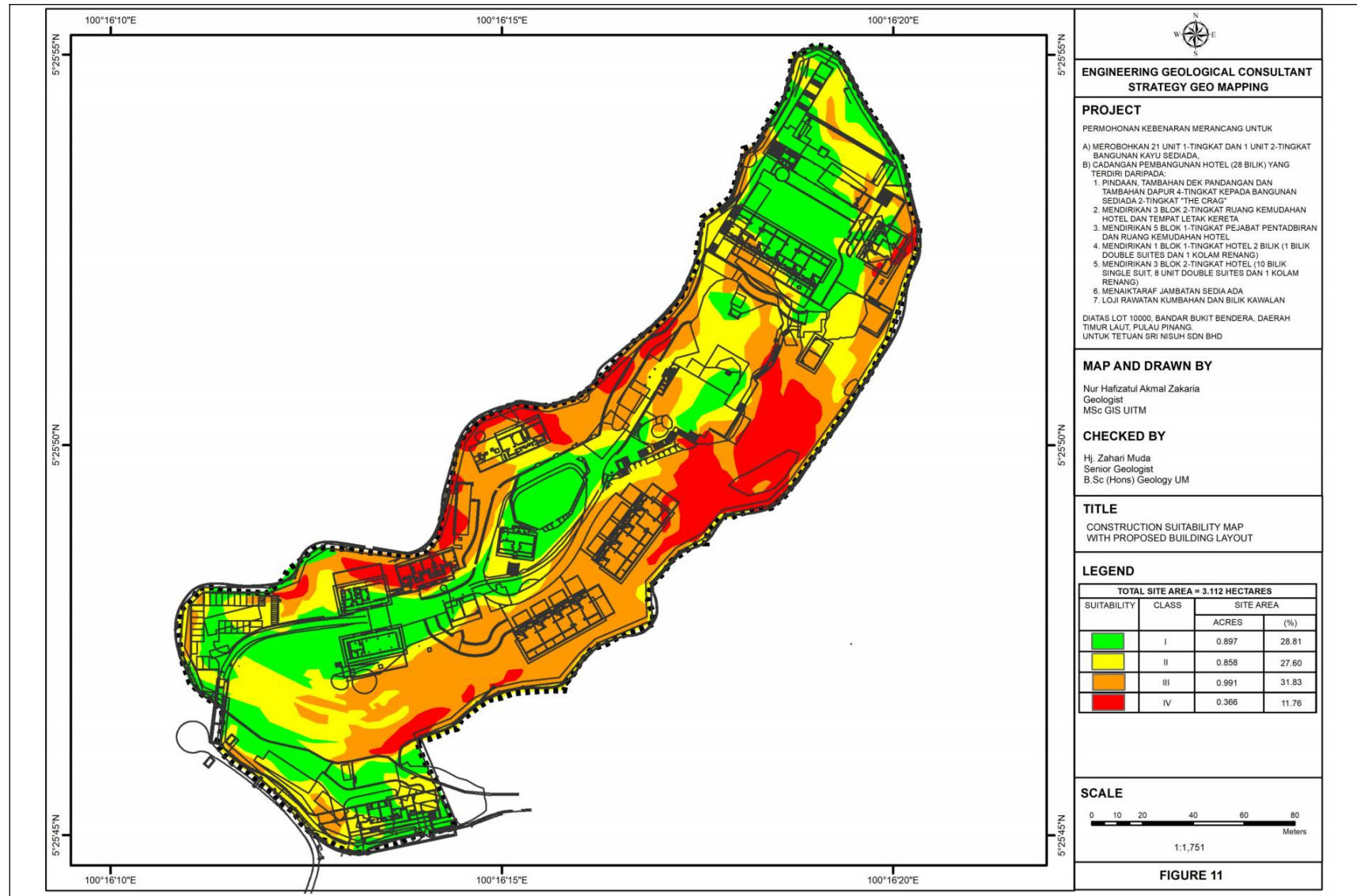


Figure 6.6: Development Suitability Map
Source: GTM Report by Strategy Geo Mapping, 2019

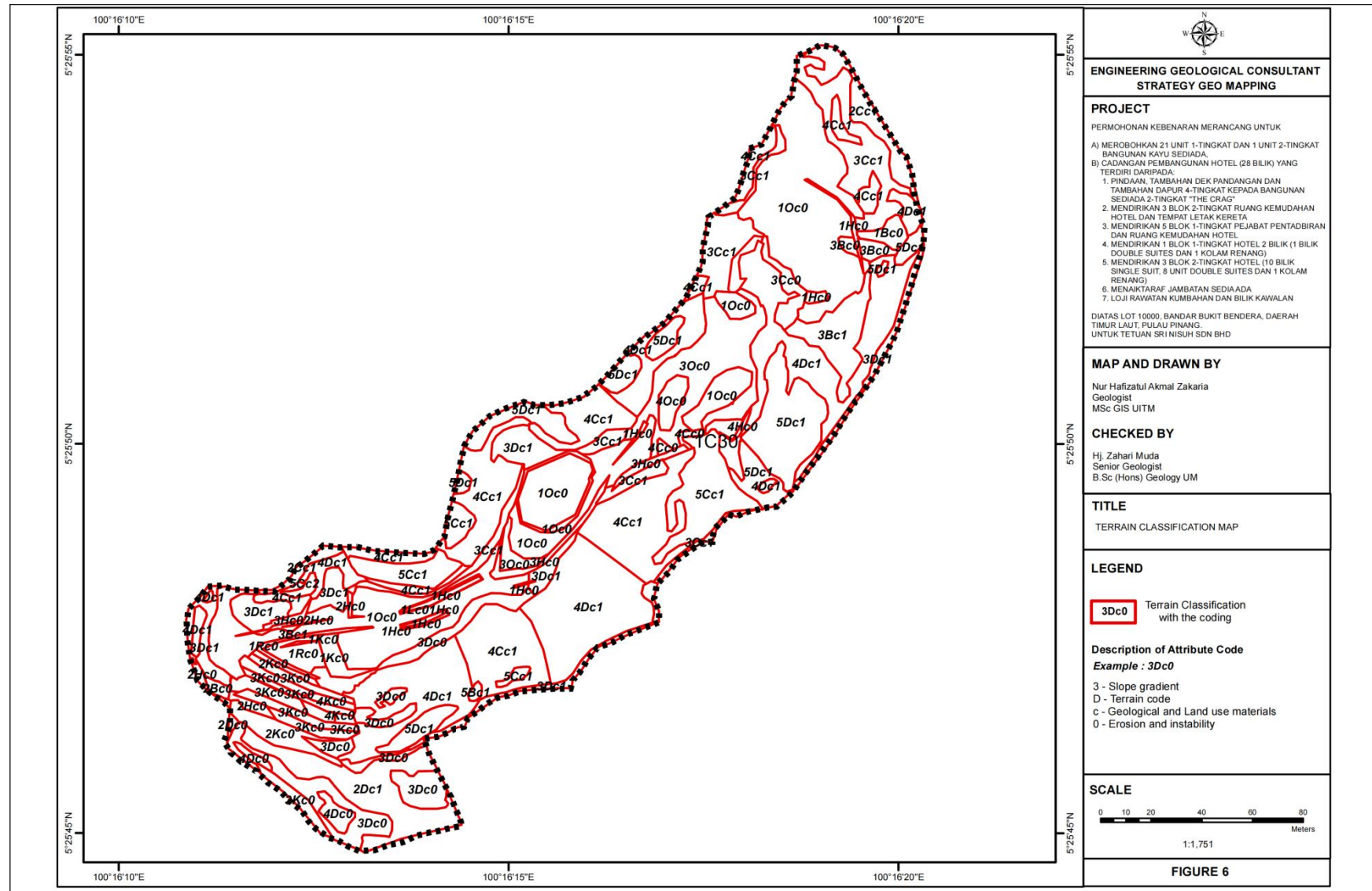


Figure 6.7: Terrain Classification Map
Source: GTM Report by Strategy Geo Mapping, 2019

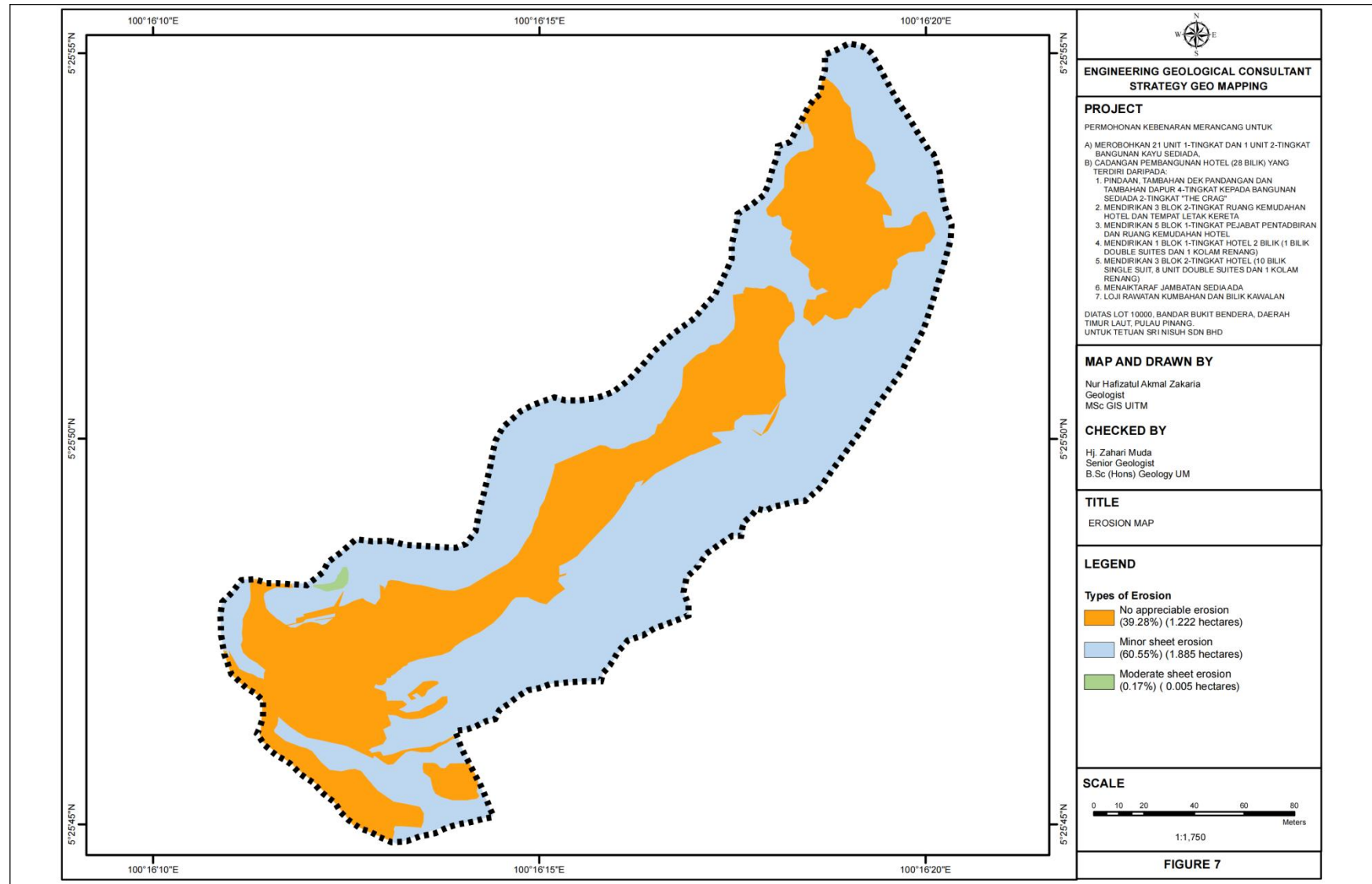


Figure 6.8 Erosion Map

Source: GTM Report by Strategy Geo Mapping, 2019

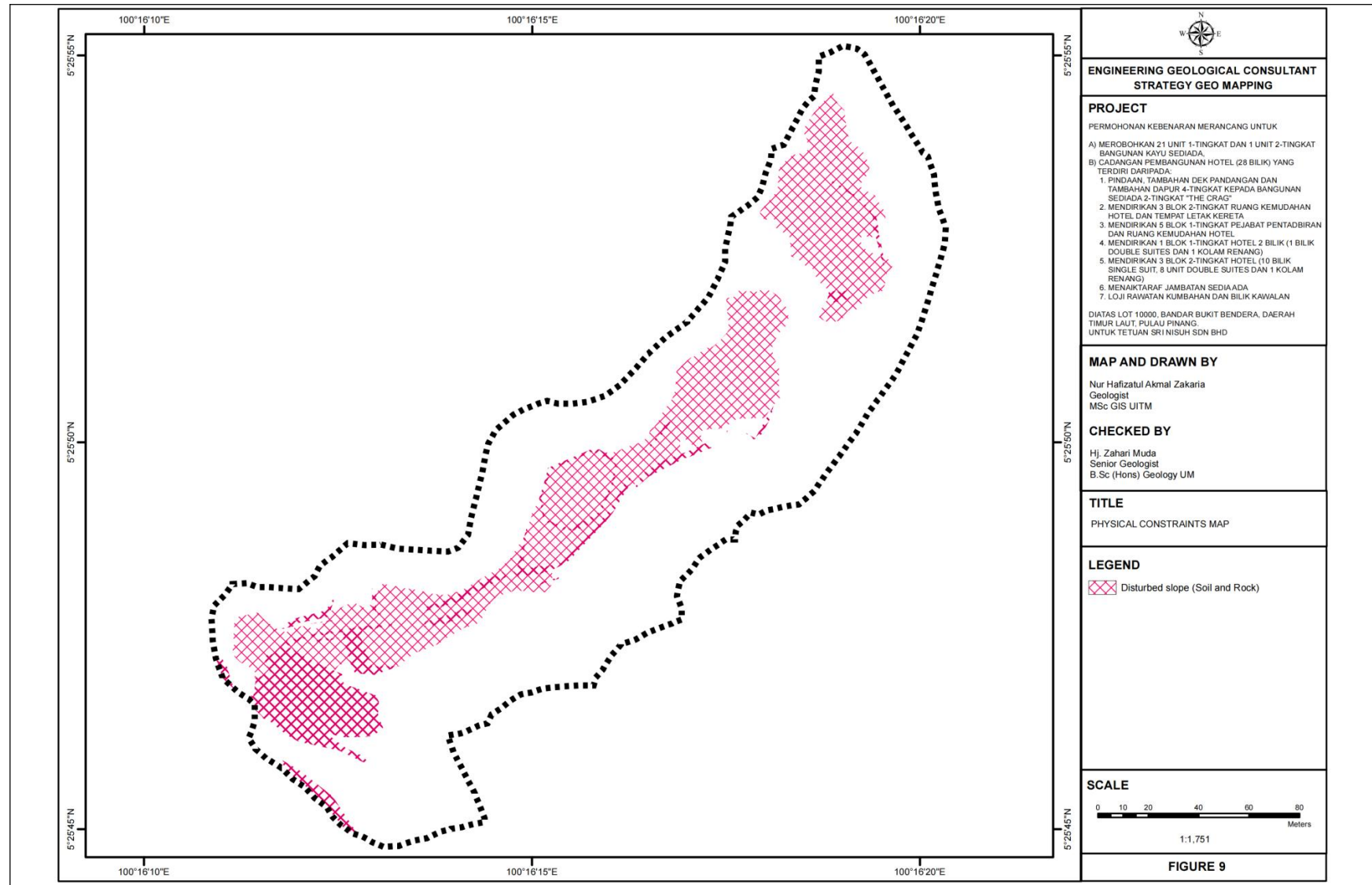


Figure 6.9 Physical Constraints Map
 Source: GTM Report by Strategy Geo Mapping, 2019

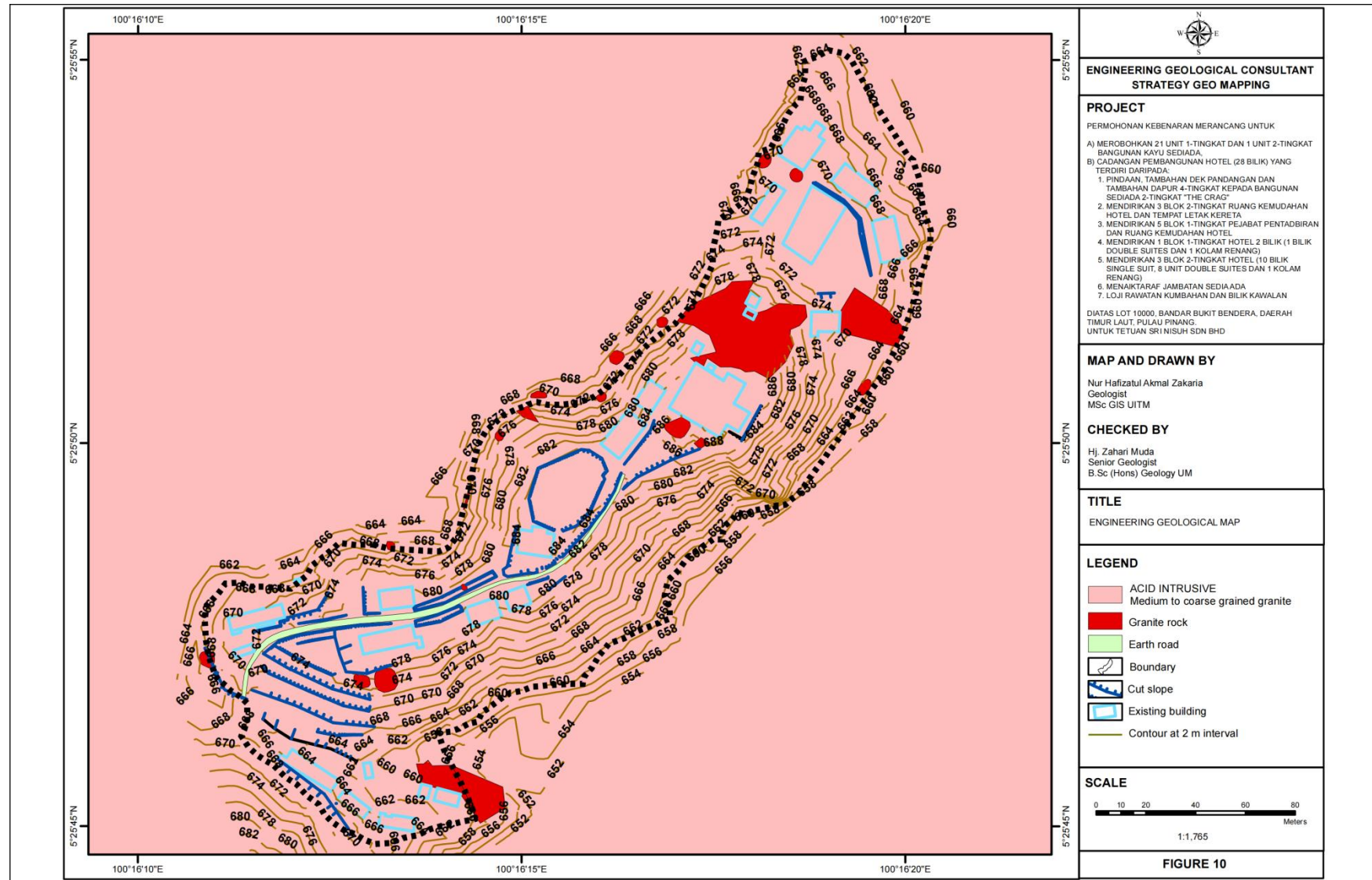


Figure 6.10 Engineering Geology Map

Source: GTM Report by Strategy Geo Mapping, 2019

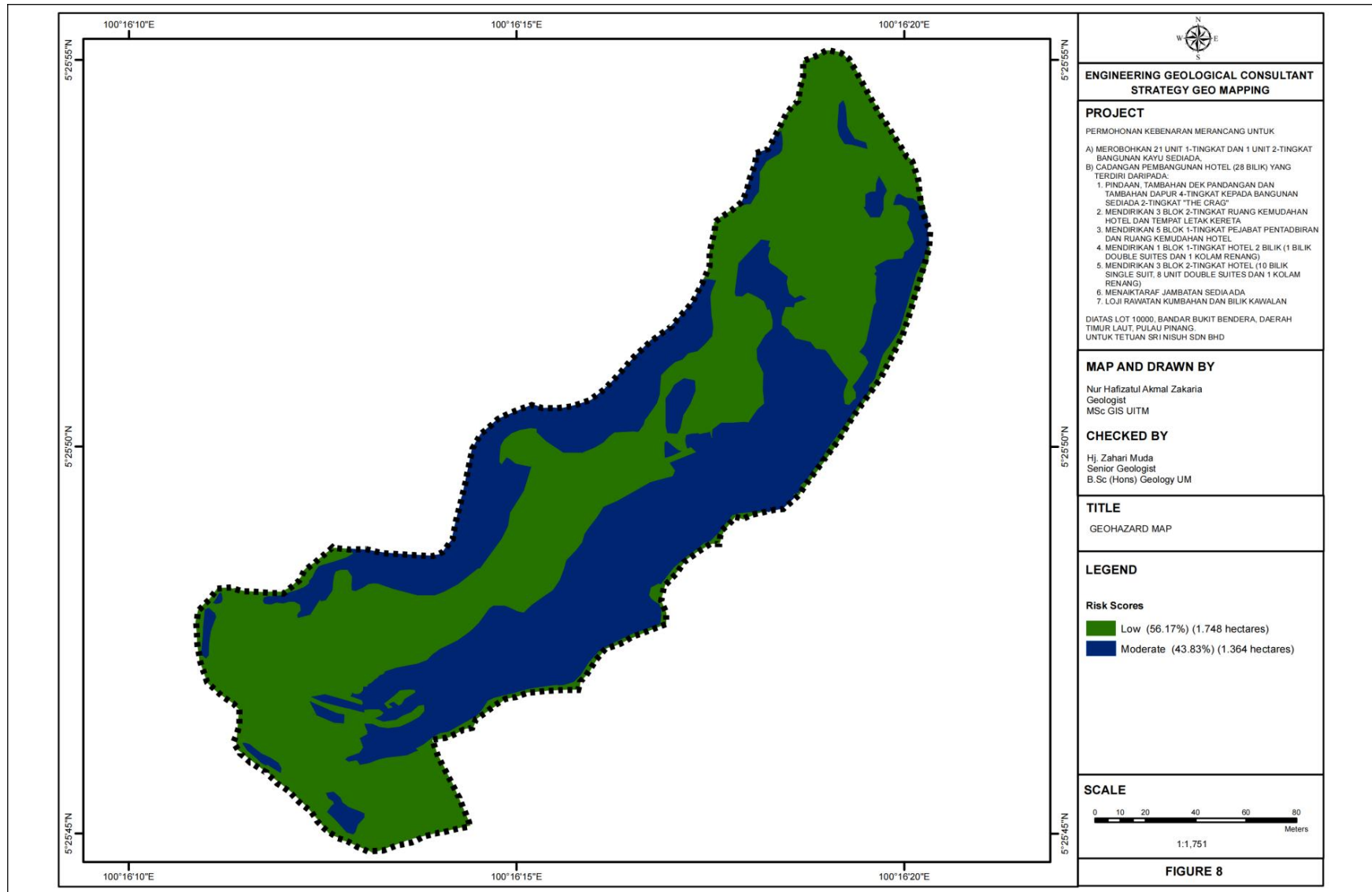


Figure 6.11 GeoHazard Map
Source: GTM Report by Strategy Geo Mapping, 2019

6.2.4 Geotechnical Report Findings

The geotechnical analysis for the proposed project was **carried out by EDP Consulting Group Sdn Bhd.** The report has been **audited, reviewed, and endorsed by Ir. Yah Kem Chui, Accredited Independent Checker (ICE)** who had prepared an ICE Report to summarize the scope of the geotechnical design reviews, findings, and recommendations. As per the letter from MBPP dated **30 January 2020 (Ref No: PKR.PP.(165)R/30/80/1 Jld.43)**, the geotechnical report prepared by EDP Consulting Group, which covers earthworks, construction regulations, slope stability analysis, retaining structures, building foundations, buffer zones, and other technical issues, has been found to be in compliance with the relevant geotechnical aspects (refer to the attachment in *Appendix A-3*).

The findings of the Geotechnical Report are summarized as follows.

6.2.4.1 Sub Surface Soil Investigation

Pacific Geoscience (M) Sdn. Bhd. carried out Soil Investigations consisting of 8 boreholes and 4 standpipe piezometers in year 2014. Generally, the soil mostly comprises of clayey SILT and clayey SAND in most of the boreholes however, localized sandy CLAY is found in BH4/PZ2. 4. The depth for Granite outcrops and boulders ranges between 2.2m – 4.5m in BH3, BH5/PZ3 & BH7/PZ4. Additionally, groundwater levels were measured mostly lower than the pipe installation depth, which is more than 20.0m below ground level.

6.2.4.2 Geophysical Survey

Seismic Refraction Survey (SRS) is designed to determine the levels and nature of rock in various parts of the site. Total six (6) lines of SRS namely L1 to L6 across the central high terrain are proposed and shown in **Figure 6.12**.

Soil hardness interpreted from the SRS results is slightly different from boreholes which show hard layer located at deeper depth. In general, overburden soil thickness before reaching hard layer ranging from 6.5m to 23.0m. The hard layer thickness ranges from 2.5m to 13.0m before encountered rock surface. The sample of the seismic profile L4 is shown in **Figure 6.13**.



Figure 6.12 Seismic Refraction Layout Plan
Source: Geotechnical Report by EDP Consulting Group , 2020

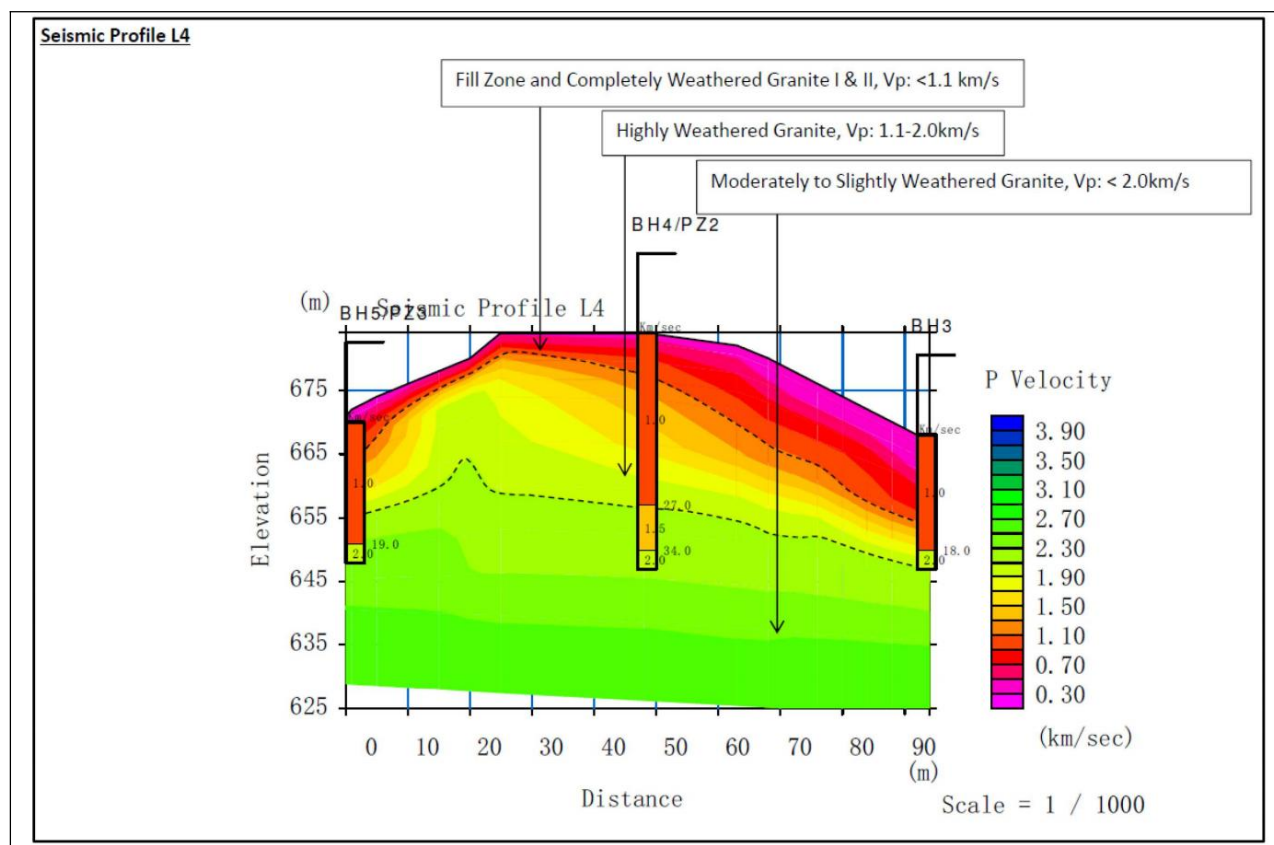


Figure 6.13 Seismic Profile L4

Source: Geotechnical Report by EDP Consulting Group , 2020

6.2.4.3 Engineering Properties of Subsoil

Based on the interpreted soil laboratory test result, the adopted parameters in the analysis are shown in **Table 6.6**. The parameters vary with the depth sections being analysed.

Table 6.6 Adopted Design Soil Parameter

Depth (m)(bgl)	Soil Type	SPT-N Value	Unit Weight kN/m ³	Effective Cohesion (c')	Effective Friction Angle (ϕ')
0 - 7.5	Sandy	7	18.0	4	28
7.5 - 12.0	Sandy	10	18.0	4	30
12.0 -	Sandy	15	18.0	4	31
16.5 -	Sandy	20	18.5	5	32
22.5 -	Sandy	25	19.0	2	33
>34.0	Granite	-	24.0	500	38

Source: Geotechnical Report by EDP Consulting Group , 2020

6.2.4.4 Slope Design & Stability Analysis

The slope stability was analysed with the Limit Equilibrium software (GEO-slope) to obtain the Factor of Safety (FOS) for the existing and propose slope. The slope stability analysis covers the entire slope of the development. **Figure 6.14** shows the layout and section lines to be analyzed.

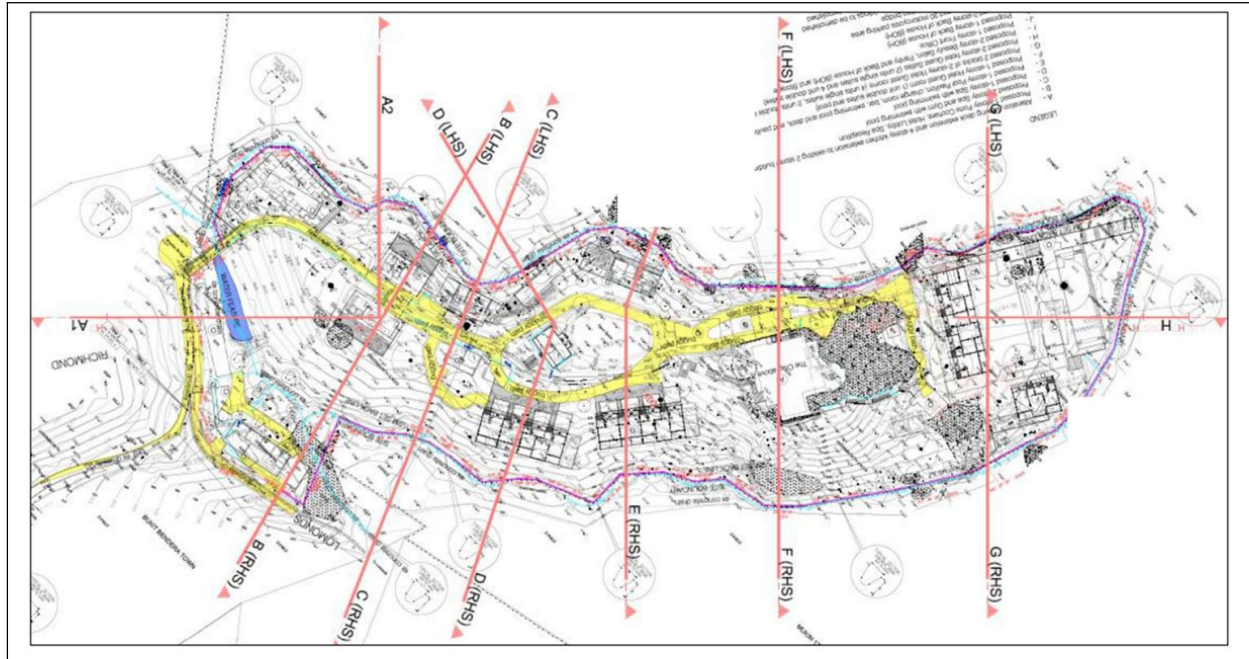


Figure 6.14 Slope Layout Plan with Section Lines

Source: Geotechnical Report by EDP Consulting Group , 2020

Nominal surcharge of 5kPa is allowed in the slope stability analysis since the building load at the slope edge all supported by micropile foundation. **Figure 6.15** shows the critical section B-B as an example.

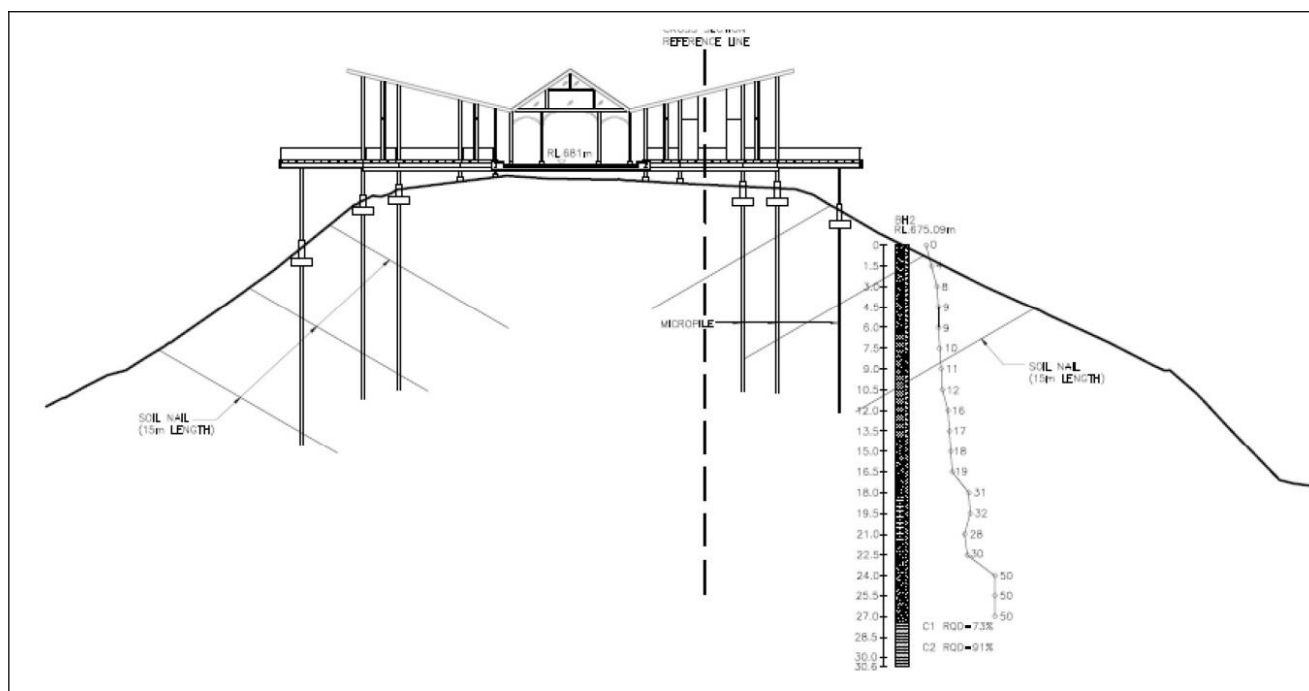


Figure 6.15 Section B-B Slope Profile

Source: Geotechnical Report by EDP Consulting Group , 2020

Both global and local areas in specified slope have been selected in the slope stability analysis. Based on the JKR slope guidelines (2010), slope stabilizing works utilizing soil nailing have been provided whenever the FOS is lower than required FOS of 1.3. The stabilized slope is designed to a **minimum FOS of 1.5**.

The critical cross sections were analyzed and the summary results of the slope stability analysis is shown in **Table 6.7**. In overall, the safety factor of natural and treated slope either in global or local conditions is acceptable. The sample of the slope stability analysis is shown in **Figure 6.16**.

Table 6.7 Summary of Results of Slope Stability Analysis

Section	Factor of Safety (FOS)							
	LHS				RHS			
	Without stabilisation		With stabilisation		Without stabilisation		With stabilisation	
	Global	Local	Global	Local	Global	Local	Global	Local
A1	1.9	1.78	-	-	-	-	-	-
A2	1.7	1.42	-	-	-	-	-	-
B	1.0	1.16	1.6	1.97	1.144	1.086	1.505	1.607
C	1.0	1.36	1.5	1.97	1.177	1.310	1.504	1.582
D	1.0	1.15	1.5	1.71	1.336	1.418	-	-
E	1.3	1.42	-	-	1.228	1.305	1.504	1.542
F	1.2	1.44	1.5	-	1.667	1.224/1.	-	1.501/1
G	1.9	1.97	-	-	2.728	2.394	-	-
H	2.8	2.86	-	-	-	-	-	-

Source: Geotechnical Report by EDP Consulting Group, 2020

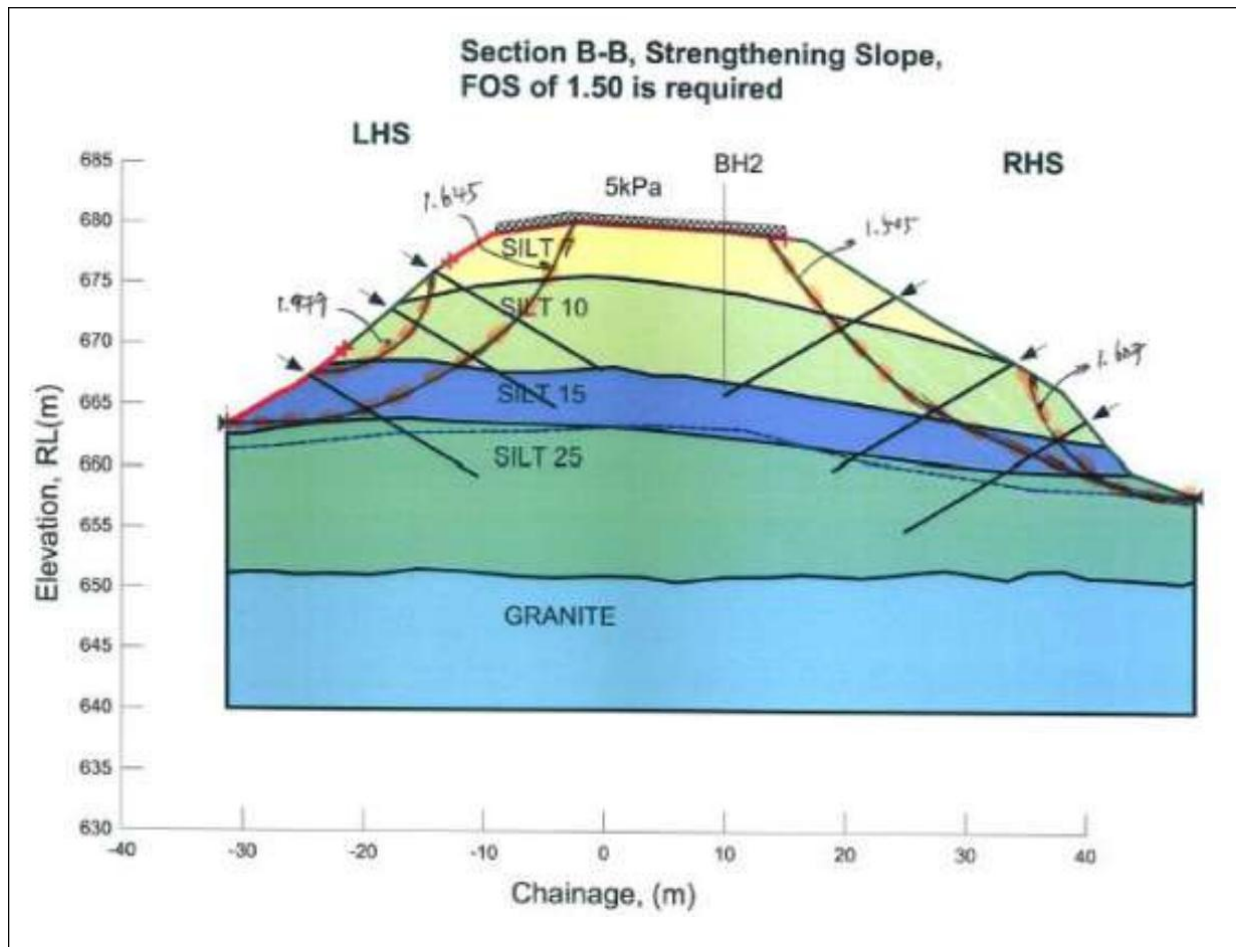


Figure 6.16 Sample of Slope Stability Analysis (Section B-B)

Source: Geotechnical Report by EDP Consulting Group , 2020

6.2.4.5 Foundation Design

In view of site constraint in accessibility and workability, the building foundations in the forms of strip footing and micropile (at slope area) are recommended.

The general soil bearing capacity equation in strip footing, which was proposed by Terzaghi (1943) is adopted:

$$q_u = c'N_c + q'N_q + 0.5\gamma B N_\gamma$$

Where c' = effective cohesion

q' = effective overburden stress at the bottom of foundation

γ = unit weight of soil

B = width of the foundation

N_c, N_q, N_γ = bearing capacity of factors

The adopted allowable bearing capacity with factor safety (FOS) of 3 is 75kPa and the allowable settlement for strip footing is limited to 25mm.

Micropile foundation is proposed to support the column, which is positioned at the slope area. 200mm diameter micropile with a working load of 275kN is proposed. The estimated pile length in pure soil condition is 21.0m and the combination of soil and rock condition is 7.0m in soil (varies) and 1.0m rock socket length. Micropile consists of an API pipe with outer diameter of 73mm and pipe thickness of 5.16mm. **Figure 6.17** shows a section of the micropile foundation that is proposed to support the column which is positioned at the slope area.

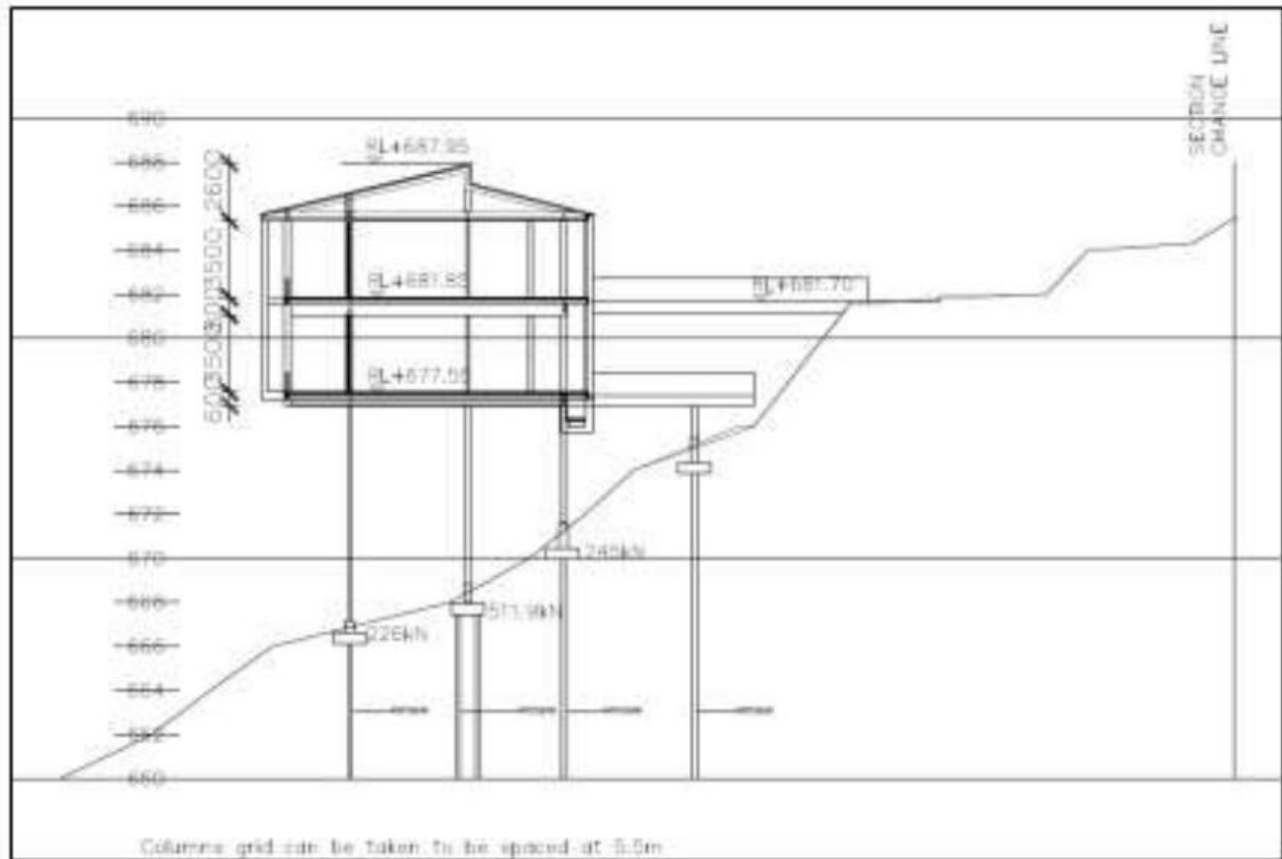


Figure 6.17 Micropile Foundation at Slope Area

Source: Geotechnical Report by EDP Consulting Group , 2020

6.2.4.6 Instrumentation and Monitoring

Instrumentation such as inclinometer is proposed to permanently monitor the slope movement. Four (4) inclinometers are proposed at the strategic locations with the frequency of the reading taking shall be on fortnightly basis or at least 10 trips during the construction stage.

After construction, the frequency of taking the readings can be adjusted. Post construction slope maintenance such as cleaning of drainage system and turfing of exposed areas will also be implemented and maintained on a monthly basis.

6.2.4.7 Conclusion and Recommendation (Geotechnical Report)

- Geotechnical design mainly consists of slope stability analysis and soil nailing design on cut/existing slopes and building foundation calculations. The soil nail mainly consists of T32 rebar; nail length of 15.0m shall provide a working load of 120kN/nail and achieve the required safety of factor in stability.
- Building strip footing and micropile foundation system are designed to support the building load. The allowable soil bearing capacity of 75kN/m² is adopted, which is controlled by 25 mm settlement and with factor of safety of 3.0. The capacity of 200mm diameter micropile is 275kN.
- The drainage system is designed to taking care the rain water surface runoff and to prevent any water seeping into the soil. Mitigation measures will be taken to prevent erosion of the slope surface. There are 2 silt traps provided for this proposed development. The dimension of the silt trap is 10.6m x 31.2m and same for both silt traps
- Total four (4) nos. of inclinometers are proposed with the monitoring frequency on fortnightly basis or at least 10 trips shall be allowed during the construction stage.

6.2.5 Hydrology and Drainage System

Under baseline conditions, the project site is located within a dual-catchment system, where the majority of surface runoff naturally drains towards Sungai Air Terjun catchment, while a smaller portion flows towards Sungai Tat (Tat's catchment) as illustrated in **Figure 6.18**. This reflects the presence of a natural watershed divide within the site, allowing runoff to be distributed between two receiving systems. Based on flow accumulation analysis using the survey information provided by Jurukur Khoo and Mas, the runoff is expected to flow toward the perimeter of the project boundary and discharge out at southern part of project area as shown in **Figure 6.19**. Based on ground survey information, there is perimeter drain along the project boundary which use to collect runoff from the project site and finally discharge out toward nearest river (**Figure 6.20**).

During the construction and operational phases, the project will alter the natural drainage regime by redirecting all surface runoff towards Sg Air Terjun, effectively eliminating the existing catchment divide and resulting in a complete transfer of flow from Tat's catchment into the Air Terjun catchment. This modification is expected to increase the total contributing area and subsequently the runoff volume and peak discharge of Sg Air Terjun, particularly during storm events. The concentration of flow into a single outlet may also increase flow velocity, thereby elevating the risk of erosion and sediment transport, especially during the construction phase. In addition, the reduction in natural flow dispersion may decrease the attenuation capacity of the site, resulting in more rapid runoff conveyance towards downstream areas.

Given the presence of a downstream water intake within the Sg Air Terjun catchment (**Figure 6.21**), there is a potential risk of increased sediment load and pollutant transport, which may affect raw water quality if not properly managed.

However, appropriate mitigation measures will be implemented to control these impacts. During the construction phase, silt traps will be installed to effectively reduce sediment-laden runoff and minimize suspended solids discharge from the site. During the operational phase, an on-site detention tank will be provided to regulate runoff discharge, thereby reducing peak flow and enhancing flow attenuation before entering the receiving watercourse.

With the implementation of these mitigation measures, the potential hydrological impacts are expected to be effectively controlled and reduced to a low level, ensuring that the project does not result in significant adverse effects on downstream flow conditions or the water intake at Sg Air Terjun.

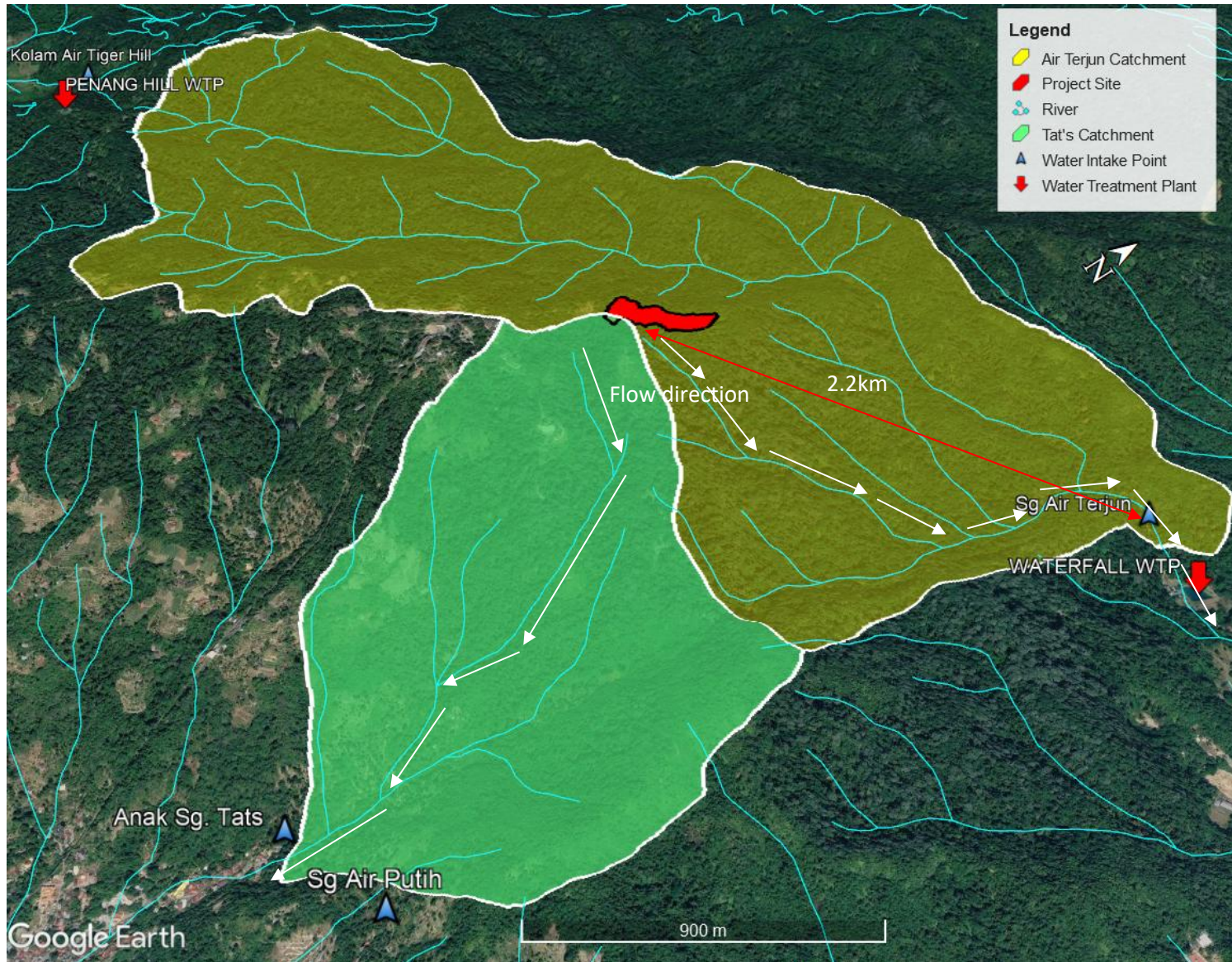


Figure 6.18 Flow Direction from Project Site to the Nearest River

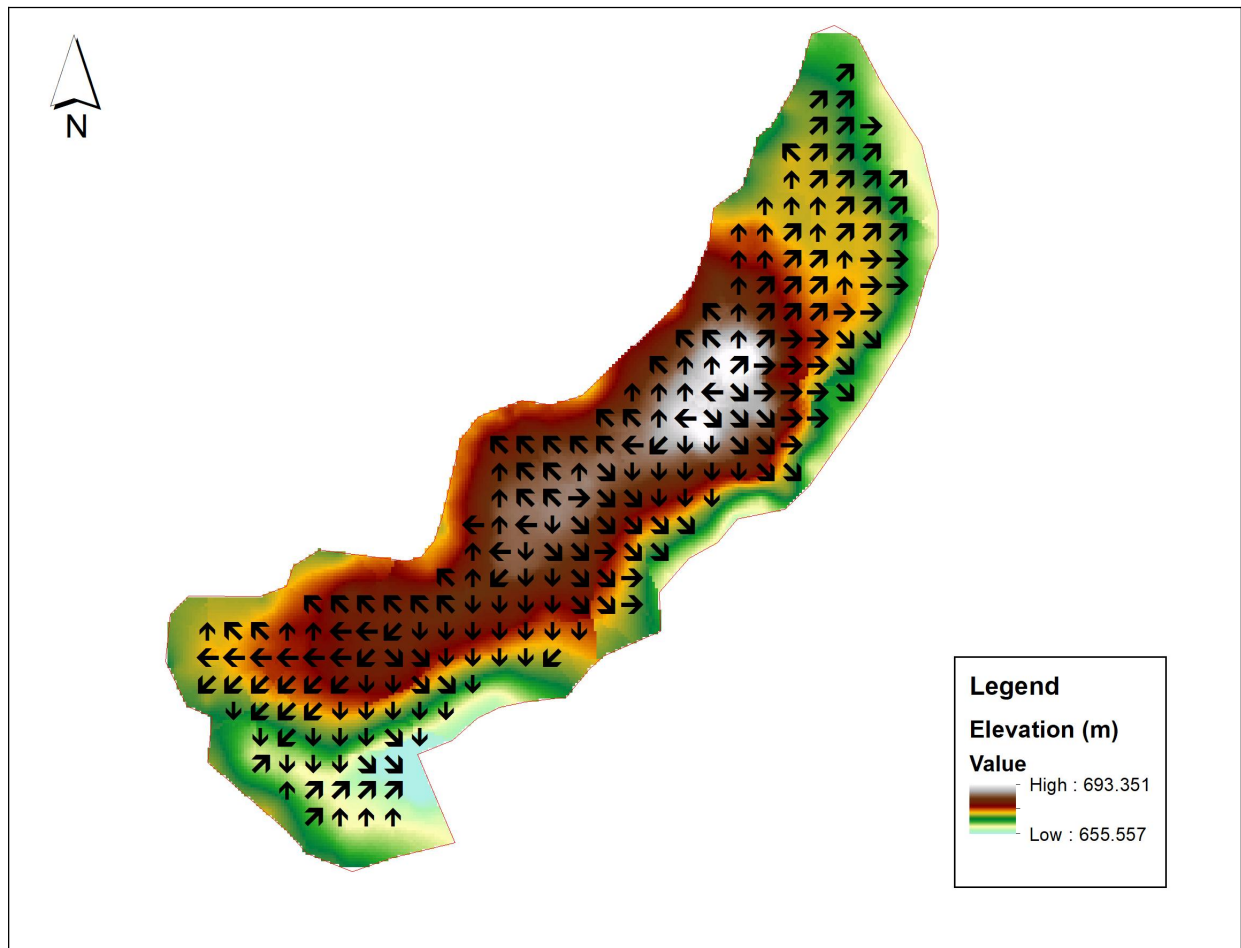


Figure 6.19 Flow Direction Map

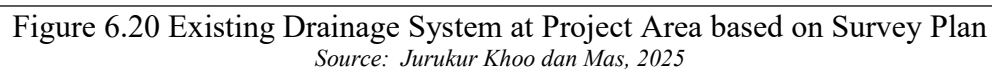




Figure 6.21 Penang Water Supply Infrastructure

Source: Retrieved from <https://pba.com.my/penang-water-supply-statistics-infrastructure/>

6.2.6 Flood Prone Area

According to the Rancangan Struktur Negeri Pulau Pinang 2030, the project site is not situated within designated flood-prone zones (**Figure 6.22**). Considering the site's topography and scale, runoff discharge from the area presents no risk of flooding to downstream regions. However, far downstream from project site which at Sungai Pinang, there is risk of flooding recorded. Discharge from the project site will be connected with Sungai Pinang via Sungai Air Hitam and Sungai Air Terjun. In order to manage site runoff and lessen any possible flooding effects on downstream communities, a drainage system and retention pond will be installed either during the construction or operating phase.

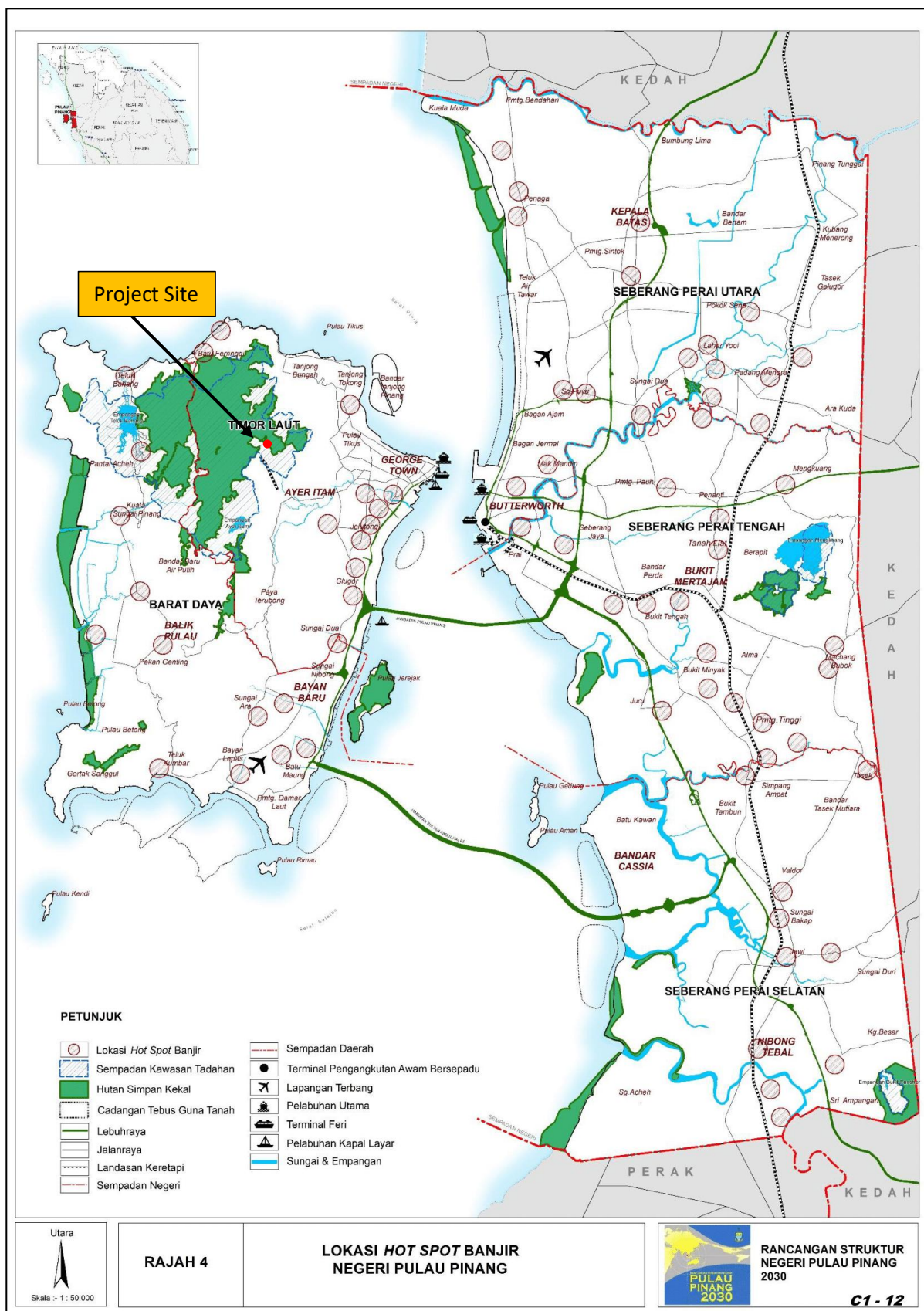


Figure 6.22 Penang Flood Hot Spot
Source: RSNPP 2030

6.2.7 Climate and Meteorology

There is no established weather monitoring station at the project location and its immediate vicinity, as per the inventory of meteorological stations by the Department of Meteorology Malaysia. Consequently, the climate conditions for the proposed project were assessed using data from the closest meteorological station to the site, which is Bayan Lepas Station, located 14.6 km away (**Figure 6.23**).



Figure 6.23 Nearest Meteorological Station to the Project Site

The meteorological data obtained from Bayan Lepas Station is summarised below:

DATA		PERIOD
1.	Rainfall (Monthly and annual)	2015 - 2024
2.	Number of Raindays (Monthly and annual)	
3.	Relative Humidity (Monthly and annual)	
4.	Temperature (Monthly and annual)	
5.	Annual Wind Rose	2015 - 2023

6.2.7.1 Rainfall

i. Monthly Rainfall Distribution Trend

The monthly rainfall varies from 54.7 mm to 338.2 mm on average, as shown in **Figure 6.24**. September records the highest precipitation, at 338.2 mm, while February has the lowest mean monthly rainfall at 54.7 mm. The average number of days with rain per month ranges from 8 to 21 as demonstrated in **Figure 6.25**. The months between October and December had the most frequent rainy days, whereas February experienced the fewest rainy days.

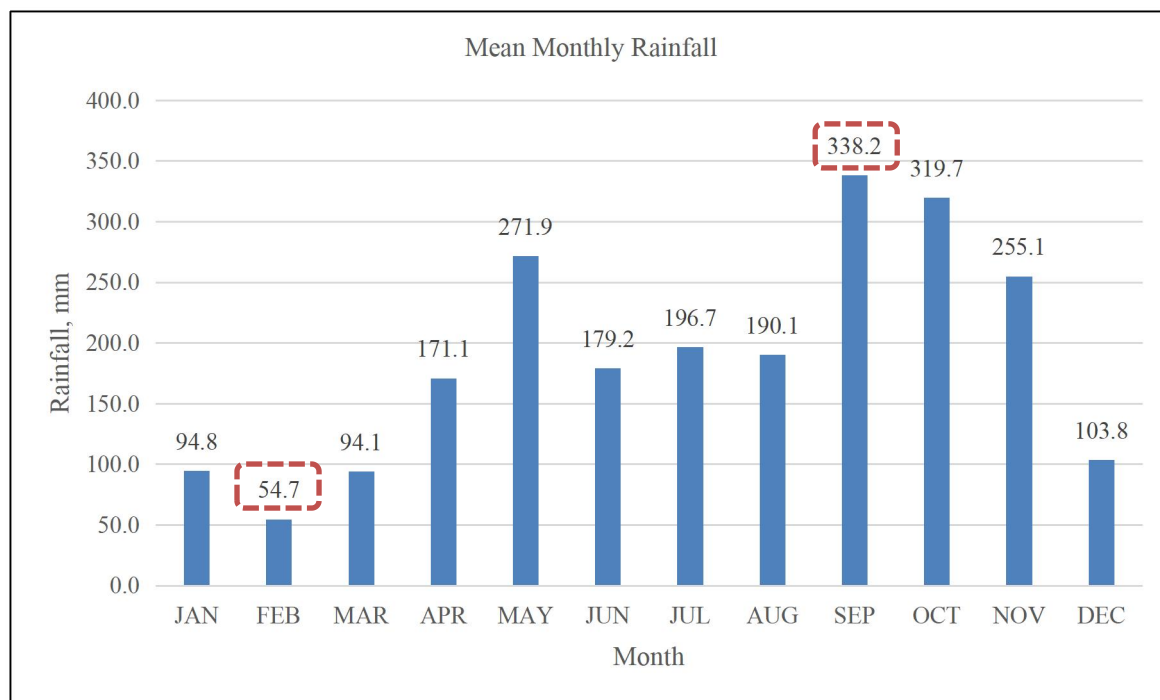


Figure 6.24 Mean Monthly Rainfall
Source: Malaysian Meteorological Department (2025)

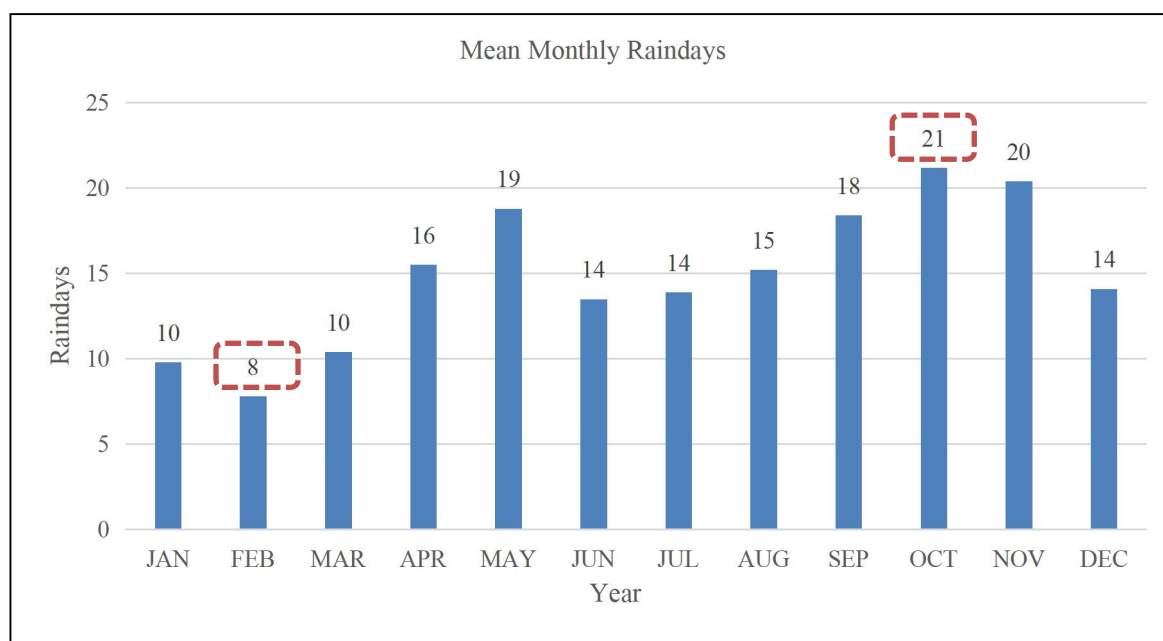


Figure 6.25 Mean Monthly Raindays
Source: Malaysian Meteorological Department (2025)

ii. Annual Rainfall and Raindays Distribution Trend

The data spanning from 2015 to 2024 were analyzed to explore the yearly rainfall distribution. The average annual precipitation ranged from 1,740.2 mm to 3,067.5 mm as depicted in **Figure 6.26**. The highest amount of rainfall was observed in 2015, while the lowest occurred in 2019. Additionally, the total annual rainy days ranged from 153 to 208 as presented in **Figure 6.27**, with the highest recorded number of rainy days being in 2022 and the lowest recorded in 2019.

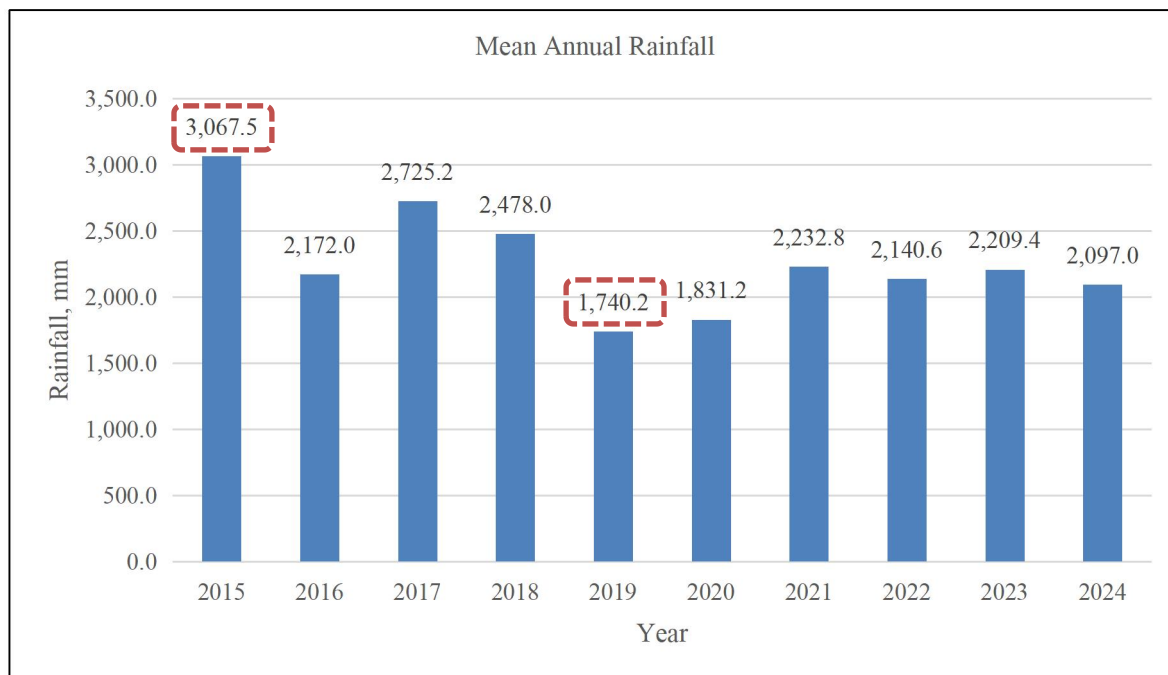


Figure 6.26 Mean Annual Rainfall

Source: Malaysian Meteorological Department (2025)

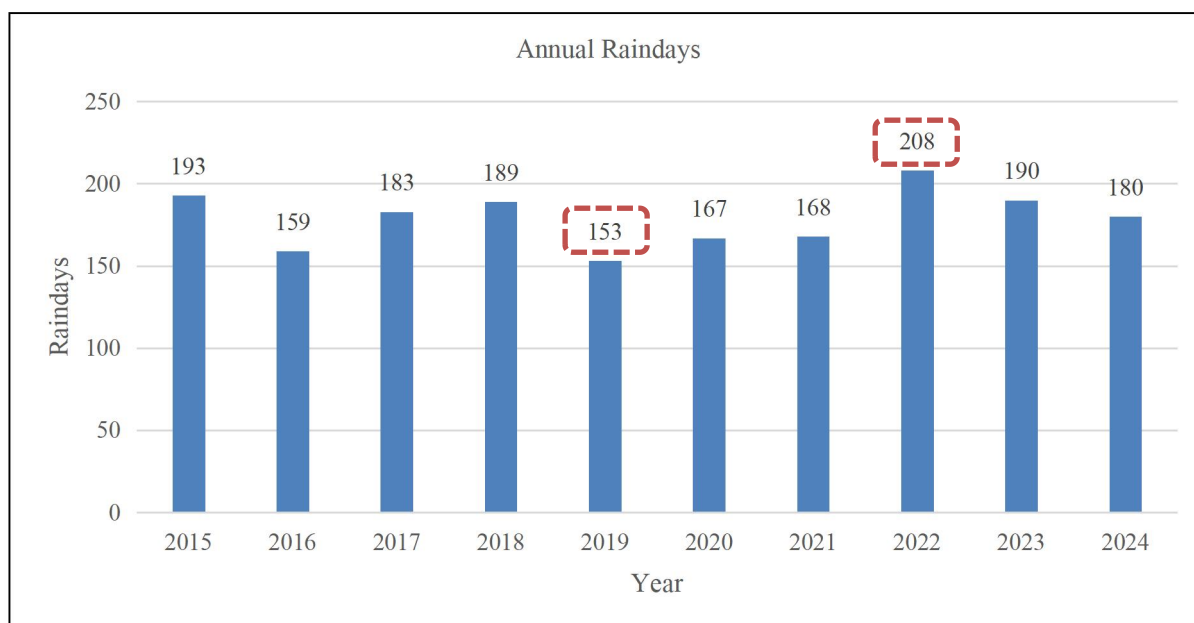


Figure 6.27 Annual Raindays

Source: Malaysian Meteorological Department (2025)

6.2.7.2 Temperature

i. Monthly Temperature Trend

Figure 6.28 illustrates the average monthly temperature assessment spanning from 2015 to 2025. The recorded mean monthly temperature varies between 27.6°C and 29.1°C, with a noticeable peak in temperatures from March to July, and a decline in temperatures from August to November.

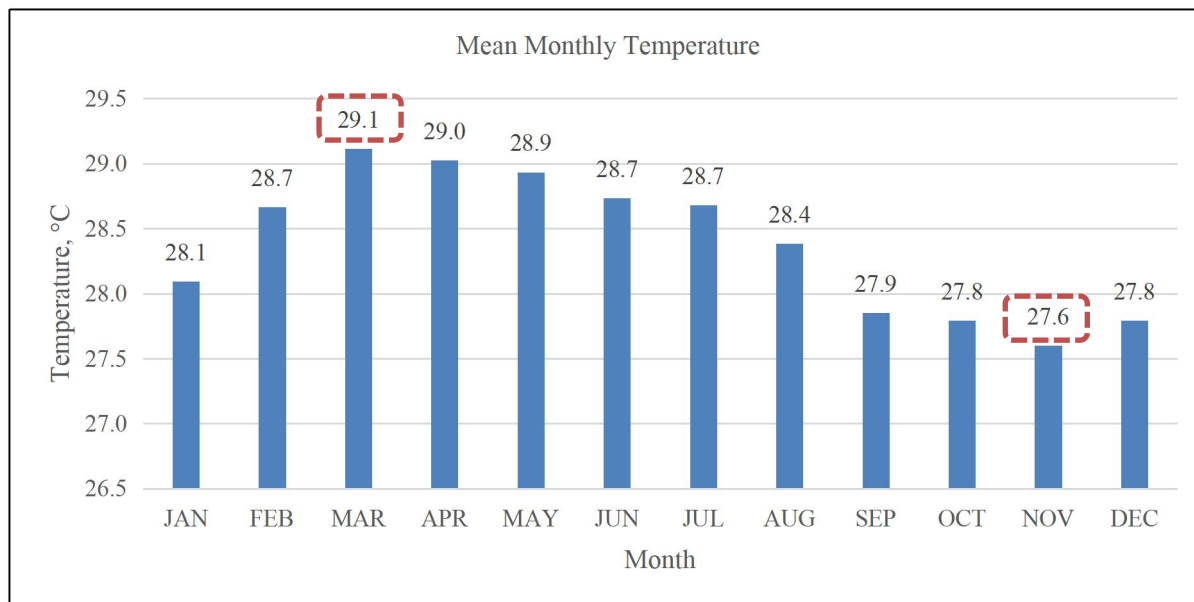


Figure 6.28 Mean Monthly 24-hr Temperature

Source: Malaysian Meteorological Department (2025)

ii. Annual Temperature Trend

The average yearly temperature remains relatively stable, fluctuating between 27.8°C and 29.3°C (**Figure 6.29**). The highest recorded mean annual temperature was in 2024, while the lowest was in 2015.

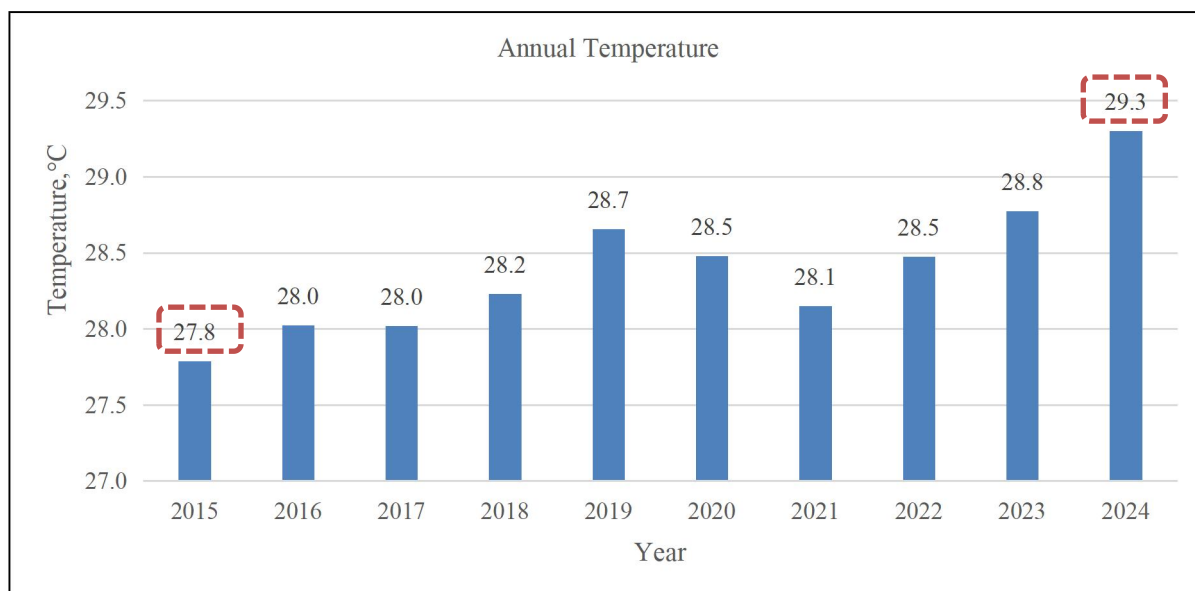


Figure 6.29 Mean Annual Temperature
Source: Malaysian Meteorological Department (2025)

6.2.7.3 Relative Humidity (RH)

i. Monthly RH Trend

The average monthly relative humidity varies from 69.6 % to 81.2 %, as illustrated in **Figure 6.30**. February had the lowest RH recorded at 69.6% while November had the highest recorded RH of 81.2%.

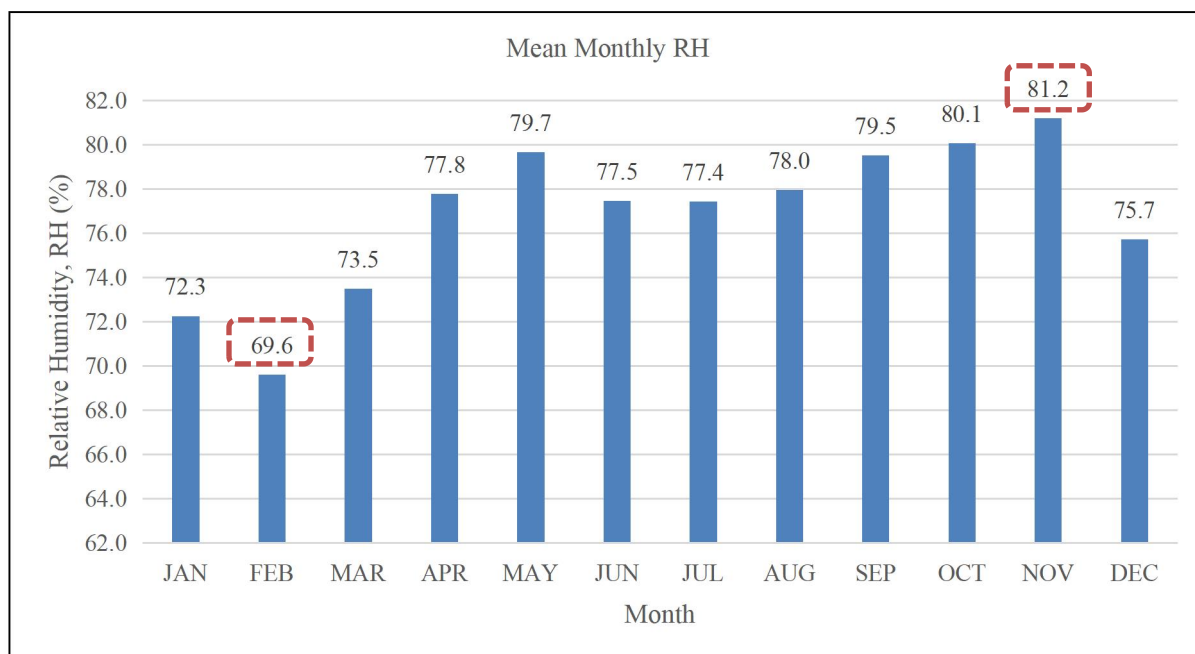


Figure 6.30 Mean Monthly Relative Humidity
Source: Malaysian Meteorological Department (2025)

ii. Annual RH Trend

The highest recorded annual RH occurred in 2017 at 79.1%, while the lowest was observed in 2024 at 72.8% as illustrated in **Figure 6.31**.

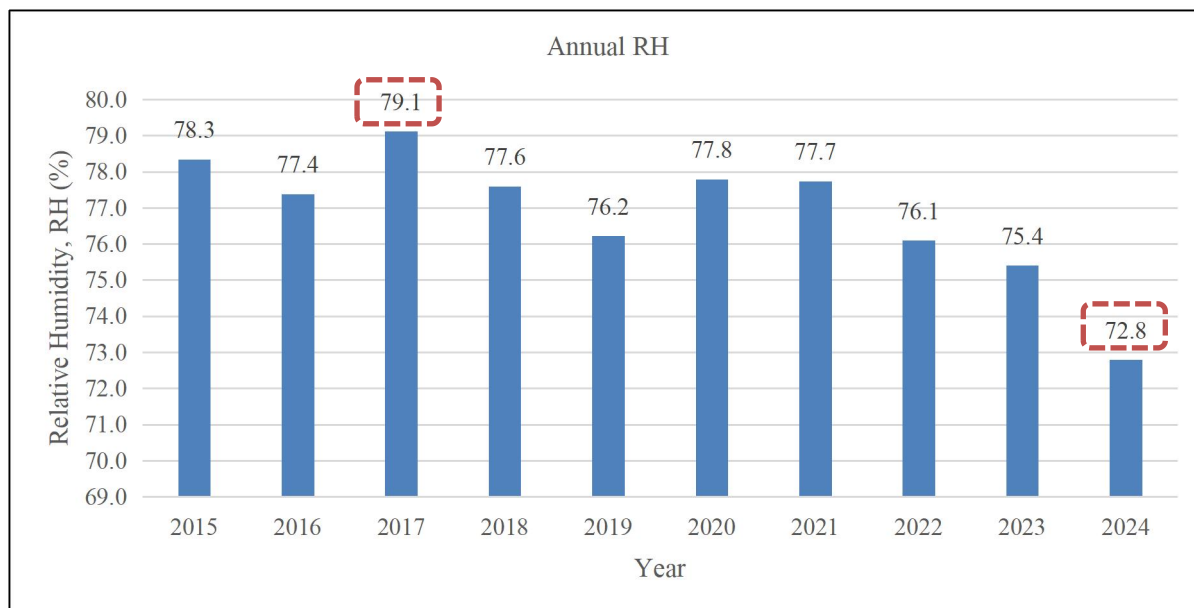


Figure 6.31 Mean Annual Relative Humidity
Source: Malaysian Meteorological Department (2025)

6.2.7.4 Wind Speed and Direction

Table 6.8 presents the frequency percentages of concurrent wind direction and speeds. The dominant wind originated from the North (20.1%). Calm days accounted for 14.5% of occurrences, with the highest wind speed coming from the SoutheWest (SW) at 3.5 m/s, and the lowest recorded at around 1.5 m/s from the North (N) and NorthWest (NW) direction. **Figure 6.32** depicts a representative overview of the yearly wind patterns between 2015 and 2023.

Table 6.8: Percentage Frequencies of Occurrence for Concurrent Wind Direction

Station:	BAYAN LEPAS	Latitude:	5.2969
WMOIndex:	48601	Longitude:	100.2721
Date:	2015 - 2023	Elevation:	2.46

Percentage frequencies of occurrence for concurrent wind direction (degrees) and speed (m/s) within specified ranges [%]								
Wind speed range								
Direction	0.3-1.5	1.6-3.3	3.4-5.4	5.5-7.9	8.0-10.7	>10.7	Total	Mean Speed
Calm							14.5	
Variable	0	0	0	0	0	0	0	
N	12.8	5.9	1.2	0	0	0	20.1	1.5
NE	4.8	8.1	3.4	0.5	0	0	16.8	2.4
E	2	2.6	0.6	0	0	0	5.1	2
SE	1.2	2.2	0.2	0	0	0	3.7	1.9
S	1.5	3.1	1.5	0.3	0	0	6.4	2.7
SW	1.8	5.6	9.2	0.9	0	0	17.6	3.5
W	4.2	4.9	1.4	0	0	0	10.6	2
NW	2.6	1.8	0.2	0	0	0	4.7	1.5

Source: Malaysian Meteorological Department (2025)

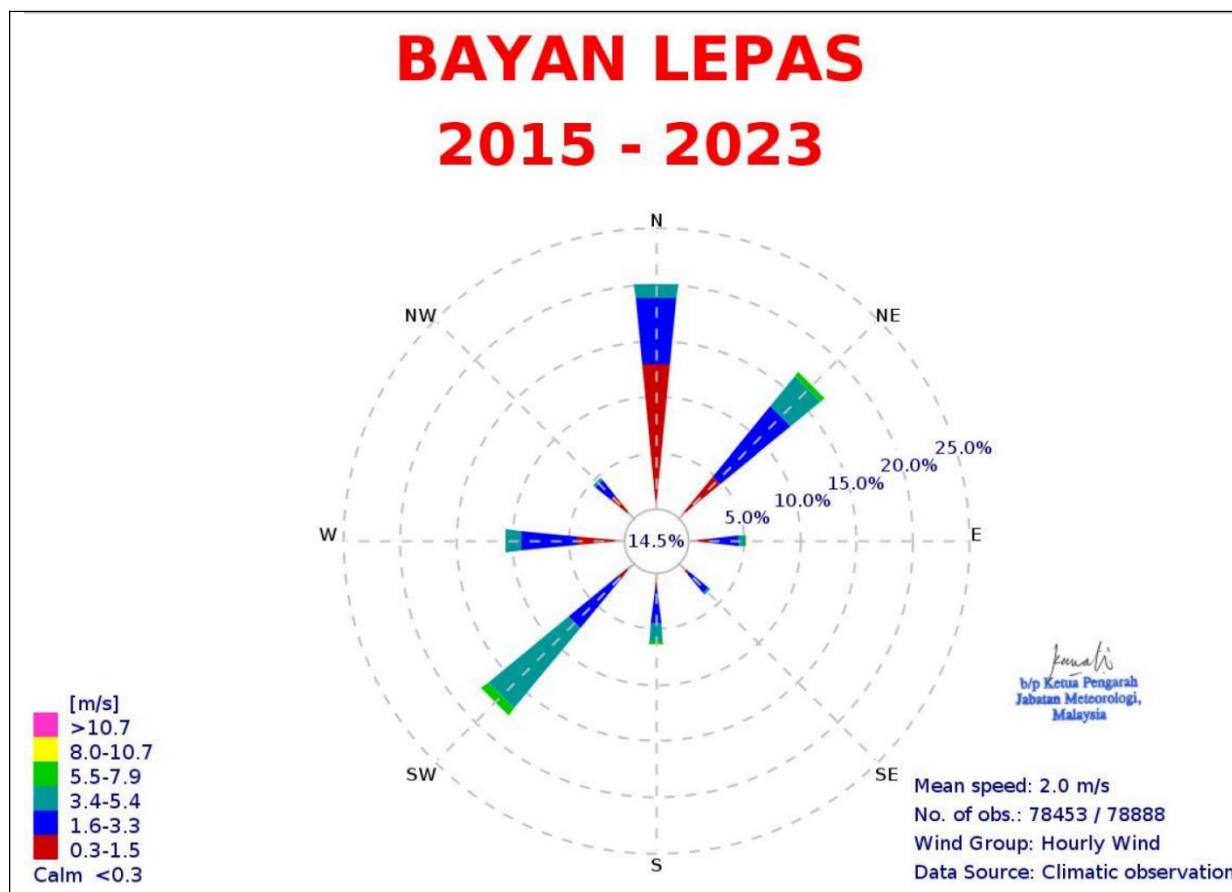


Figure 6.32 Wind rose

Source: Malaysian Meteorological Department (2025)

6.2.8 Environmental Baseline

6.2.8.1 Air Quality

Ambient air quality monitoring was conducted at three distinct sites, as illustrated in **Figure 6.33**. The descriptions of each sampling location are provided in **Table 6.9**. The monitoring techniques used in this investigation adhere to the established protocols outlined in **Table 6.10**. The monitoring activities were executed on 10th - 11th September 2025 with the findings compared against the New Malaysia Ambient Air Quality Standard (**Table 6.11**). **Figure 6.34** presents a summary of the ambient air quality findings, indicating that all measured parameters **met the allowable limits** at every monitoring location.

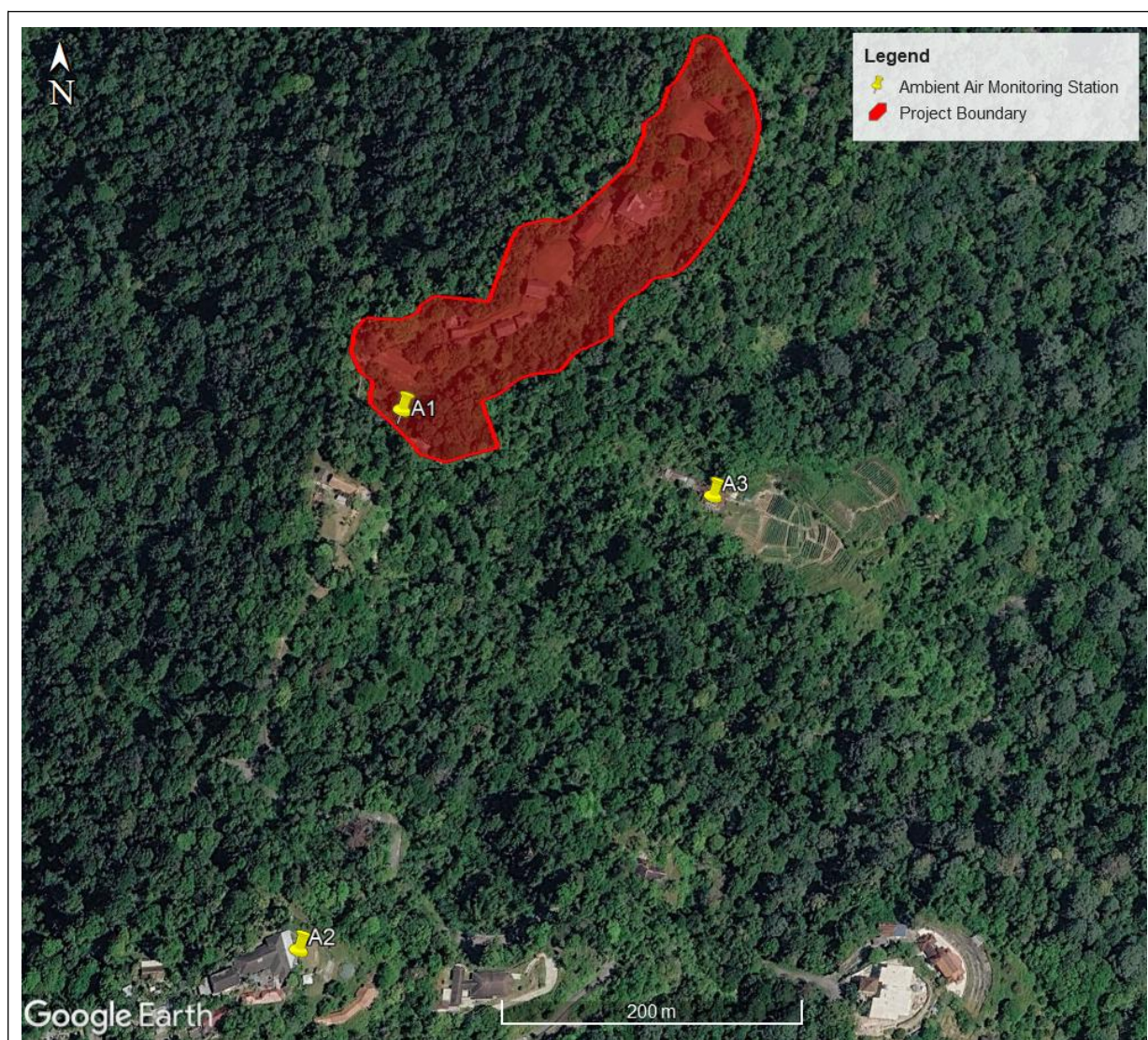


Figure 6.33 Ambient Air Quality Sampling Locations

Source: Updated by Runding Alam in Google Earth, 2025

Table 6.9: Description of Ambient Air Quality Sampling Location

Station	Coordinates	Landuse of Receiving Receptor	Description
A1	5°25'45.38"N 100°16'12.47"E	Residential	Near Richmond Bungalow (inside project boundary)
A2	5°25'33.45"N 100°16'10.82"E	Commercial Business Zones	Near Bellevue Hotel (south of project site)
A3	5°25'43.39"N 100°16'19.62"E	Industrial Zones (Agricultural)	Near agricultural land (southeast of project site)

Table 6.10: Ambient Air Quality Standard Method

Parameters	Unit	Standard Method Used
Particulate Matter (PM ₁₀)	µg/m ³	USEPA 40 PART 50, Appendix J
Particulate Matter (PM _{2.5})	µg/m ³	USEPA 40 PART 50, Appendix J

Table 6.11: New Ambient Malaysia Air Quality Standard

Pollutants	Averaging Time	Ambient Air Quality Standard		
		IT-1 (2015)	IT-2 (2018)	Standard (2020)
		µg/m ³	µg/m ³	µg/m ³
Particulate Matter with the size of less than 10 micron (PM ₁₀)	1 Year	50	45	40
	24 Hour	150	120	100
Particulate Matter with the size of less than 2.5 micron (PM _{2.5})	1 Year	35	25	15
	24 Hour	75	50	35
Sulfur Dioxide (SO ₂)	1 Hour	350	300	250
	24 Hour	105	90	80
Nitrogen Dioxide (NO ₂)	1 Hour	320	300	280
	24 Hour	75	75	70
Ground Level Ozone (O ₃)	1 Hour	200	200	180
	8 Hour	120	120	100
*Carbon Monoxide (CO)	1 Hour	35	35	30
	8 Hour	10	10	10

*mg/m³

Source: New Ambient Malaysia Air Quality Standard (2020)

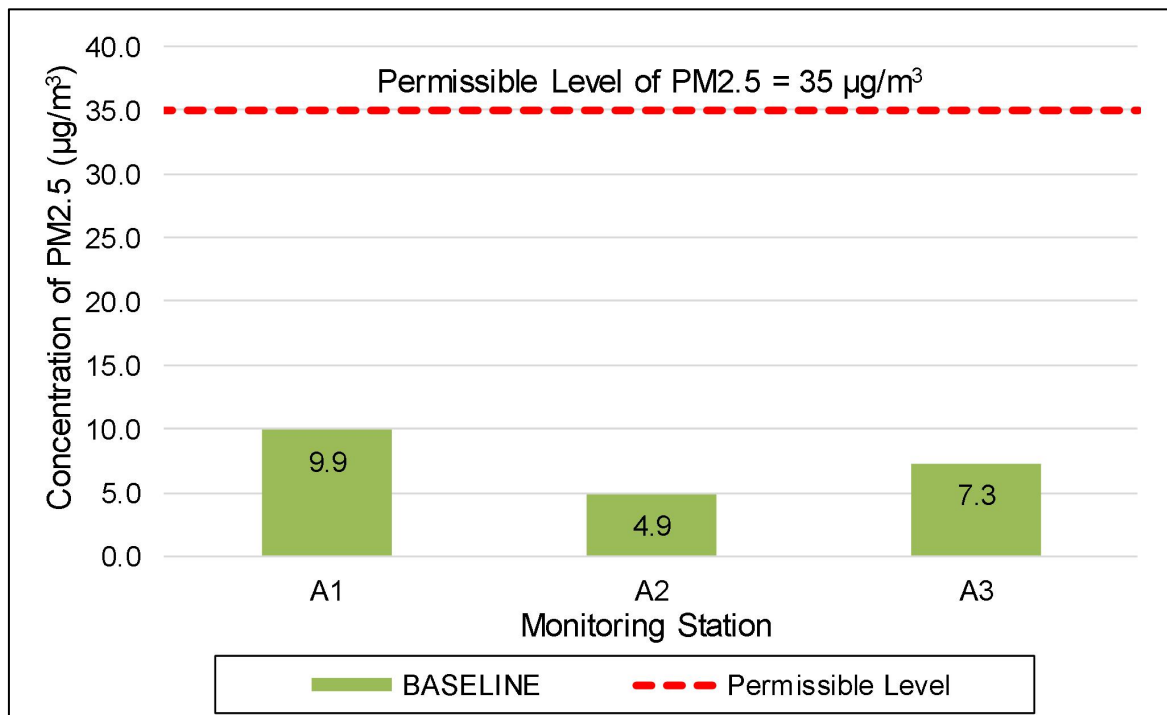


Figure 6.34(a): Particulate Matter 2.5 Monitoring Result

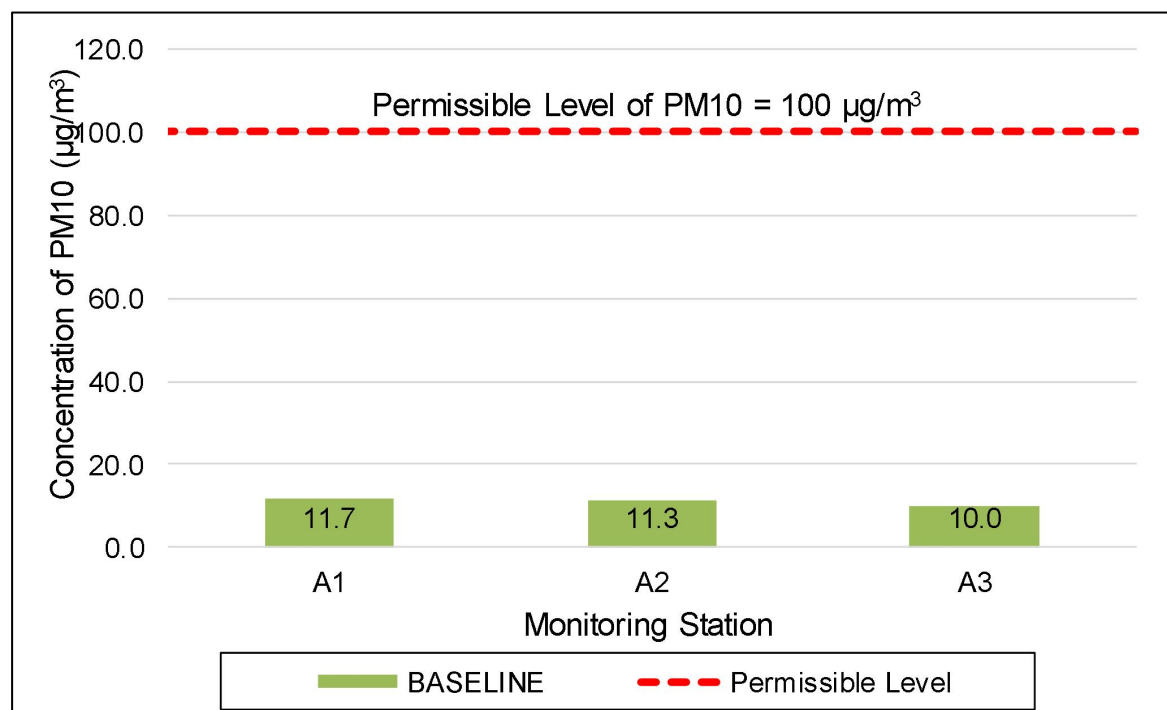


Figure 6.34(b): Particulate Matter 10 Monitoring Result

6.2.8.2 Noise Level

Noise level monitoring was conducted at three different locations. **Figure 6.35** shows the sampling point locations. The descriptions of each sampling location are provided in **Table 6.12**. The monitoring took place on 10th- 11th September 2025 and adhered to the standard procedure, ISO 1996/1 (**Table 6.13**). The results were assessed for compliance with the "Maximum Permissible Sound Level by Receiving Land Use for Planning and New Development". Guideline values from **Table 6.14** were used, varying according to the respective receiving land use categories at different monitoring stations. A summary of the monitoring results can be found in **Figure 6.36**, indicating **good compliance at all stations** during both daytime and nighttime observations.

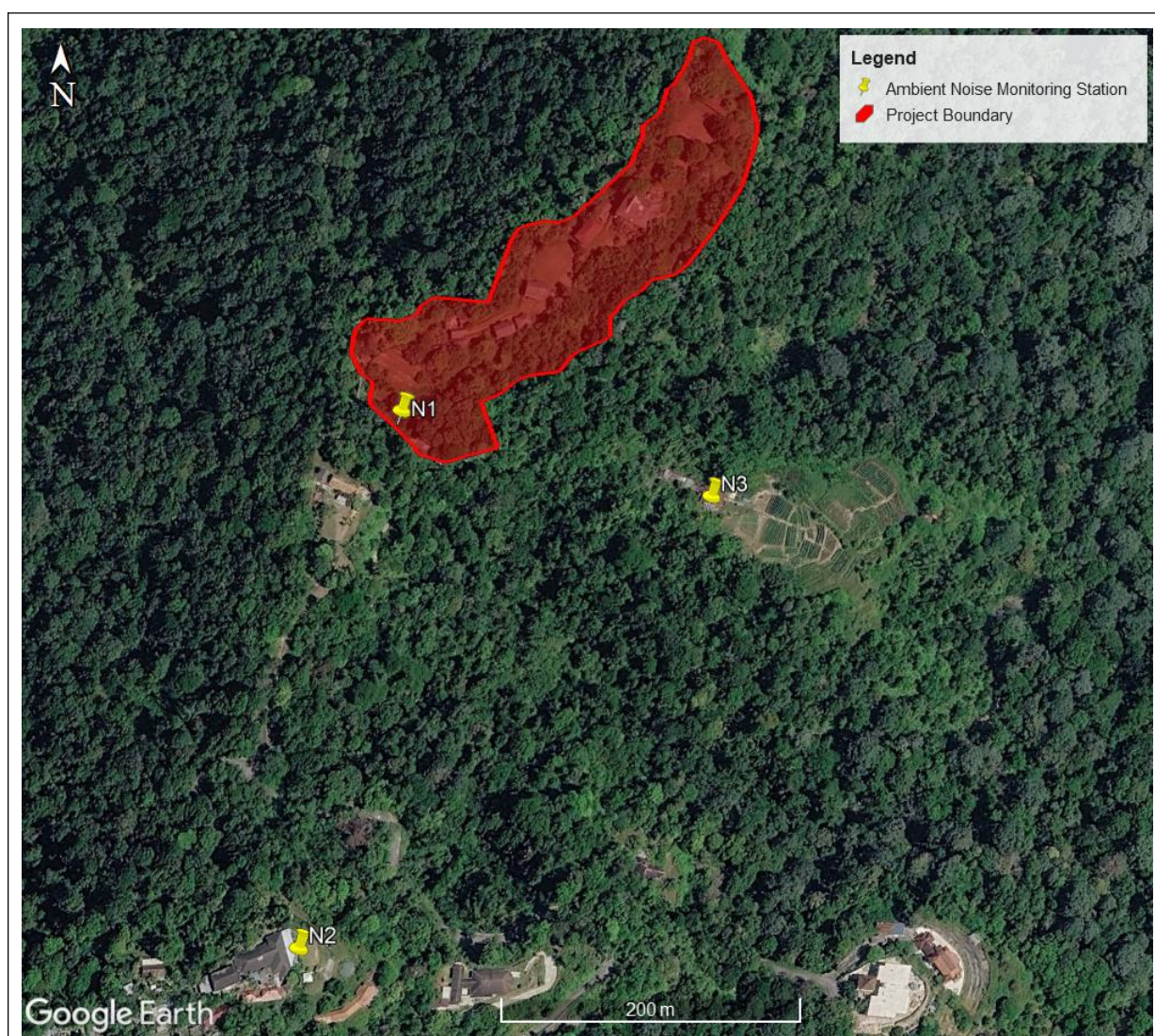


Figure 6.35 Ambient Noise Level Sampling Locations

Source: Updated by Runding Alam in Google Earth, 2025

Table 6.12: Description of Ambient Noise Level Sampling Location

Station	Coordinates	Landuse of Receiving Receptor	Description
N1	5°25'45.38"N 100°16'12.47"E	Residential	Near Richmond Bungalow (inside project boundary)
N2	5°25'33.45"N 100°16'10.82"E	Commercial Business Zones	Near Bellevue Hotel (south of project site)
N3	5°25'43.39"N 100°16'19.62"E	Industrial Zones (Agricultural)	Near agricultural land (southeast of project site)

Table 6.13: Ambient Noise Level Standard Method

Parameters	Unit	Standard Method Used
Ambient Noise	dBA	ISO 1996/1 (2003)

Table 6.14: Recommended Permissible Level (L_{Aeq}) by Receiving Land use for New Development

Receiving Land Use Category	L_{Aeq} Day 7.00 am - 10.00 pm	L_{Aeq} Night 10.00 pm - 7.00 am
Low Density Residential, Noise Sensitive Receptors, Institutional (School, Hospital, Worship).	55 dBA	50 dBA
Suburban Residential (Medium Density), Recreational	60 dBA	55 dBA
Urban Residential (High Density), Mixed Development	65 dBA	60 dBA
Commercial Business Zones.	65 dBA	60 dBA
Industrial Zones	70 dBA	65 dBA

Source: *Guidelines for Environmental Noise Limits and Control Third Edition 2019 (Reprint 2021) (DOE)*

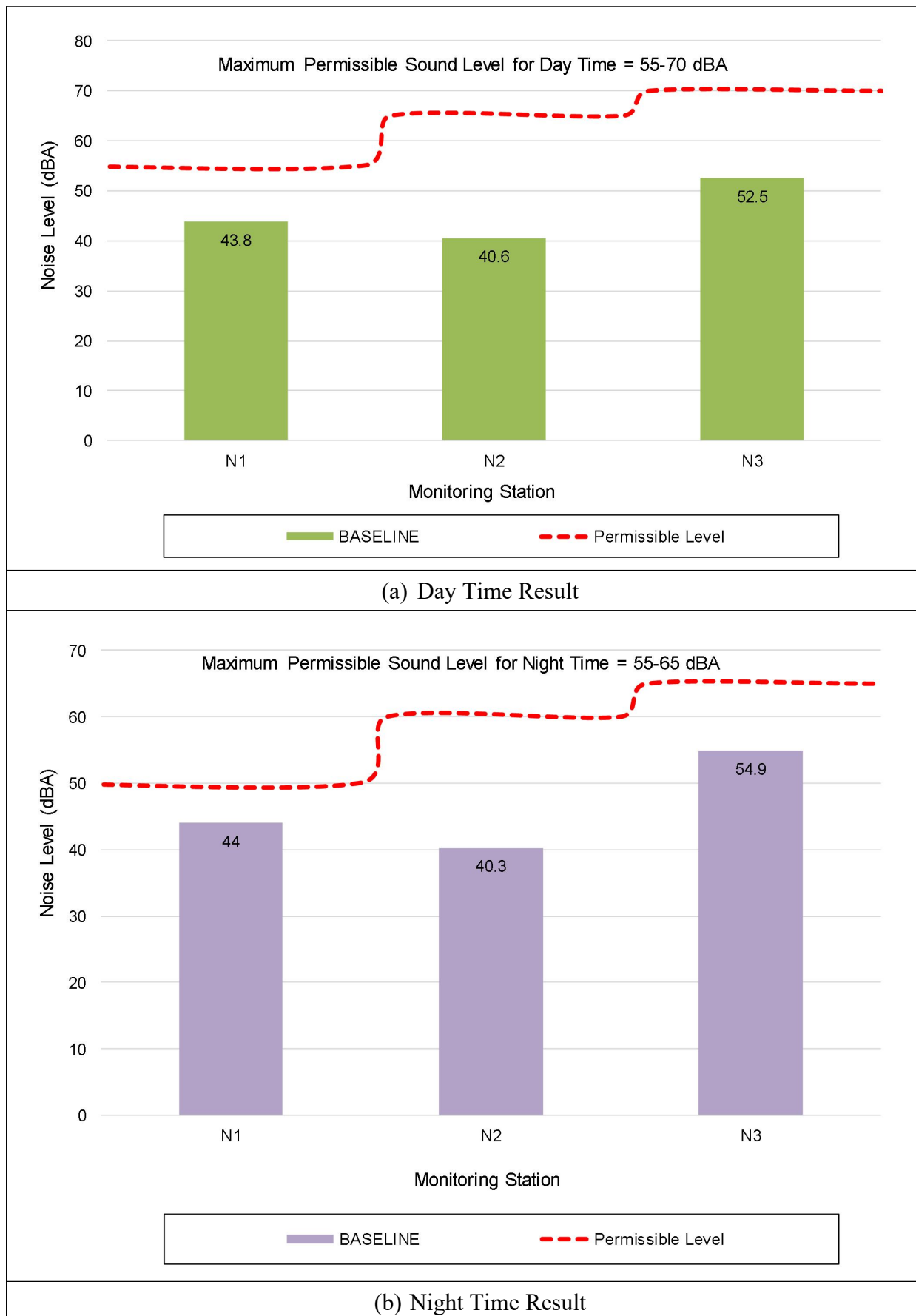


Figure 6.36 Compliance of Noise Level During Daytime and Night-time

6.2.8.3 Vibration

Vibration level assessments were carried out at three (3) monitoring stations, as shown in **Figure 6.37**. The descriptions of each sampling location are provided in **Table 6.15**. The measurements aimed to assess ground-borne vibration levels near the proposed project site. These measured levels were compared with the "Guidelines for Environmental Vibration Limits and Control", outlined in **Table 6.16** and **Table 6.17**, to evaluate compliance with vibration acceptance criteria.

Baseline vibration levels for both daytime and nighttime at V1 (residential) and V2 (commercial/business) are **well within the recommended limits**, with Peak Particle Velocity (PPV) values ranging from 0.381 to 0.458 mm/s as detailed in **Table 6.18**. The vibration levels are classified as barely noticeable, with minimal environmental impact and no potential sources of non-compliance identified. Overall, the study area is considered to have a low vibration environment, indicating that existing conditions are stable and unlikely to cause disturbance to surrounding receptors.

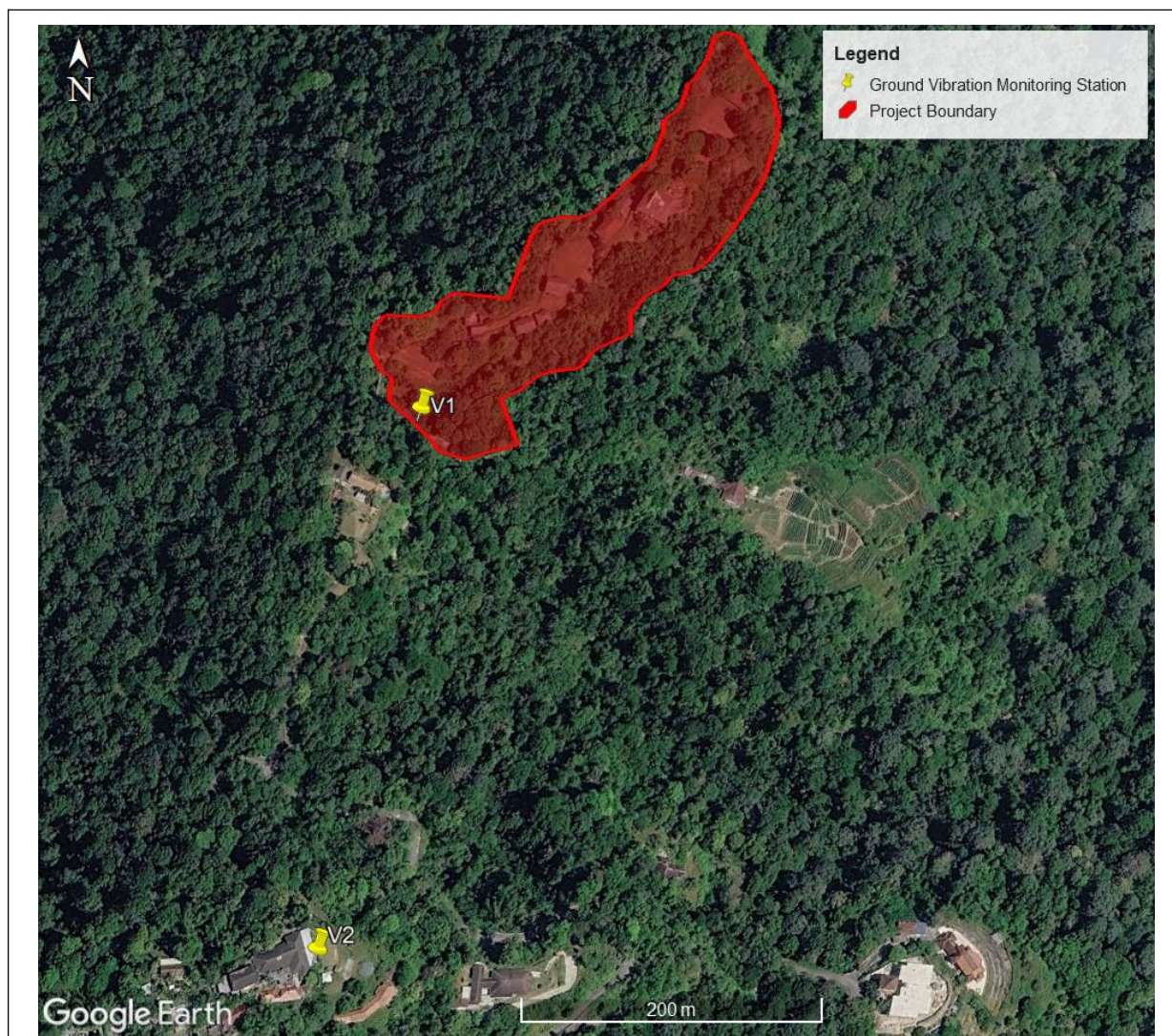


Figure 6.37 Vibration Sampling Locations

Source: Updated by Runding Alam in Google Earth, 2025

Table 6.15: Description of Vibration Sampling Locations

Station	Coordinates	Landuse of Receiving Receptor	Description
V1	5°25'45.38"N 100°16'12.47"E	Residential	Near Richmond Bungalow (inside project boundary)
V2	5°25'33.45"N 100°16'10.82"E	Commercial Business Zones	Near Bellevue Hotel (south of project site)

Table 6.16: Recommended Vibration Limits for Human Response and Annoyance from Intermittent Vibrations (Third Schedule)

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am
Vibration Sensitive Facilities	0.1 mm/s (R=1)	0.1 mm/s (R=1)
Residential	0.8 mm/s to 1.6mm/s (R=8 to R=16)	0.4 mm/s (R=4)
Commercial, Business	1.6 mm/s (R=16)	1.6 mm/s (R=16)
Industrial	3.2 mm/s (R=32)	3.2 mm/s (R=32)

Source: Guideline for Environmental Vibration Limits and Control Third Edition (DOE, 2021)

Table 6.17: Human Perception of Vibration and Likely Environmental Impact

Approximate vibration level (Peak Particle Velocity)	Degree of perception	Environmental Impact
0.14 mm/s	Threshold of perception	None
0.3 mm/s	Barely noticeable	Little
1.0 mm/s	Noticeable	Medium
2.2 mm/s	Easily noticeable	Strong
6 mm/s	Strongly noticeable	Very strong

Source: Guideline for Environmental Vibration Limits and Control (DOE, 2021)

Table 6.18: Ground Vibration Monitoring Result

DAY TIME			
Monitoring Station		V1	V2
Receiving Land Use Category		Residential	Commercial, Business
Recommended Limit		0.8 mm/s to 1.6 mm/s	1.6 mm/s
BASELINE	Peak Particle Velocity (mm/s)	0.421	0.458
	Compliance Status	Complied	Complied
	Degree of Perception	Barely noticeable	Barely noticeable
	Environmental Impact	Little	Little
	Potential Source of Non-Compliance	-	-
NIGHT TIME			
Monitoring Station		V1	V2
Receiving Land Use Category		Residential	Commercial, Business
Recommended Limit		0.4 mm/s	1.6 mm/s
BASELINE	Peak Particle Velocity (mm/s)	0.381	0.458
	Compliance Status	Complied	Complied
	Degree of Perception	Barely noticeable	Barely noticeable
	Environmental Impact	Little	Little
	Potential Source of Non-Compliance	-	-

6.2.8.4 Water Quality

Baseline water sampling was conducted at three locations from 10th - 11th September 2025. **Figure 6.38** shows the water sampling point locations. The descriptions of each sampling location are provided in **Table 6.19**. Laboratory testing was performed by Spectroscience Laboratories, an accredited laboratory under SAMM.

Table 6.19: Description of Water Sampling Locations

Station	Coordinates	Description
W1	5°25'45.21"N 100°16'15.27"E	At concrete drain near final discharge point from project site
W2	5°26'25.77"N 100°16'57.22"E	Upstream of Sungai Air Terjun (upstream of water intake)
W3	5°26'24.94"N 100°17'12.08"E	Downstream of Sungai Air Terjun (downstream of water intake)

The baseline results from the current sampling are best analyzed by comparing them with the latest database published by the Department of Environment in 2024. Comparative data available for Sungai Air Terjun are WQI data from year 2020 until 2024 as shown in **Table 6.20**. Historical baseline data from 2020 to 2024 shows that Sungai Air Terjun consistently maintained excellent water quality (Class I – clean) with WQI values ranging from 95 to 97. However, the current baseline (2025) indicates a declining trend in water quality, where W3 recorded Class II (clean) with a WQI of 85.81, and W4 further declined to Class III (slightly polluted) with a WQI of 76.12. This downward trend suggests a gradual deterioration in river water quality over time, particularly in the downstream section.

Table 6.20: Comparison Baseline Data with DOE's Database

Parameter	Baseline from DOE ¹					Baseline Current Sampling	
	2020	2021	2022	2023	2024	2025 (W3)	2025 (W4)
WQI Value	95	97	97	97	97	85.81	76.12
WQI Category	Clean	Clean	Clean	Clean	Clean	Clean	Slightly Polluted
WQI Class	Class I	Class I	Class I	Class I	Class I	Class II	Class III

Source: 1) Department of Environment (2025). Environmental Quality Report 2024. *Department of Environment, Ministry of Natural Resources and Environmental Sustainability.*

Overall, while the river remains generally within acceptable conditions near the water intake area, the observed decline highlights the need for continued monitoring and the identification of potential external pollution sources affecting the downstream stretch of Sungai Air Terjun.

Further analysis was carried out to compare the current baseline result with Class IIA limit of the National Water Quality Standards for Malaysia, as this standard represents the minimum acceptable level of good water quality for potable water. **Table 6.21** shows the water quality monitoring results for each sampling station. **Figures 6.39 - 6.40** show the water quality classification while **Table 6.22** shows the uses for each class.

Baseline results indicate that W1 (concrete drain) recorded no water discharge (NWD) during the sampling period, which is consistent with site conditions where the drain is normally dry during dry weather. This indicates no direct contribution from the drain to Sungai Air Terjun at the time of monitoring.

W2, located further downstream from the confluence and just upstream of the water intake facility, achieved Class II (clean) status, confirming that the river water quality at the intake vicinity is in good and acceptable condition.

Further downstream, W3, representing the main river zone, recorded Class III (slightly polluted) due to low dissolved oxygen (DO) levels, suggesting localized water quality deterioration likely influenced by natural conditions or external sources.

Overall, the findings indicate that the concrete drain does not have any observable impact on Sungai Air Terjun during dry period, while the water intake point remains within a clean water quality zone. The reduced water quality at W3 is localized and not attributable to the drain discharge. Field observations indicate that multiple discharge points from surrounding area likely contribute to these observed compliance failures.

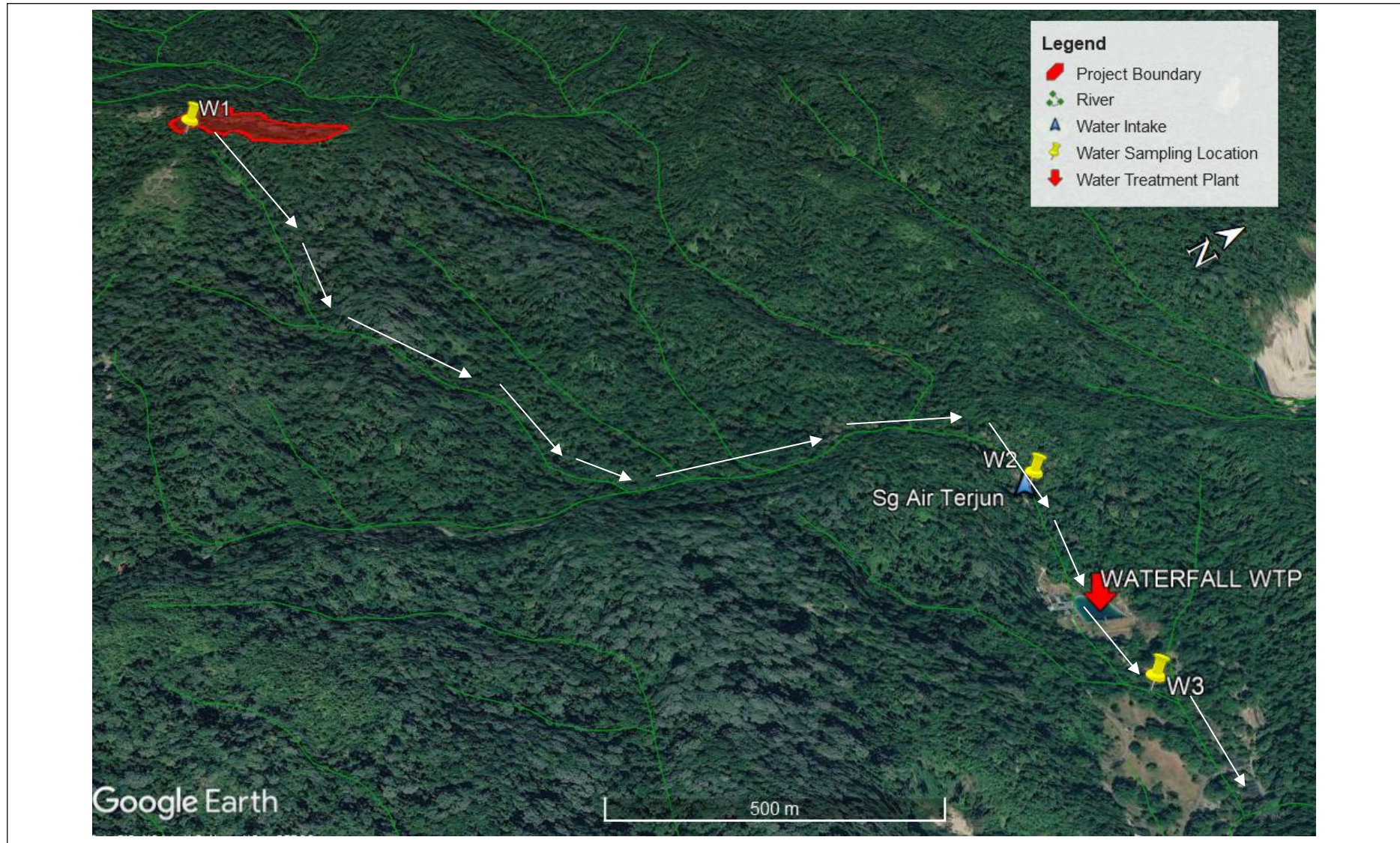


Figure 6.38 Water Quality Sampling Locations

Source: Updated by Runding Alam in Google Earth, 2025

Table 6.21: Water Quality Result Analysis

Parameters	Unit	BASELINE								
		Concrete Drain			Sungai Air Terjun					
		W1			W2			W3		
		Result	Compliance Limit (Class IIA)	Compliance Status	Result	Compliance Limit (Class IIA)	Compliance Status	Result	Compliance Limit (Class IIA)	Compliance Status
pH Value @25C	unitless	NWD	6.5-8.5	-	7.3	6.5-8.5	Complied	7.9	6.5-8.5	Complied
BOD - 5 days test @ 20°C	mg/L	NWD	3	-	3.0	3	Complied	3.0	3	Complied
COD	mg/L	NWD	25	-	13.5	25	Complied	10.4	25	Complied
Total Suspended Solids	mg/L	NWD	50	-	ND	50	Complied	ND	50	Complied
Ammonical Nitrogen	mg/L	NWD	0.3	-	ND	0.3	Complied	ND	0.3	Complied
Dissolved Oxygen (DO)	mg/L	NWD	5-7	-	5.2	5-7	Complied	2.5	5-7	Not Complied
Temperature	°C	NWD	Normal+2oC	-	21.5	Normal+2oC	Complied	21.6	Normal+2oC	Complied
Turbidity	NTU	NWD	50	-	2.8	50	Complied	2.1	50	Complied
Oil&Grease	mg/l	NWD	-	-	ND	-	-	ND	-	-
Escherichia coli	MPN/100ml	NWD	-	-	79.0	-	-	9.3	-	-
WATER QUALITY INDEX (WQI)	SCORE	-			85.81			76.12		
	CLASS	-			CLASS II			CLASS III		
	STATUS	-			CLEAN			SLIGHTLY POLLUTED		

Note: NWD = No water discharge; ND = Not detected

Source: Spectroscience Laboratories Sdn. Bhd, 2025

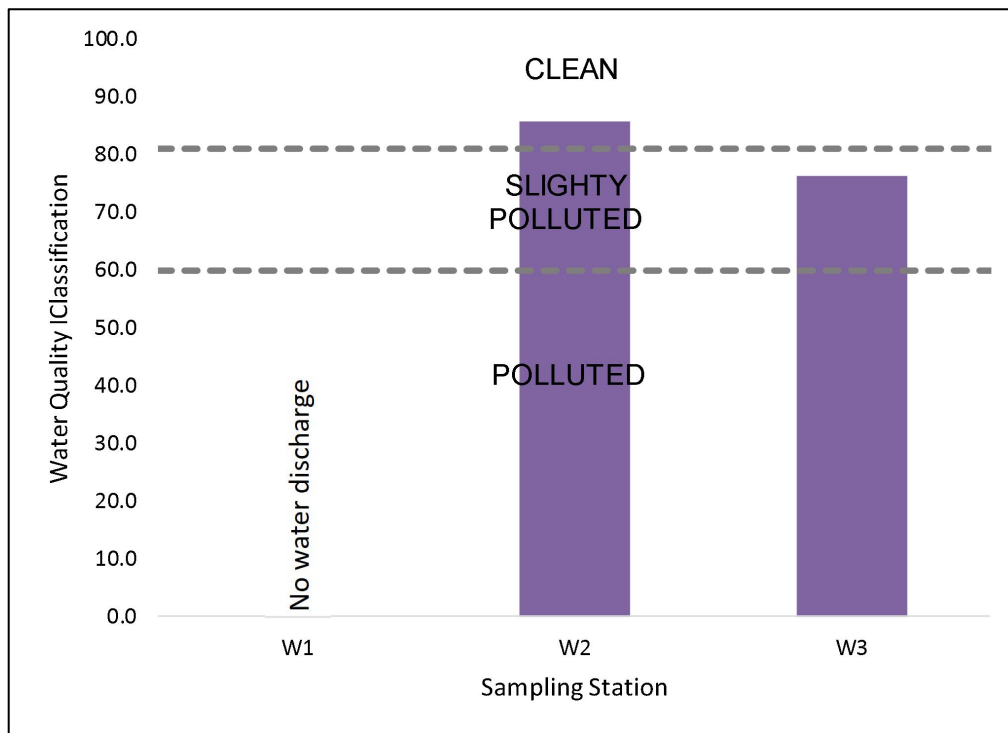


Figure 6.39 Water Quality Classification

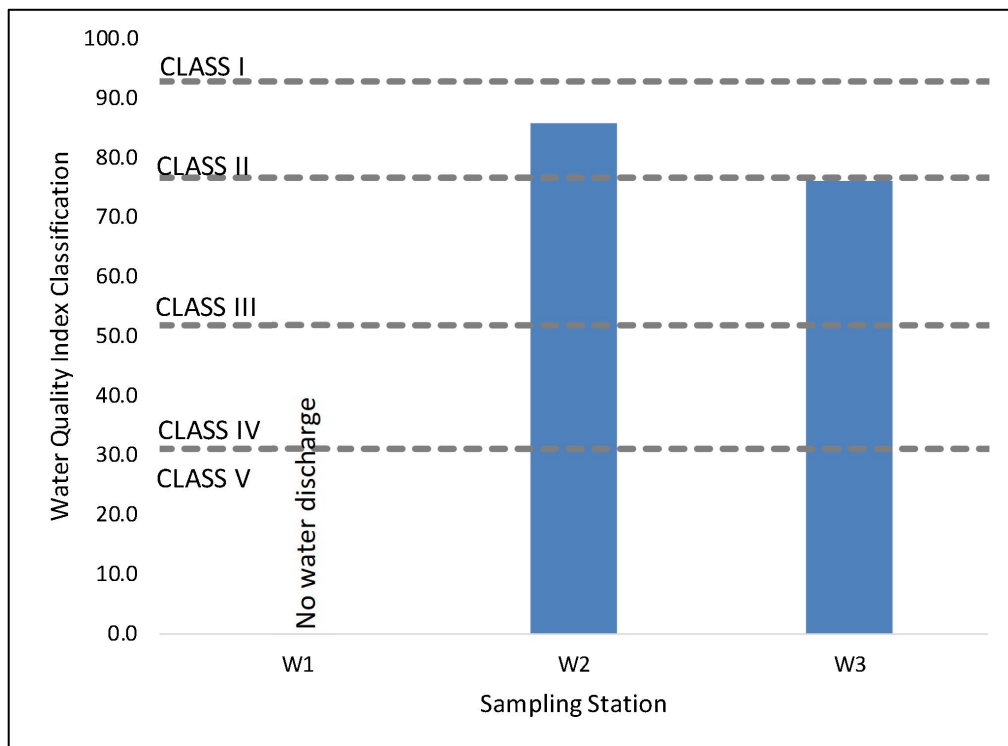


Figure 6.40 Water Quality Index Classification Based on Water Uses

Table 6.22: Water Uses Classification

CLASS	USES
Class I	Conservation of natural environment. Water Supply I – Practically no treatment necessary. Fishery I – Very sensitive aquatic species.
Class IIA	Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species.
Class IIB	Recreational use with body contact.
Class III	Water Supply III – Extensive treatment required. Fishery III – Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

Source: DOE, 2017

6.3 BIOLOGICAL ENVIRONMENT

The current environment was observed to be forested land with existing abandoned dilapidated buildings, as shown in **Figure 6.41**.



Figure 6.41 Current site condition

A flora and fauna assessment was done on the project site to further understand the existing ecosystems. The details are discussed in the next subsection, **6.3.1**.

6.3.1 Flora and Fauna Assessment

This Flora and Fauna Assessment Report was prepared based on a Rapid Ecological Assessment (REA) conducted within the immediate vicinity of the project boundary. The REA serves as a critical method for managing terrestrial, freshwater, marine and estuarine ecosystems, particularly in data-deficient areas. This assessment documents the biodiversity status, establishes baseline site conditions and identifies existing species. The findings facilitate monitoring species recovery or retention rates and include recommendations to enhance biodiversity.

In the planning and development of this project, several key principles were taken into account, including attraction potential, accessibility, economic viability, as well as environmental and social impacts. To support this, Ts. Tn. Haji Mohd Khairul Anwar Ahmad, a specialist in flora and fauna, has been appointed to conduct a series of biodiversity surveys across the project area, which spans approximately 3.112 hectares. The full report is attached in *Softcopy Attachments - Flora and Fauna Assessment Report*.

6.3.1.1 Objective of Assessment Study

This report presents a summary of the key ecological features within the project area, focusing on the composition and distribution of flora, vegetation, and fauna. It also provides an assessment of potential project-related impacts on these ecological components, including the significance and sensitivity of such impacts based on field observations and available references.

The objectives of the study were to:

- i. To determine preliminary/ general biodiversity and flora and fauna composition at the proposed project area
- ii. To identify the presence of any endemic, protected and rare species at the proposed project
- iii. To investigate potential impact on flora fauna diversity

6.3.1.2 Existing Environment

Located on the northern edge of the hills, the Crag Hotel site is situated **within the Buffer Zone of the Penang Hill Biosphere Reserve (PHBR)**, a UNESCO-designated area established in 2021 (**Figure 6.42**).

Established on September 15, 2021, under the UNESCO Man and the Biosphere (MAB) Programme, the Penang Hill Biosphere Reserve (PHBR) spans a total of 12,481 hectares. This vast expanse includes 7,285 hectares of terrestrial land and 5,196 hectares of marine ecosystems, creating a unique environment where ecological conservation and cultural legacy are managed as one integrated landscape. While the Core Area of the PHBR consists of strictly protected permanent forest reserves and water catchment areas, the Crag Hotel falls into this intermediate zone where activities compatible with ecological conservation, such as

scientific research, environmental education, and sustainable tourism, are permitted. This classification ensures that any future heritage restoration or biodiversity monitoring at the site serves to protect the integrity of the adjacent primary forest while allowing for the continued study of the unique flora and fauna that thrive on its fringes.

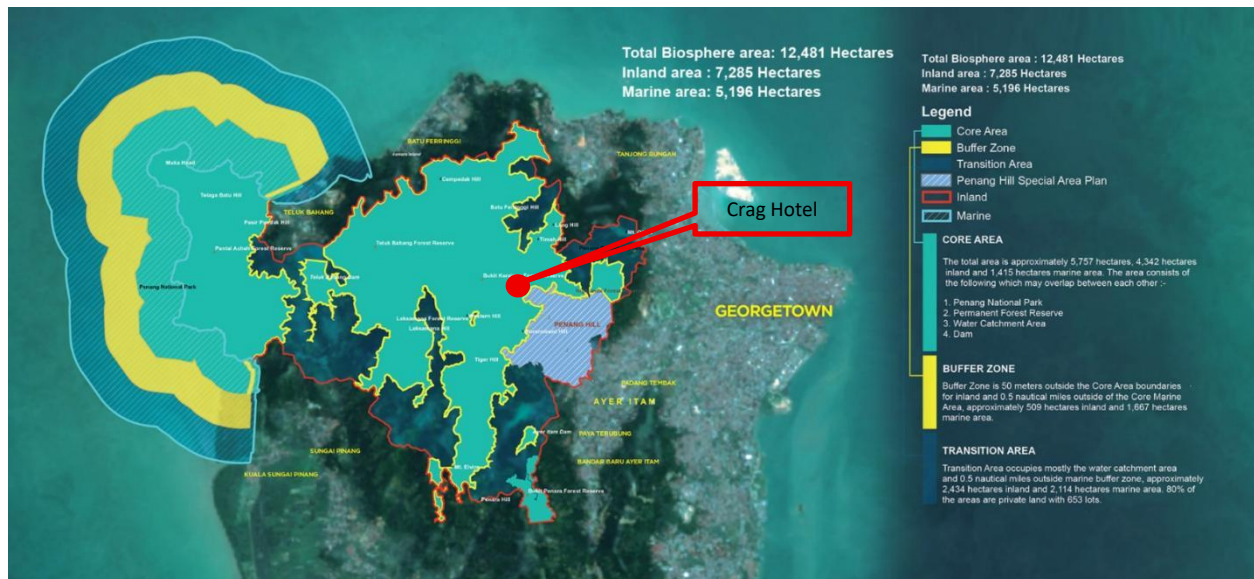


Figure 6.42 Overall Biosphere Area with Project Site

Source: Flora & Fauna Assessment for Crag Hotel, 2025

➤ Management of the Buffer Zone

The Buffer Zone, which includes the Crag Hotel site, serves as a protective layer for the Core Area. According to the PHBR framework:

- **Connectivity:** This zone acts as a biological corridor, allowing species from the strictly protected Core Area which includes Penang National Park and Permanent Forest Reserves to move safely across the landscape.
- **Regulated Development:** Unlike the Transition Area, which is largely private land and allows for more intensive human activity, the Buffer Zone is 50 meters wide (inland) and strictly restricts activities to those that support conservation.
- **Ecological Buffer:** It minimizes "edge effects" on the primary forest, such as noise, light pollution, and the encroachment of invasive species.

➤ Significance of the Crag Hotel Site

Because the Crag Hotel is situated on the northern edge of the hill, it occupies a unique ecological and historical space:

- **Heritage Integration:** As a site noted for heritage restoration, its placement in the Buffer Zone means any development must follow the Penang Hill Special Area Plan, ensuring that the restoration of colonial-era structures does not disturb the surrounding ecosystem.

- **Research Hub:** Its location makes it an ideal research hub for biodiversity monitoring, as it hosts a diverse flora and fauna species.
- **Water Catchment Protection:** Parts of the PHBR Core Area consist of Water Catchment Areas. The Crag Hotel's management within the Buffer Zone is critical for maintaining the water quality and soil stability that flows into these sensitive zones.

6.3.1.3 Key Policies and Relevant Legislatives

The Malaysian Government has formulated several policy instruments and legislative frameworks that address matters pertaining to biodiversity management and conservation. These documents serve as a strategic reference for government agencies, non-governmental organizations (NGOs), and the public in formulating responses to ecological sustainability and biodiversity-related challenges.

The key policies and legislative references relevant to this study are summarized below:

- i. National Policy on Biological Diversity 2016-2025
- ii. Wildlife Conservation Act 2010
- iii. National Conservation Strategy 1993
- iv. Pesticides Act 1973
- v. National Forestry Act 1984
- vi. National Forestry Policy 1992
- vii. National Strategy for Plant Conservation 2009
- viii. Biosafety Act 2007
- ix. Environmental Quality Act 1974
- x. Water Quality Standards
- xi. Access to Biological Resources and Benefit Sharing Act 2017
- xii. International Union for Conservation of Nature (IUCN) Red List of Threatened Species
- xiii. Global Biodiversity Information Facility (GBIF)

6.3.1.4 Ecological and Biological Conditions of Site

An overview of ecological and biodiversity aspects was compiled from site surveys and secondary data acquisition (gathered from relevant departments, open-source publications, scientific journals, articles, and websites) and is discussed below.

i. **Ecological Conditions**

ECOSYSTEM TYPES	SURROUNDING ECOSYSTEMS	- The area is characterized by Upper Hill Dipterocarp Forest, dominated by mixed dipterocarp species - Forest type exhibits a multi-layered vegetation structure, comprising mature canopy, sub-canopy and dense understorey and supporting diverse flora and fauna.
	RIPARIAN ECOSYSTEMS	- The riparian zones along the rivers provide essential habitats for aquatic and semi-aquatic species. These areas act as ecological corridors, supporting biodiversity and stabilizing riverbanks. - Native vegetation may still exist in riparian areas, providing nesting and feeding grounds for wildlife.
	AQUATIC ECOSYSTEMS	The aquatic ecosystems near the Crag Hotel on Penang Hill consist mainly of high-altitude headwater streams and riparian transition zones. Located between 700 and 800 meters above sea level, these environments serve as vital ecological pillars within the Penang Hill Biosphere Reserve.

ii. **Biodiversity Conditions**

FLORA	TYPES OF VEGETATION
	ENDEMISM & RARE SPECIES
	- Historically there are 2,456 plant species with around 20 species on the IUCN Red List such as Penang Slipper orchid (<i>Paphiopedilum barbatum</i>), Maingaya malayana (Witch Hazel) and Pitcher Plants (<i>Nepenthes</i> species). - Furthermore, the consistently cool and misty conditions at the summit foster a rich community of Fungi and Mosses, notably including bioluminescent species such as <i>Mycena chlorophos</i> (emitting a pale green light). This structural richness is completed by the abundant presence of Lianas and Climbers, which interweave throughout the upper layers, physically binding the forest canopy together and contributing significantly to the overall plant species richness. - The botanical conditions of Penang Hill are defined by high diversity, a result of sharp habitat stratification across elevation. This concentration of endemic and IUCN-listed species establishes the area as a mandatory focus for biodiversity study and protection in Malaysia.

FAUNA	TYPES OF FAUNA	
	VERTEBRATES	INVERTEBRATES
	<u>Mammals:</u> Due to its topographical steepness and geographical condition, the hill environment prohibits the establishment of large, wide-ranging fauna, which predominantly sustain smaller-bodied species and those adapted to an arboreal existence. Arboreal & diurnal species such as Dusky Leaf Monkey (<i>Trachypithecus obscurus</i>) and Long tailed macaque (<i>Macaca fascicularis</i>) can be seen at Project Site surrounding.	<u>Insects and Crustaceans:</u> Through comprehensive ecological assessments, such as the Penang Hill BioBlitz 2017, the defunct colonial structure was found to be a key element in local biodiversity. The decaying ruins, with their moist, dark crevices, create specialized microhabitats that successfully support and shelter numerous invertebrate species. Abundant and diverse population of invertebrates are crucial for nutrient cycling and the food web. Unique endemic species such as Penang Hill Vampire Crab (<i>Geosesarma faustum</i>) can be found within the area. Insects such as cicadas can be heard, followed by elusive large insects like stick insects and leaf mantises where they can camouflage easily with Penang Hill surrounding.
	<u>Birds:</u> The species richness for birds on Penang Hill is the result of the area acting as an ecological refuge, which features a steep altitude gradient compared to other areas such as George Town. Over 100 bird species can be observed in the area as the large contiguous forest canopy is able to provide a stable environment. Species of birds such as Bulbuls, Sunbirds, Flowerpeckers, and Myna can be generally observed at disturbed areas where they coexists with human habitation. While species such as Greater Racket-Tailed Drongo require dense and undisturbed canopy cover and highly sensitive to habitat loss	
	<u>Reptiles and Amphibians:</u> The cool and wet forest floor, supports a diverse range herpetofauna based on the observations recorded. Species of venomous snakes such as Wagler's Pit Viper and non-venomous species like Paradise Tree Snake were observed at the project site. The humid environment and certain structural decay can create micro-shelters for herpetofauna species which is essential for them.	

The high elevation of the project site results in a consistently cooler climate which contributes to ideal conditions for lush and dense growth. A stable, humid and altitudinally varied environment directly supports diverse species richness fostering diverse flora and fauna. The Crag Hotel represents a compelling example of an anthropogenic ecotone, where the decaying colonial infrastructure has been fundamentally integrated back into the surrounding rainforest ecosystem. This intersection of human heritage and ecological recovery establishes specialized microhabitats specifically, the moist, dark, and sheltered crevices and structural gaps within the ruins that are critical to the survival of small, habitat-restricted fauna. These sites function as essential refuge and breeding grounds for particular species, including endemic invertebrates like the Penang Hill Vampire Crab and various sensitive amphibian species, protecting them from the macro-environment and providing necessary conditions for their complex life cycles.

6.3.1.5 Survey Methodology

i. Desktop Review

A desktop review was first undertaken to collect available background information relevant to the study area. This included the review of previous ecological reports, satellite imagery, and observations ranging from flora to fauna recorded by previously Penang Hill's visitor which can be access through <https://www.inaturalist.org/home>. The project boundary was established based on provided coordinates, and base maps showing general land cover, vegetation, and drainage features were prepared to guide fieldwork. Sampling locations were selected to represent different habitat types within the project areas.

ii. Field Survey

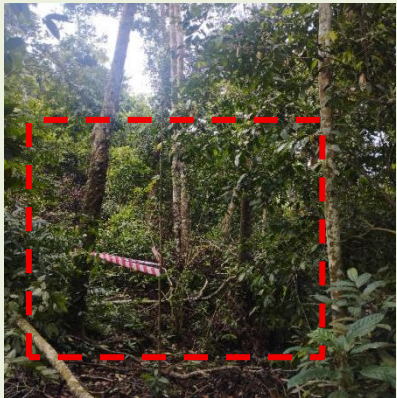
A preliminary survey was carried out within the project site for **10 weeks, starting from 25th September 2025 to 4th December 2025**. Within this timeframe, survey methods such as **exploration, collection, and observations** were used to assess species diversity and to identify any Rare, Endangered, and Threatened (RET) species within the proposed project site. A total of **five (5) sampling locations** were established to represent the range of habitat types and landscape conditions within the project area. The selection of sampling locations was meticulously executed through habitat stratification, deliberately covering the full range of environmental within project to ensure a comprehensive census of the entire flora and fauna assemblage within the study site.

The survey employed **transect-based sampling**, where linear paths were followed to facilitate standardized sampling effort. This design was critical for recording species distribution across the pronounced altitudinal stratification of the hill environment.

iii. Fauna Survey

A preliminary survey was carried out for more than **3 weeks** to sample the fauna composition of the project site. A total of **five (5) terrestrial fauna sampling stations** were established across representative habitat types within the site. At each station, ground-based observations were conducted using visual detection aided by binoculars and cameras. Observations targeted mammals, birds, and herpetofauna, which were observed, photographed, and recorded to provide an overview of species occurrence and relative abundance in relation to habitat conditions. Sampling methods used for fauna survey are listed below in **Table 6.23**.

Table 6.23 Fauna Survey Methods

METHOD	DETAILS
Observational Method 	A data collection method in which a person (usually trained) observes subjects or phenomena and records information about characteristics of the phenomena.
Transect Method 	Established perimeter, main access trails (linear paths) and internal routes were used as a transect path. Transects were covered once a day in the morning (08.00 h to 11.00 h) and once in the evening (14.00 h to 17.30 h) each day, subject to weather and accessibility, to ensure the sampling effort was standardized and repeatable across different survey days
Mist Netting 	The sites for Mist Nets (MN) were chosen near forest fringes, water bodies, and fruiting or flowering trees. For MN, five mist nets with 9m length, 4m height and 2.5cm mesh size were used. A single MN was erected at each station. The MN placed at site locations were checked from 9.00 a.m. to 12pm. Trapped birds were released immediately and placed in cloth bags, then brought back for identification and documentation purposes. Birds that were trapped in the morning were released immediately, while birds trapped in the late afternoon were released he next day

Camera Trapping



CT is a passive sampling technique with effort to implement. Throughout, the sampling, two (2) camera traps were set up. The sites were chosen based on several criteria, namely near water bodies, near wildlife trails, and far from human settlements. After the survey areas were identified, the camera was tied to trees, with the height from the ground ranging from 0.5 to 1.0 m. The proper height of the camera is crucial for the camera to capture clear images of the animals. To attract animals to come near the camera, baits were used. Baits were placed near the cameras and for a minimum of one (1) month.

Interview



Some staff who were in charge of maintaining the site were approached and invited for an interview. A list of animal species was provided by respondents, which included large mammals, birds, and reptiles that they had previously observed. The sighting locations and the observed animal species were then identified.

Source: Flora & Fauna Assessment for Crag Hotel, 2025

Most of the fauna assessment was made through ground assessment. Some patches of the project site were not assessed due to inaccessible tracks and unsuitable terrestrial fauna habitat, such as highly disturbed terrain or areas with steep slopes.

The assessment methods were designed based on 2 approaches:

- **Direct Evidence:** Primary sighting of the fauna species at the observation point
- **Indirect Evidence:** Secondary evidence which indicates the existence of fauna species at the observation point through finding and interview

6.3.1.6 Results and Findings

6.3.1.6.1 Ecological Assessment

Defined by its location within the protected Hill Dipterocarp Forest on Penang Hill, the Crag Hotel site is characterized by specific environmental factors: a cool, wet climate and the presence of a highly degraded, abandoned colonial structure. These conditions create a specialized substrate for ecological succession and localized microhabitats.

This structural decay yields two critical microenvironments: perpetually shaded recesses that support specialized flora (like fungi and parasitic plants), and ephemeral pools in the ruins. These pools are essential predator-free aquatic sites that maximize the reproductive success of local amphibians and harbor unique invertebrates, underscoring the site's importance as a treasury of localized biodiversity.

6.3.1.6.2 Flora

The primary forest type covering Penang Hill is the Hill Dipterocarp Forest. At greater heights, the canopy diversifies to include submontane oak-laurel and coniferous trees, alongside large tree ferns, which are indicators of the cooler, higher-altitude environment.

The conservation value of Penang Hill's flora is underscored by the presence of several rare and endangered species. These include the specialized parasitic plant, *Exorhopalia ruficeps*, which thrives in the perpetually shady and damp undergrowth. The iconic Penang Slipper Orchid (*Paphiopedilum barbatum*) faces a severe threat due to intensive over-collection, leading to its rapid decline. However, local conservation efforts have seen success, particularly with the endangered witch hazel, *Maingaya malayana*, which was rediscovered and has since been actively propagated. During the survey, these species were not found within the project site.

i. Conservation Value and Summary

No flora species of high conservation importance—either listed under the IUCN Red List (2023), CITES Appendices, or the Malaysia Plant Red List (FRIM, 2010)—were recorded during the survey. Consequently, the existing vegetation assemblage at the project site is of low conservation significance, representing a heavily modified plantation habitat with limited ecological value.

Results of floristic composition for the study area are divided into five categories in terms of habit of the plants which are **trees, climbers, fern-allies, herbaceous, rattans and palm**.

The majority of the flora inventory reflects a heterogeneous habitat composition, with **24 out of 34 species categorized as Least Concern (LC)** or comprising common cultivated and ornamental varieties such as *Artocarpus integer*, *Durio zibethinus*, and *Myristica fragrans* Houtt., suggesting a blend of native forest and areas subject to prior disturbance or cultivation. Furthermore, the classification of several species as Data Deficient (DD) or Not Evaluated

(NE) underscores existing limitations in scientific knowledge regarding the full extinction risk and ecological presence of certain plant taxa on the site.

Table 6.24 shows the number of species of each family identified during site survey.

Table 6.24 Number of Species Identified

No of Species	Family
1	Annonaceae, Apocynaceae, Arecaceae, Aspleniaceae, Asteraceae, Bignoniaceae, Chloranthaceae, Cupressaceae, Cyatheaceae, Dipterocarpaceae, Gentianaceae, Hypericaceae, Malvaceae, Meliaceae, Myristicaceae, Sapindaceae, Thymelaeaceae, Zingiberaceae
2	Euphorbiaceae, Gleicheniaceae, Melastomataceae, Myrtaceae
4	Fabaceae, Moraceae

Source: Flora & Fauna Assessment for Crag Hotel, 2025

Table 6.25 shows the list of all recorded flora species while **Figure 6.43** shows details of some of the recorded species. Based on the IUCN status of the listed species, only **one (1) species**, *Hopea odorata* is recorded as **Vulnerable (VU)**. Other species are found to fall under the categories of Least Concern (LE) and Not Evaluated (NE). Furthermore, the tree inventory plan done as part of this assessment can be referred to in the full report attached in **Softcopy Attachments**.

Table 6.25 Total Flora Species Composition of Proposed Project Site

NO	FAMILY	SPECIES	LOCAL NAME	GROWTH FORM	CONSERVATION STATUS		SAMPLING SITES	
					MALAYSIAN RED LIST	IUCN	TRACK	RIPARIAN
1	Annonaceae	<i>Annona mucosa Jacq.</i>	Nona	Tree	NT	NE	✓	
2	Apocynaceae	<i>Alstonia macrophylla</i>	Pokok Pulau Bukit	Tree	NT	LC	✓	
3	Arecaceae	<i>Caryota mittis</i>	Common Fish Tail	Palm	NT	LC	✓	
4	Aspleniaceae	<i>Asplenium nidus</i>	Bird's nest fern	Fern	NT	LC	✓	
5	Asteraceae	<i>Chromolaena odorata</i>	Pokok	Shrub	NT	NE	✓	
6	Bignoniaceae	<i>Spathodea campanulata</i>	African Tulip	Tree	NT	LC	✓	
7	Chloranthaceae	<i>Glabrous Sarcandra Herb</i>	Pecah Periuk	Herb	NT	LC	✓	
8	Cupressaceae	<i>Juniperus chinensis</i>	Chinese juniper	Tree	NA	LC	✓	
9	Cyatheaceae	<i>Dicksonia lanata Colenso</i>	Stumpy tree fern	Tree-fern	NT	NE	✓	
10	Dipterocarpaceae	<i>Hopea odorata Roxb.</i>	Merawan Siput Jantan	Tree	VU	VU	✓	
11	Euphorbiaceae	<i>Macaranga spp</i>	Pokok Mahang	Tree	NT	LC	✓	
12	Euphorbiaceae	<i>Codiaeum variegatum (L.) Rumph. ex A.Juss.</i>	Adal-adal	Shrub	NT	LC	✓	
13	Fabaceae	<i>Koompassia excelsa (Becc.) Taub.</i>	Pokok Tualang	Tree	NT	LC	✓	
14	Fabaceae	<i>Acacia mangium</i>	Akasia Daun Lebar	Tree	NT	LC	✓	
15	Fabaceae	<i>Senna multijuga (Rich.) H.S.Irwin & Barneby</i>	November shower	Tree	NT	LC	✓	
16	Fabaceae	<i>Mimosa pudica</i>	Semalu	Herb	NT	LC	✓	

17	Gentianaceae	<i>Fagrea fragrans</i>	Pokok Tembusu	Tree	NT	LC	✓	
18	Gleicheniaceae	<i>Sticherus brackenridgei</i> (E.Fourn.) <i>H.St.John</i>	Forking fern	Tree	NT	NE	✓	
19	Gleicheniaceae	<i>Dicranopteris linearis</i>	False Staghorn Fern	Fern	NT	LC	✓	
20	Hypericaceae	<i>Cratoxylum formosum</i>	Pokok Kayu Arang	Tree	NT	LC	✓	
21	Malvaceae	<i>Durio zibethinus</i>	Pokok Durian	Tree	NT	DD	✓	
22	Melastomataceae	<i>Melastoma malabathricum</i>	Senduduk	Shrub	NT	LC	✓	
23	Melastomataceae	<i>Pleroma semidecandrum</i>	Glory Bush	Shrub	NT	NE	✓	
24	Meliaceae	<i>Azadirachta indica</i>	Pokok Semambu	Tree	NT	LC	✓	
25	Moraceae	<i>Artocarpus integer</i>	Pokok Cempedak	Tree	NT	NE	✓	
26	Moraceae	<i>Ficus benjamina</i>	Pokok Banyan	Tree	NT	LC	✓	
27	Moraceae	<i>Artocarpus elasticus</i>	Pokok Terap Nasi	Tree	NT	LC	✓	
28	Moraceae	<i>Ficus variegata</i>	Pokok Ara	Tree	NT	LC	✓	
29	Myristicaceae	<i>Myristica fragrans</i> Houtt.	Nutmeg	Tree	NT	DD	✓	
30	Myrtaceae	<i>Sapium baccatum</i>	Pokok Ludai	Tree	NT	DD	✓	
31	Myrtaceae	<i>Syzygium myrtifolium</i>	Kelat Paya	Tree	NT	LC	✓	
32	Sapindaceae	<i>Nephelium lappaceum</i>	Pokok Rambutan	Tree	NT	LC	✓	
33	Thymelaeaceae	<i>Aquilaria malaccensis</i>	Pokok Karas	Tree	VU	VU	✓	
34	Zingiberaceae	<i>Shorea robusta</i>	Pokok Sal	Tree	NT	NE	✓	

Source: Flora & Fauna Assessment for Crag Hotel, 2025

			
Family : Asteraceae Genus species : Bidens alba (L.) DC.	Family : Onagraceae Genus species : Ludwigia leptocarpa	Family : Fabaceae Genus species :Senna multijuga (Rich.) H.S.Irwin & Barneby	Family : Bignoniaceae Genus species : Spathodea campanulata
			
Family : Myristicaceae Genus species : Myristica fragrans Houtt.	Family : Poaceae Genus species : Axonopus compressus	Family : Nyctaginaceae Genus species : Mirabilis jalapa L.	Family : Myristicaceae Genus species: Knema attenuata
	Family : Annonaceae Genus species : Annona mucosa Jacq		Family : Annonaceae Genus species : Annona reticulata L

Figure 6.43 Some Flora Species Observed at Site

Source: Flora & Fauna Assessment for Crag Hotel, 2025

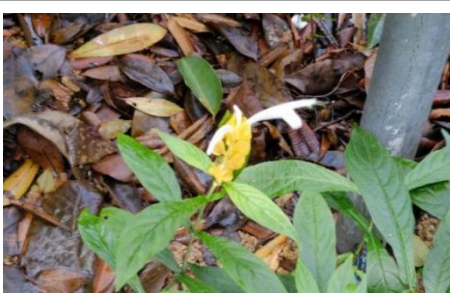
			
Family : Epipremnum Genus species : Epipremnum giganteum (Roxb.) Schott	Family : Bignoniaceae Genus species : Spathodea campanulata	Family : Acanthaceae Genus species : Pachystachys lutea Nees	Family : Lycopodiaceae Genus species : Lycopodiella cernua (L.) Pic.Serm
			
Family : Asparagaceae Genus species : Dracaena angustifolia (Medik.) Roxb	Family : Pandanaceae Genus species : Pandanus namakiensis Martelli.	Family : Fabaceae Genus species : Mimosa pudica L.	Family : Fabaceae Genus species : Acacia auriculiformis

Figure 6.43 Some Flora Species Observed at Site (cont)

Source: Flora & Fauna Assessment for Crag Hotel, 2025

6.3.1.6.3 Fauna

A total of 37 species of mammals and reptiles, belonging to 18 families, were recorded and expected to be observed within the study area based on direct and indirect evidence. Several mammals were anticipated to be identified within the study area through footprint tracking, analysis of animal faeces, and interviews with nearby local residents.

i. Terrestrial Fauna (Mammals, Reptiles & Amphibians)

A list of mammals, reptiles, and amphibians observed or likely to occur within the project site is presented in **Table 6.26**. Some of the animals found are pictured in **Figure 6.44**.

Table 6.26 List of Mammals, Reptiles and Hepterofauna Species Observed in Study Area

No	Family	Scientific Name	Local Name	Observation Method	Wildlife Act 2010	IUCN Status
1	Agamidae	<i>Leiolepis belliana</i>	Common Butterfly Lizard*	O	NA	LC
2	Cercopithecidae	<i>Macaca fascicularis</i>	Long-tailed macaque (Kera)	O	P	EN
3		<i>Macaca nemestrina</i>	Pig-tailed macaque	S	NA	VU
4		<i>Trachypithecus obscurus</i>	Dusky leaf monkey	O/S	P	EN
5	Cynocephalidae	<i>Galeopterus variegatus</i>	Sunda colugo	S	TP	LC
6	Elapidae	<i>Naja sumatrana</i>	Ular Senduk Sembur	S	P	LC
7	Felidae	<i>Felis catus</i>	Domestic cat	S	NA	LC
8	Gekkonidae	<i>Hemidactylus platyurus</i>	Flat-tailed House Gecko	S	NA	LC
9		<i>Hemidactylus craspedotus</i>	Friiled Gecko	S	NA	LC
10		<i>Gekko monarchus</i>	Spotted House Gecko	O	NA	LC
11	Lorisidae	<i>Nycticebus coucang</i>	Kongkang	O/S	TP	EN
12	Manidae	<i>Manis javanica</i>	Sunda Pangolin	S	TP	CR
13	Microhylidae	<i>Chaperina fusca</i>	Brown thorny frog	S	NA	LC
14		<i>Kalophrynus heterochirus</i>	Variable sticky frog	S	NA	LC
15	Muridae	<i>Niviventer bukit</i>	White-bellied Rat	S	NA	LC
16		<i>Niviventer fulvescens</i>	Chestnut White-Bellied Rat	S	NA	LC
17		<i>Rattus argentiventer</i>	Rice field rat (Tikus sawah)	S	NA	LC
18		<i>Rattus diardi</i>	Malaysian House Rat (Tikus rumah)	S	NA	LC
19		<i>Rattus tiomanicus</i>	Tikus belukar	O/S	NA	LC
20		<i>Sundamys muelleri</i>	Muller's Giant Rat (Tikus ayer)	S	NA	LC
21	Ophiophagus	<i>Ophiophagus hannah</i>	King Cobra	S	NA	VU
22	Pythonidae	<i>Python reticulus</i>	Ular Sawa	S	NA	LC
23	Pteropodidae	<i>Cynopterus brachyotis</i>	Lesser dog-faced fruit bat / Lesser Short-nosed Fruit Bat	S	NA	LC
24		<i>Cynopterus horsfieldii</i>	Horsfield's fruit bat	S	NA	LC

25		<i>Penthetor lucasi</i>	Lucas's short-nosed fruit bat	S	NA	LC
26	Ranidae	<i>Hylarana erythraea</i>	Common green frog	S	NA	LC
27		<i>Hylarana nicobariensis</i>	Cricket frog	S	NA	LC
28	Rhacophoridae	<i>Nyctixalus pictus</i>	Cinnamon frog	S	NA	NT
29		<i>Polypedates leucomystax</i>	Four lined tree frogs	S	NA	LC
30		<i>Polypedates macrotis</i>	Katak Pokok Telinga	S	NA	LC
31	Scandentia	<i>Tupaia glis</i>	Common shrew	S	P	LC
32	Scincidae	<i>Tytthoscincus temmincki</i>	Big Tree Skink	S	P	LC
33	Sciuridae	<i>Callosciurus notatus</i>	Tupai kampung	S	NA	LC
34		<i>Lariscus insignis</i>	Three striped ground squirrel	S	P	LC
35		<i>Petaurista petaurista</i>	Red Giant Flying Squirrel	S	P	LC
36		<i>Ratufa bicolor</i>	Black Giant Squirrel	S	TP	NT
37	Suidae	<i>Sus scrofa</i>	Wild boar (Babi hutan)	S	NA	LC

Source: Flora & Fauna Assessment for Crag Hotel, 2025

Note:

- ** : Direct evidence
- * : Indirect evidence
- MN : Mist Netting
- CT : Camera Trapping
- O : Observe
- V : Voice
- S : Secondary sources
- TP : Total protected
- P : Protected
- EN : Endangered
- VU : Vulnerable
- CR : Critically Endangered
- NT : Near Threatened
- LC : Least Concern
- NA : Not Available



Figure 6.44 Some Terrestrial Fauna Observed at Project Site
 Source: Flora & Fauna Assessment for Crag Hotel, 2025



Figure 6.44 Pictures of Terrestrial Fauna found at Project Site (cont)

Source: Flora & Fauna Assessment for Crag Hotel, 2025

ii. Avifauna

The survey documented a total of 50 avian species across 13 family at the Project Site indicating a diverse bird community influenced by both the natural forest ecosystem and within human settlement.

The site exhibits high conservation value where avifauna inventory confirms the high conservation value of the site by documenting species holding various levels of protection under Malaysian law, alongside a globally Near Threatened species.

List of bird species found and expected to be found in the Project Area is described in **Table 6.27** and **Figure 6.45**.

Table 6.29 List of Avifauna species observed on site

No	Family	Scientific Name	Local Name	Protection / Conservation Status	
				Wildlife Act 2010	IUCN Status
1	Accipitridae	Buteoninae	Buteonine Hawks	P	LC
2		Ichthyophaga leucogaster	White-bellied Sea-Eagle	TP	LC
3	Aegithinidae	Aegithina tiphia	Common Iora	P	LC
4	Apodidae	Aerodramus	Dark Swiftlets	P	LC
5		Apus nipalensis	House Swift	P	LC
6		Apus pacificus	Pacific Swift	P	LC
7		Hirundapus giganteus	Malaysian Hawk-Cuckoo	P	LC
8	Ardeidae	Butorides atricapilla	Little Heron	P	LC
9	Chloropseidae	Chloropsis moluccensis	Blue-winged Leafbird	TP	LC
10	Columbidae	Chalcophaps indica	Asian Emerald Dove	P	LC
11		Columba livia domestica	Feral Pigeon	NP	LC
12	Coraciidae	Eurystomus orientalis	Dollarbird	P	LC
13	Corvidae	Corvus macrorhynchos	Large-billed Crow	NP	LC
14		Corvus splendens	House Crow	NP	LC
15	Cuculidae	Cacomantis merulinus	Plaintive Cuckoo	P	LC
16		Cacomantis sepulcralis	Sunda brush cuckoo	P	LC
17		Cacomantis sonneratii	Banded Bay Cuckoo	P	LC
18		Cuculinae	Typical Cuckoos	P	LC
19		Cuculus micropterus	Indian Cuckoo	P	LC

20	Dicaeidae	Dicaeum cruentatum	Scarlet-backed Flowerpecker	P	LC
21		Dicaeum trigonostigma	Orange-bellied Flowerpecker	P	LC
22	Dicruridae	Dicrurus paradiseus	Greater Racket-tailed Drongo	P	LC
23	Hirundinidae	Cecropis daurica	Eastern Red-rumped Swallow	P	LC
24		Hirundo javanica	Pacific Swallow	P	LC
25	Irenidae	Irena puella	Asian Fairy-bluebird	TP	LC
26	Laniidae	Lanius tigrinus	Tiger Shrike	P	LC
27	Motacilidae	Dendronanthus indicus	Forest Wagtail	P	LC
28	Muscicapidae	Copsychus malabaricus	White-rumped Shama	TP	LC
29		Copsychus saularis	Oriental Magpie-Robin	P	LC
30		Cyanoptila	Blue-and-white Zappey's Flycatchers	P	LC
31		Cyornis	Blue Flycatchers	P	LC
32		Cyornis sumatrensis	Indochinese Blue Flycatcher	P	NT
33		Ficedula mugimaki	Mugimaki Flycatcher	P	LC
34		Ficedula zanthopygia	Yellow-rumped Flycatcher	P	LC
35		Larvivora cyane	Siberian Blue Robin	P	LC
36	Nectariniidae	Aethopyga siparaja	Crimson Sunbird	P	LC
37		Anthreptes malacensis	Brown-throated Sunbird	P	LC
38		Arachnothera chrysogenys	Yellow-eared Spiderhunter	P	LC
39		Arachnothera longirostra	Little Spiderhunter	P	LC
40		Cinnyris ornatus	Ornate Sunbird	P	LC
41		Leptocoma brasiliana	Van Hasselt's Sunbird	P	LC

42	Phasianidae	Gallus gallus domesticus	Domestic Chicken	NP	NA
43	Rallidae	Amauornis phoenicurus	White-breasted Waterhen	P	LC
44	Sturnidae	Acridotheres	Typical Mynas	P	LC
45		Acridotheres cristatellus	Crested Myna	P	LC
46		Acridotheres fuscus	Jungle Myna	P	LC
47		Acridotheres javanicus	Javan Myna	P	C
48		Acridotheres tristis	Common Myna	NP	LC
49		Aplonis panayensis	Asian Glossy Starling	NP	LC
50	Turdidae	Geokichla sibirica	Siberian Thrush	P	LC

Source: Flora & Fauna Assessment for Crag Hotel, 2025

Notes: TP = “Totally Protected”; P = “Protected” ; NA = “Not Available”; EN = “Endangered”; VU = “Vulnerable”; NT = “Near Threatened” ; LC = “Least Concern”; NE = “Not Evaluated”; R = “Resident”; M = “Migrant”



Figure 6.45 Some Avifauna Species Observed at Project Site
 Source: Flora & Fauna Assessment for Crag Hotel, 2025

iii. Aquatic biodiversity

Based on the general biodiversity of the Penang Hill area that is located within the Penang Hill Biosphere Reserve (PHBR), the aquatic diversity can be inferred from streams and existing water bodies common to the surrounding hills. Species that can be observed in the vicinity of the project site are the Penang Hill Vampire Crab, an endemic species (**Figure 6.46**).

Penang Hill Vampire Crab (*Geosesarma faustum*) can be observed at Penang Hill Biosphere Reserve in small pockets of water in bromeliads. The conservation status of primarily or wholly freshwater sesarmids like *Geosesarma*, have not been analysed following IUCN Red List guidelines, however it should be noted that this species is endemic to the area.



Figure 6.46 Penang Hill Vampire Crab

Source: "On the identities of the highland vampire crabs, *Geosesarma foxi* (Kemp, 1918) and *G. serenei* Ng, 1986, with description of a new phytotelmic species from Penang, Peninsular Malaysia (Crustacea: Decapoda: Brachyura: Sesarmidae)" by Peter Ng, 2017 (published in *Raffles Bulletin of Zoology* vol.65)

6.3.1.7 Conclusion from Flora & Fauna Assessment

- The flora around the Crag Hotel ruins on Penang Hill is shaped by ecological succession since its abandonment. While the immediate vicinity supports common pioneer species and weeds adapted to poor soil (near paths and structures), the majority of the area is rapidly reverting to secondary and hill dipterocarp forest. The dominant vegetation consists of native trees, ferns, and epiphytes, thriving due to the hill's characteristic humidity and elevation.
- The fauna survey found that 2 Endangered (EN) fauna species (Dusky leaf monkey and Sunda Slow Loris) , 1 Critically Endangered (CR) fauna species (Sunda Pangolin) found in the vicinity of the project area. For avifauna species, 1 Near Threatened species (Indochinese Blue Flycatcher) and 4 Totally Protected species are likely to inhabit or pass through the surrounding area.
- Therefore, mitigation will focus on protecting the important fauna species and facilitating their return following the completion of the project. Impact and mitigation measures are further discussed in **Chapter 7** and **Chapter 8** respectively.

6.4 HUMAN ENVIRONMENT

6.4.1 Landuse and Sensitive Receptors

The proposed development comprises a comprehensive revitalization of the site, involving both adaptive reuse and new structural footprints. The master plan involves the following components:

- Accommodation & amenities: Guest suites for accommodation and recreational facilities such as spa and swimming pool
- Operational Infrastructure for Front-of-House (FOH) and Back-of-House (BOH) operations to ensure seamless hospitality management.
- Heritage Conservation: The primary historic Crag Hotel structure will undergo restoration to preserve its architectural integrity.
- Support Utilities: Integration of an on-site Private Small Sewage Treatment System (SSTS), a dedicated guardhouse, and formalized parking provisions.

The project site is situated on the Penang Hill plateau, characterized by a **low-density, high-heritage-value** environment. It is strategically positioned approximately 15 minutes (on foot) from the Upper Station transport hub. The macro-environment is a mosaic of:

1. **Institutional & Heritage:** Restored colonial-era bungalows and gazetted landmarks.
2. **Eco-Tourism:** Nature-based attractions and biodiversity corridors.
3. **Residential & Agricultural:** Sporadic private dwellings and small-scale highland agriculture.

While RSNPP 2030 classifies the area as forested land, the development is legally permissible as it prioritizes the functional restoration of a heritage asset and is furthermore in line with the strategies listed in Penang Hill Special Area Plan 2016 (PHSAP 2016) as discussed in **Chapter 1**. The project complies with the state's strategy to revitalize highland heritage buildings through sustainable tourism, ensuring that the site's historical significance is preserved while bringing underutilized land back into productive use.

6.4.1.1 Environmental Sensitive Areas (ESAs)

According to the National Physical Plan 4 (NPP4), an Environmentally Sensitive Area (ESA) is defined as “a special area that is highly sensitive to any form of change to its ecosystem due to natural processes or activities in or around it, where its level of sensitivity is determined based on the integration of disaster risk, life support value, and heritage value”. **Figure 6.47** shows the overall locations of ESAs in Peninsular Malaysia, with the approximate location of project site highlighted. Penang Structure Plan 2030 further details the surrounding ESAs areas near the site, which is shown in **Figure 6.48**.

The site is also part of the Penang Hill Biosphere Reserve (**Figure 6.49**), which includes several protected areas such as Penang National Park, Penang Botanical Garden, six (6) forest reserves, eight (8) water catchment areas and two (2) water dams, spanning over a multitude of ecosystems consisting of both terrestrial and marine. The reserve was established in September 2021 under UNESCO’s Man & the Biosphere Programme and is one of the three such reserves in Malaysia.

The project site, located on Penang Hill, falls under the Penang Hill Special Area Plan 2016 zonation and the “Transition Zone” of the Biosphere Reserve, which contains rich biodiversity, wildlife, trekking, scenic views, and other attractions, such as the Penang Hill area itself.

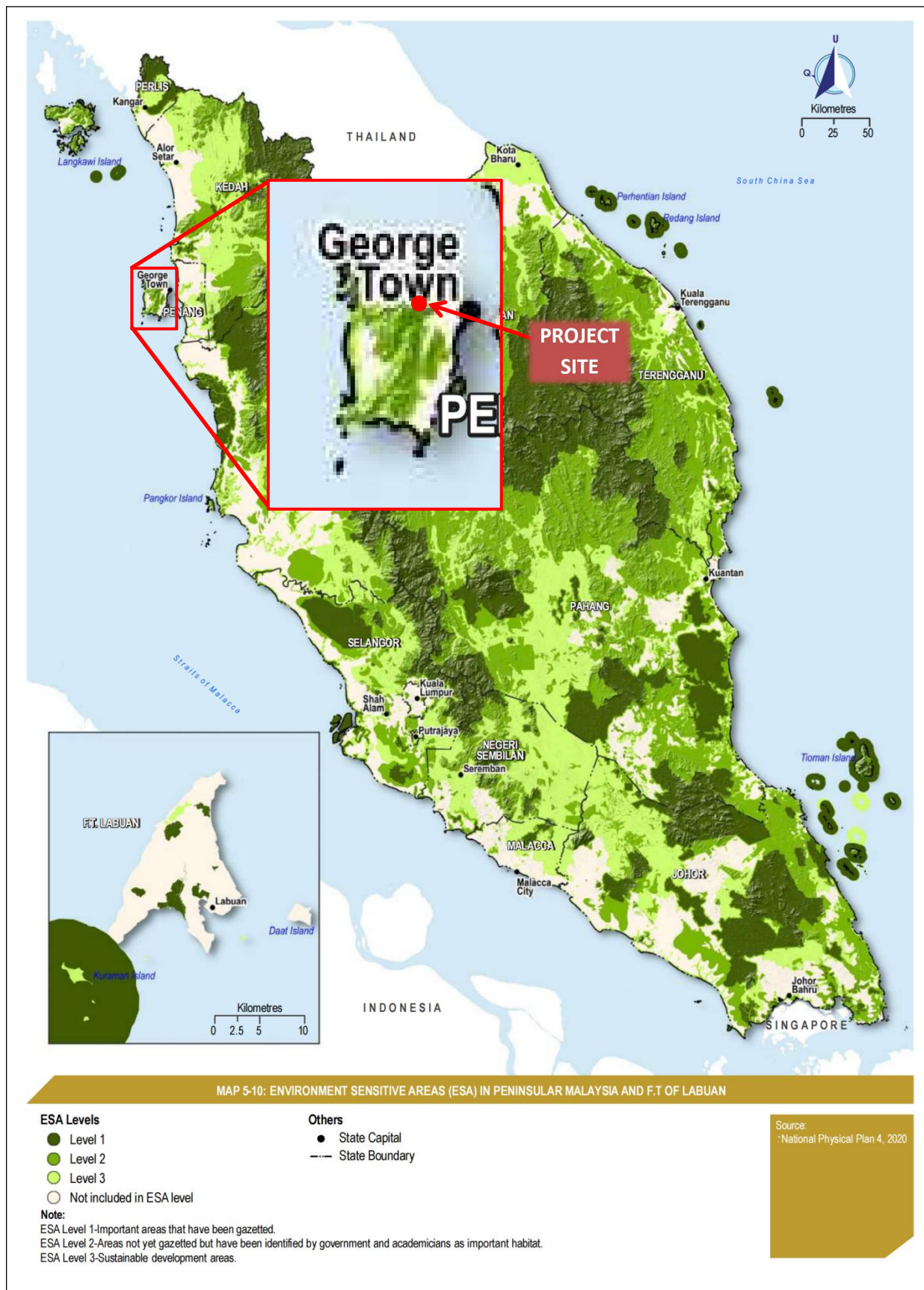


Figure 6.47 Environmentally Sensitive Areas (ESA) in Peninsular Malaysia & F.T of Labuan
 Source National Physical Plan 4 (NPP4), 2020

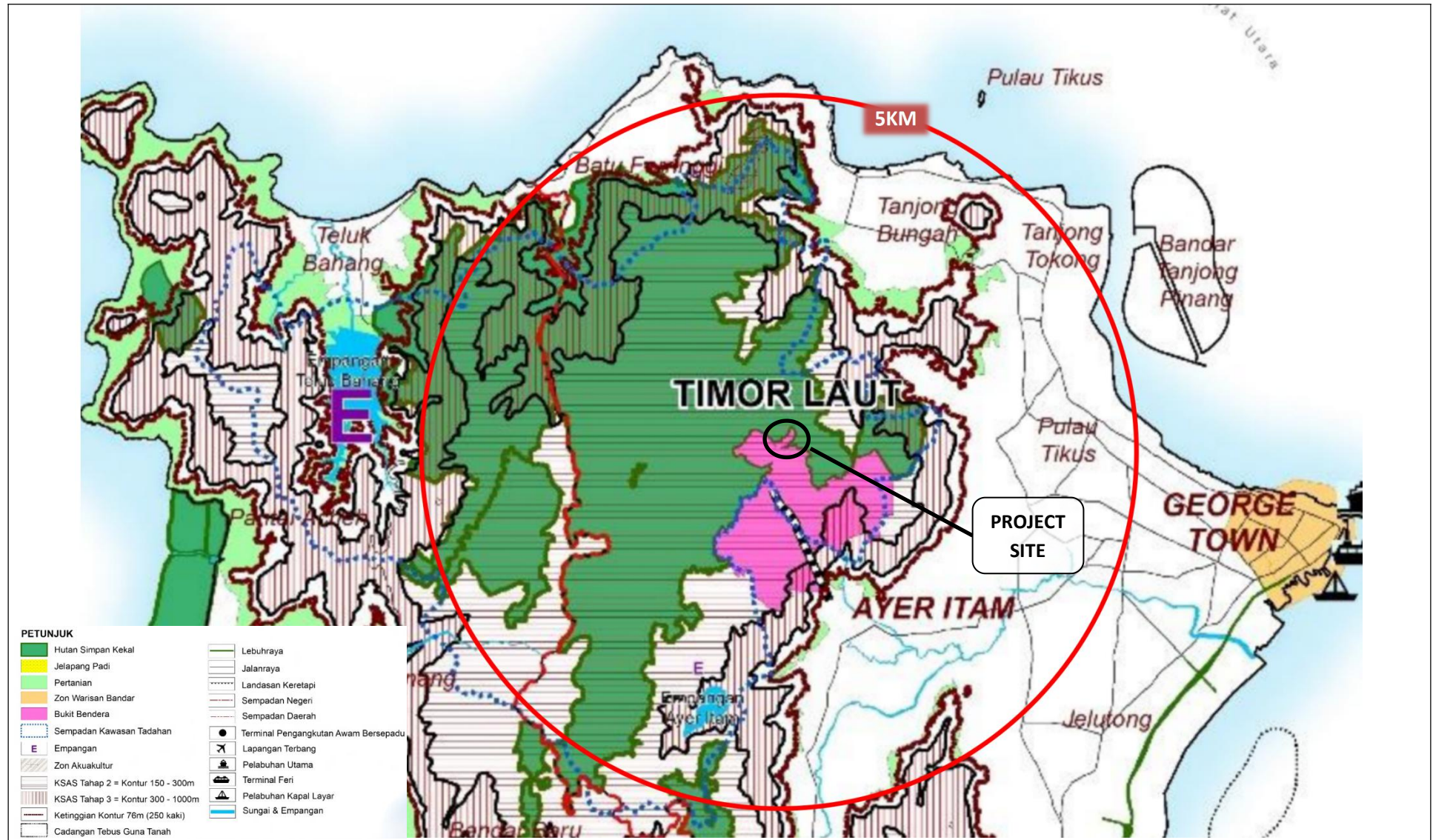


Figure 6.50 Environmentally Sensitive Areas in RSNPP 2030 within 5km radius of project site

Source: RSNPP 2030

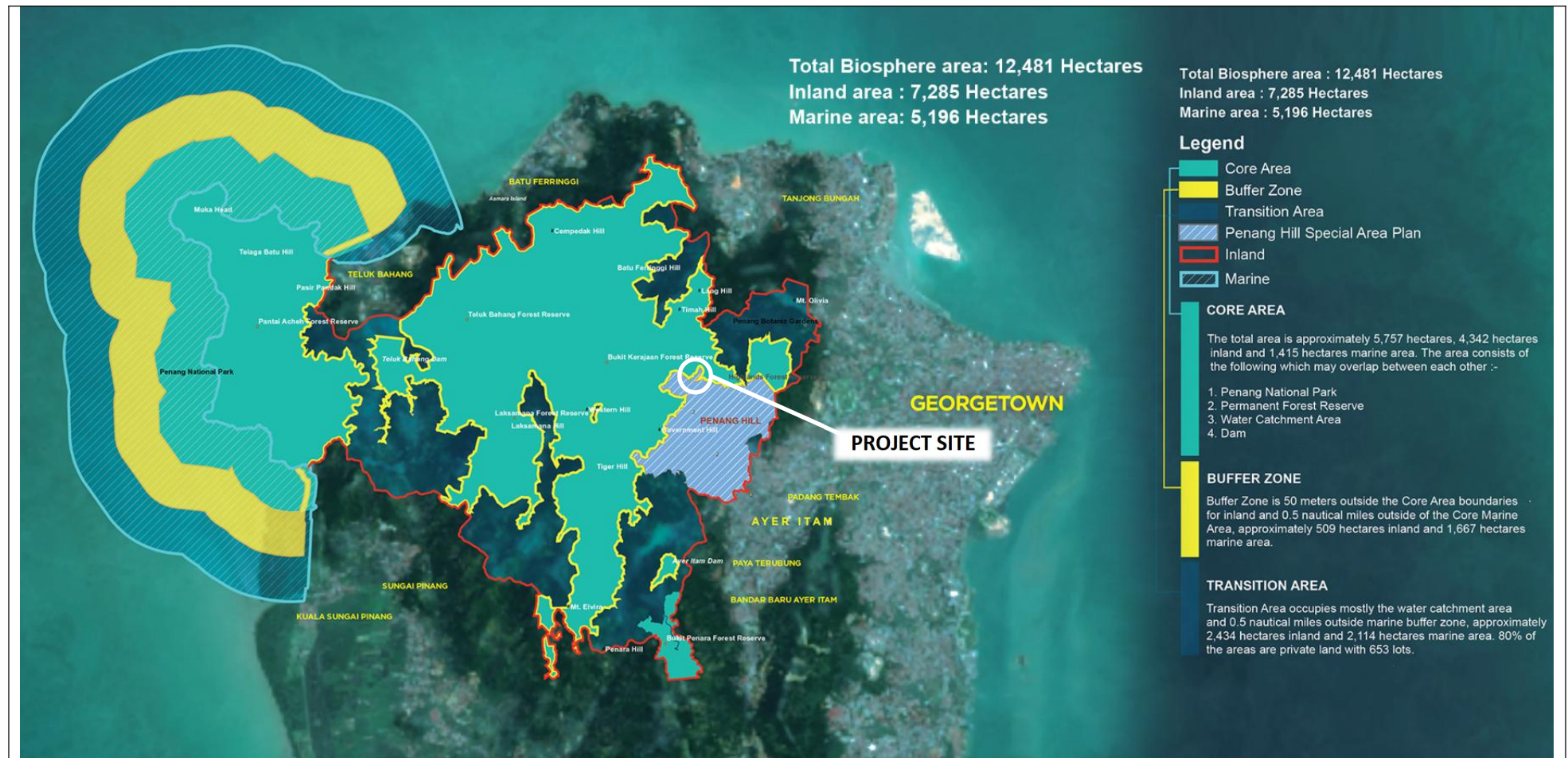


Figure 6.49 Penang Hill Biosphere Reserve
 Source: Penang Hill Biosphere Reserve website (<https://phbr.penanghill.gov.my>)

The map displays the study area, which is a coastal region in Penang, Malaysia. The area is bounded by a red line and is divided into several zones. The zones are labeled as follows:

- R1 through R15:** Residential zones, indicated by blue labels.
- H1 through H8:** Hillside zones, indicated by yellow labels.
- F1 through F5:** Forest zones, indicated by green labels.
- W1:** Water zone, indicated by a purple label.

The project site is located within the H1 zone, marked by a pink arrow. The map also shows the coastline, major roads, and surrounding towns like Batu Ferringhi and Tanjung Bagan. A scale bar indicates a distance of 5KM.

Figure 6.50 Environmentally Sensitive Areas within 5km radius of Project Site

Table 6.28 List of Environmentally Sensitive Areas (ESAs) within 5km from the Proposed Project Site

TYPE OF ESA	CODE	LOCATION	APPROXIMATE DISTANCE (km)
Permanent Forest Reserve	F1	Bukit Kerajaan Forest Reserve	0
	F2	Highlands Forest Reserve	2
	F3	Penang Botanical Garden	2
	F4	Laksamana Forest Reserve	4
	F5	Teluk Bahang Forest Reserve	4
Water Bodies	W1	Ayer Itam Dam	4
Hilly Areas	H1	Penang Hill	0
	H2	Zi Zai Hill	1.5
	H3	Cendana Hill	1.5
	H4	Western Hill	2
	H5	Tiger Hill	2.8
	H6	Laksamana Hill	4
	H7	Batu Feringghi Hill	2.5
	H8	Cempedak Hill	3
River	R1	Batu Feringghi River	3.8
	R2	Satu River	4
	R3	Emas River	4.5
	R4	Kechil River	3
	R5	Kelian River	3
	R6	Balik Batu River	4
	R7	Bagan Jermal River	3.4
	R8	Air Terjun River	0.4
	R9	Kecil River	3.5
	R10	Pinang River (Georgetown)	4.7
	R11	Ayer Itam River	3.5
	R12	Dondang River	4
	R13	Ayer Puteh River	2.5
	R14	Pinang River (Pantai Acheh)	5
	R15	Teluk Bahang River	4.6

6.4.1.2 Compatibility with Surrounding Land

The project site is located on top of Penang Hill, with the immediate land use mainly consisting of forested land and the tourist attraction area of Upper Hill Station, along with some scattered residences and agricultural lands.

The area within a five (5) kilometer radius from the boundary of the Project Site is herein defined as the Zone of Impact area. Land use data for this area has been obtained from iPlan@PLANMalaysia database, with certain boundaries refined based on findings from field surveys and desktop assessments conducted using digital mapping tools, such as Google Earth.

Based on this assessment and as reflected by **Figure 6.51** (which shows the overall land use composition for the defined zone of impact based on data extracted from the iplan website), the area predominantly consists of forested and agricultural land up to 2km, followed by residential and commercial areas 3km onwards. Half of the zone of impact consists of forested hilly areas while the rest are densely populated towns and suburbs.

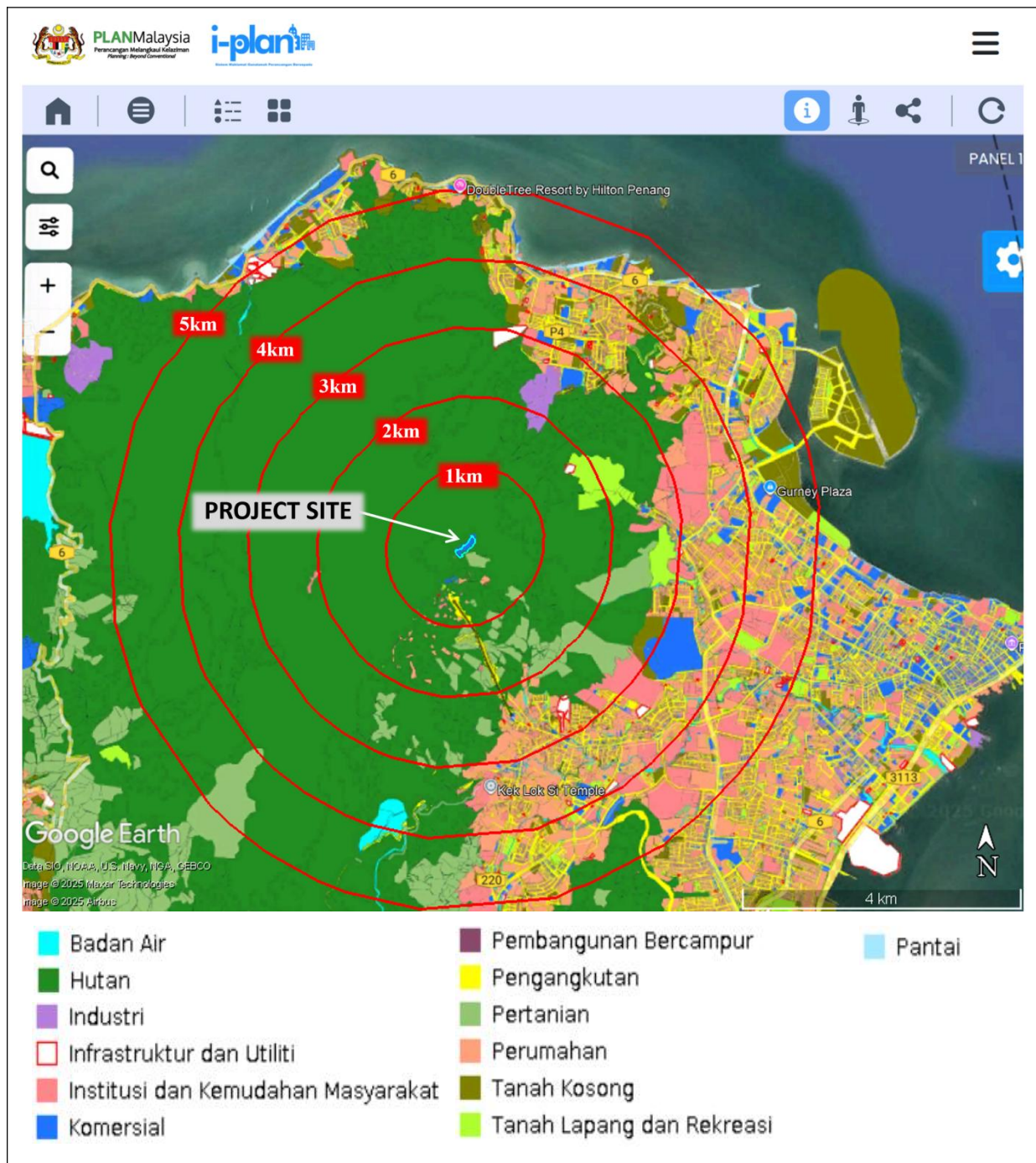


Figure 6.51 Landuse within 5km radius of Project Boundary (Project Site circled in black)

Source: iplan website, 2026

Figures 6.52-6.54 highlight the various residential and commercial areas along with major landmarks for each 1km radius up to a 5km radius from the project site.

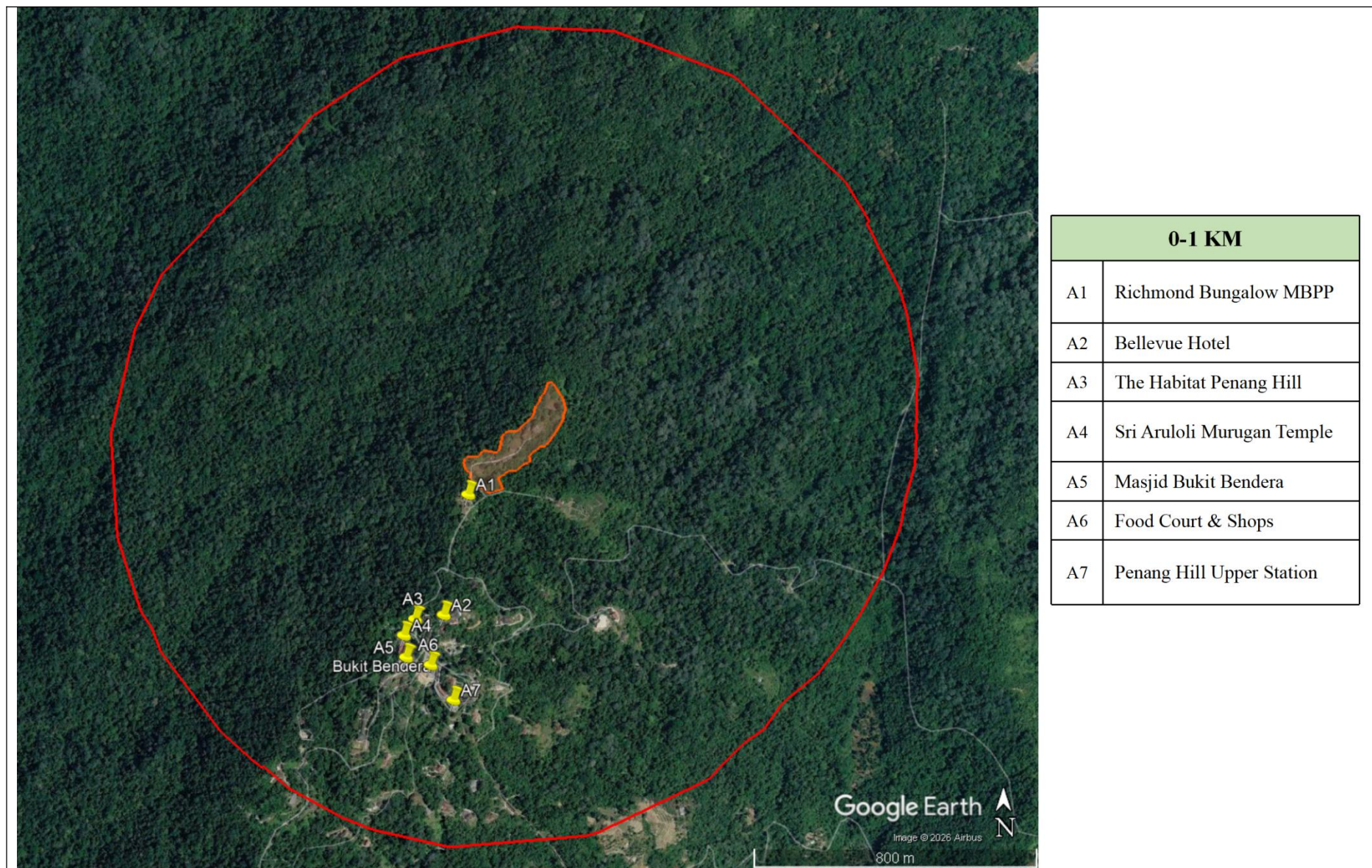


Figure 6.52 Landuse within 1km of Project Boundary

Source: Updated in Google Earth by Runding Alam Resources, 2025

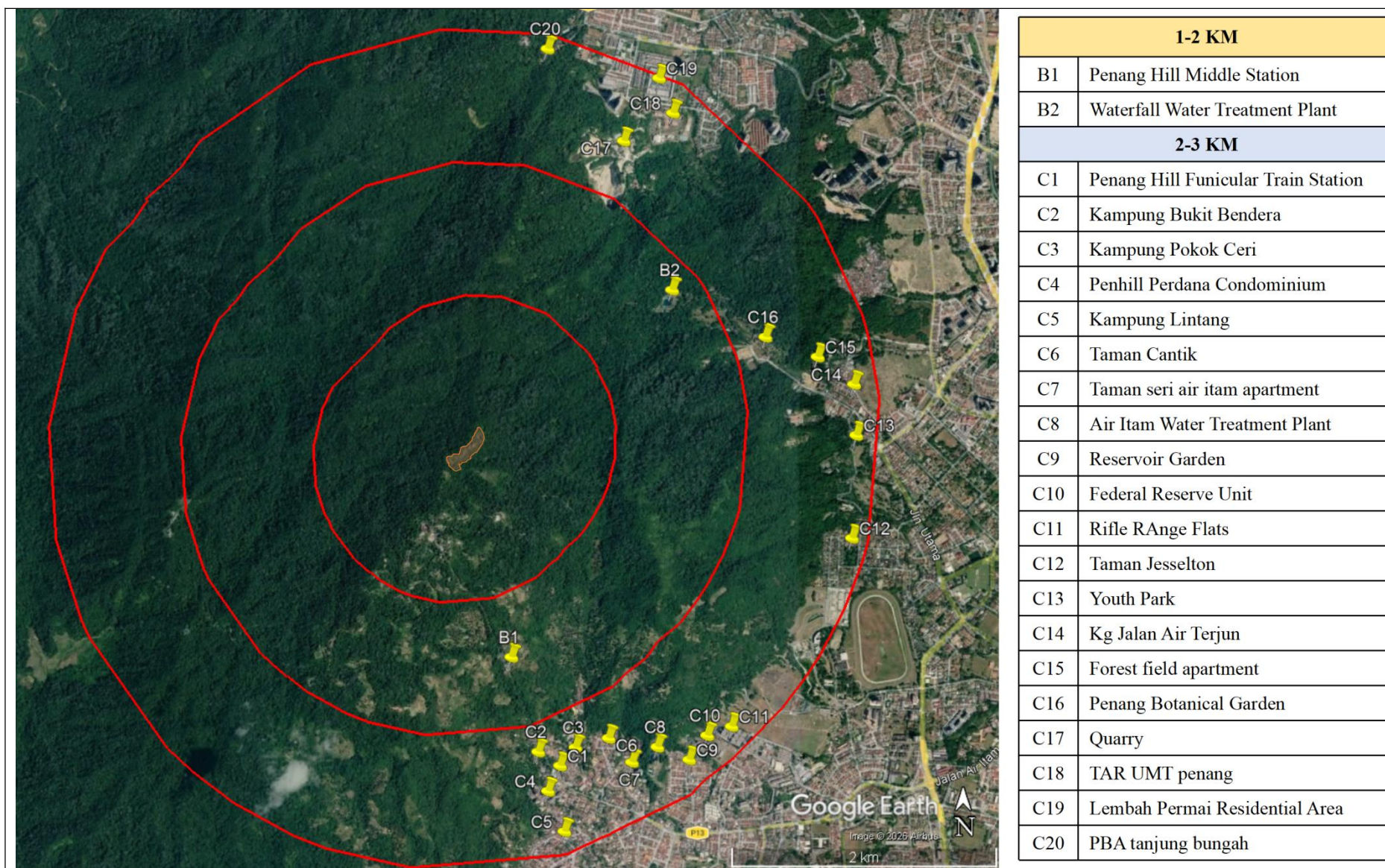


Figure 6.53 Landuse within 3 km of Project Boundary

Source: Updated in Google Earth by Runding Alam Resources, 2025

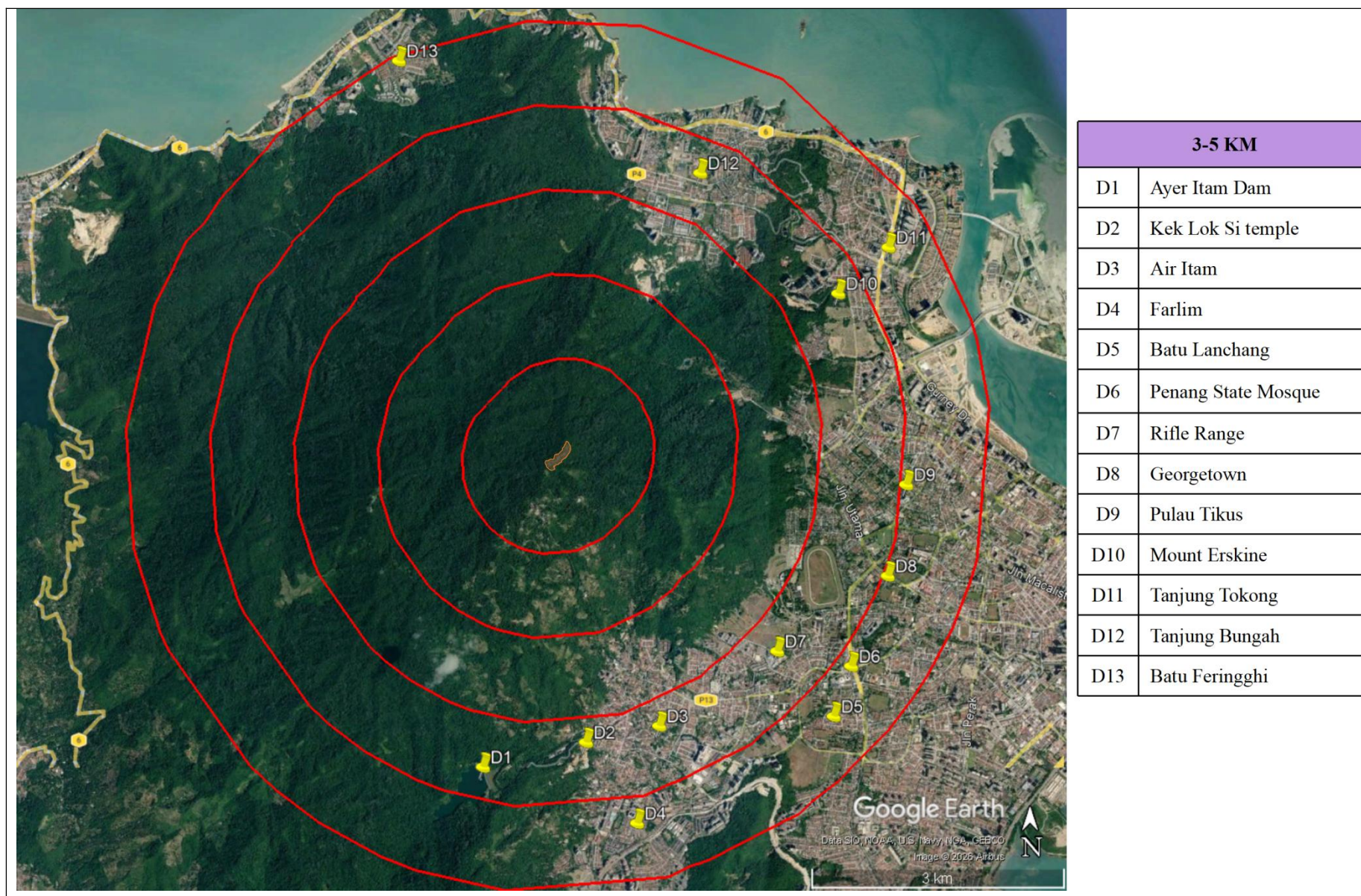


Figure 6.54 Landuse within 3-5 km of Project Boundary

Source: Updated in Google Earth by Runding Alam Resources, 2026

6.4.2 Socioeconomic Study

The socio-economic survey conducted for the proposed project at Crag Hotel focuses on the immediate surrounding areas within Penang Hill, forming an integral part of the this EIA. This assessment aims to establish a clear baseline understanding of the local socio-economic conditions, particularly among communities, workers, and businesses operating within the vicinity of the project site.

Given the unique setting of Penang Hill as an eco-tourism destination with historical and cultural value, the survey places emphasis on the interactions between tourism-driven activities and the local socio-economic environment. Key aspects assessed include demographic characteristics, sources of income, level of dependency on tourism, perception towards ongoing and proposed developments, and potential sensitivities to environmental changes.

The outcomes of this survey will support the identification of potential socio-economic impacts arising from the proposed development, enabling the formulation of targeted mitigation and enhancement measures to ensure that development within the Crag Hotel area aligns with sustainable and inclusive growth objectives.

6.4.2.1 Zone of Influence

The zone of influence for this socio-economic study extends to a radius of 3 km from the project site, as shown in **Figure 6.55**. Within this zone, a total of **362 respondents** were randomly selected and interviewed as part of a survey to gather socio-economic data. The responses were from stakeholders who will receive a direct impact from this development, such as residents, businesses, institutions, tourists, and the broader community within the zone of impact.

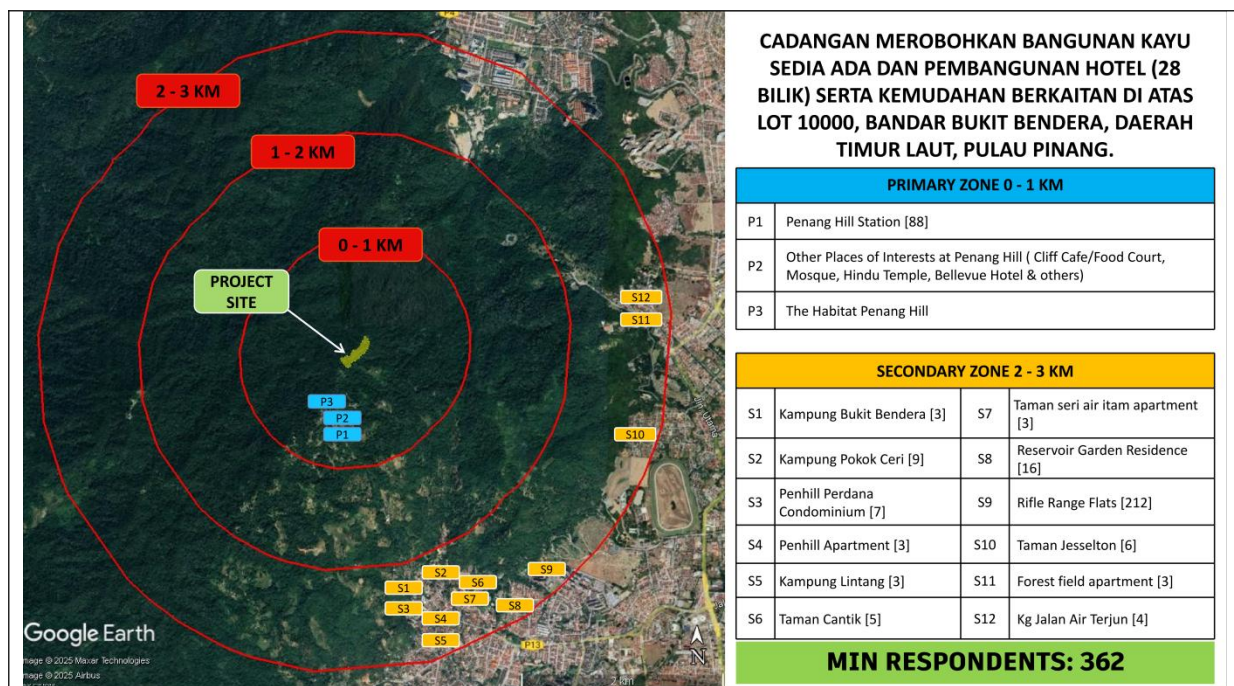


Figure 6.55 Zone of Influence (ZOI) within 3km

6.4.2.2 Methodology

The methodology used a quantitative approach, where a questionnaire was prepared according to the social impact variables and socio-economic background questions of the population within the study radius. Primary data were collected through a survey of households using physical questionnaires. Data from this questionnaire were then analyzed to assess the social impact of the proposed development (**Figure 6.56**).

The main purpose of this primary data collection was to:

1. Obtain data and detailed information on key issues in the development area;
2. Identify issues and problems related to the existing socio-economic situation of the local community;
3. Analyze the social impact before, during, and after the proposed development.

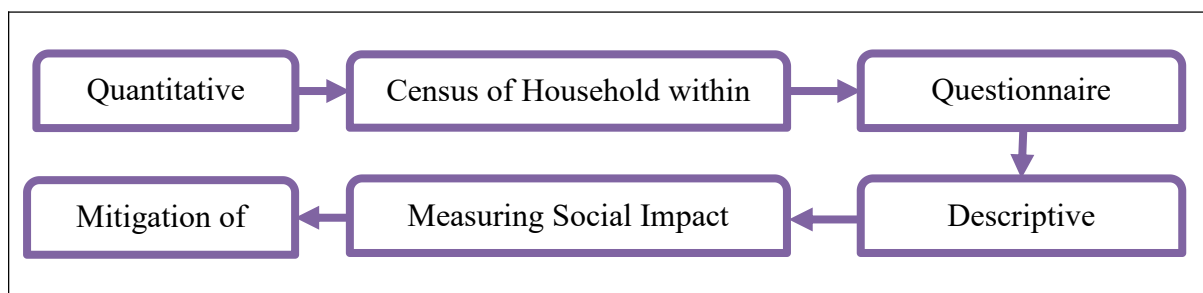


Figure 6.56 Methodology Approach

The sample size calculation for this study was done using the Rea and Parker (1997) equation (**Figure 6.57**) with a confidence level of 95%, Z_a was set at 1.96, p was assumed at 0.5, and the margin of error was set at 5%.

After that, to ensure that the sample size obtained was representative of the entire population living within a radius of 3 km from the proposed site, the total population according to house units in housing estates and existing villages was used. From the sample size calculation, it was found that the number of household sample units required for this study was **362**. This means that 362 households were included as respondents in the questionnaire conducted.

Table 6.29 lists the residential and commercial areas that were within the 3km range of Zone of Impact (ZOI) while **Figure 6.58** shows some photographs captured during the survey works.

$$n = \frac{Z_a^2 [p(1-p)] N}{Z_a^2 [p(1-p)] + (N-1) ME_p^2}$$

Dimana;-

ME_p = margin of error in term of proportions

Z_a = Z score for various level of confidence

p = the true proportions

n = the sample size

N = the population size

Sample Size Formula (Source: Rea & Parker, 1997)

Raosoft®		Sample size calculator
What margin of error can you accept? 5% is a common choice	5 %	The margin of error is the amount of error that you can tolerate. If 90% of respondents answer yes, while 10% answer no, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55. Lower margin of error requires a larger sample size.
What confidence level do you need? Typical choices are 90%, 95%, or 99%	95 %	The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer yes would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone. Higher confidence level requires a larger sample size.
What is the population size? If you don't know, use 20000	605	How many people are there to choose your random sample from? The sample size doesn't change much for populations larger than 20,000.
What is the response distribution? Leave this as 50%	50 %	For each question, what do you expect the results will be? If the sample is skewed highly one way or the other, the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under More information if this is confusing.
Your recommended sample size is	236	This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey.

Raosoft Sample Size Calculator

Figure 6.57 Sample Size Calculation

Table 6.29: Village/Housing/Industrial Areas Within the 3km ZOI

No.	Area	Housing Units/ Population Size	Sample Size
0 - 1 KM			
1.	Penang Hilltop Area (tourists)	1500	88
1-2 KM			
<i>No residential or commercial areas were identified in this zone.</i>			
2 - 3 KM			
1.	Kampung Bukit Bendera	50	3
2.	Kampung Pokok Ceri	150	9
3.	Penhill Perdana Condominium	122	7
4.	Penhill Apartment	50	3
5.	Kampung Lintang	50	3
6.	Taman Cantik	90	5
7.	Taman Seri Air Itam Apartment	45	3
8.	Reservoir Garden Residence	267	16
9.	Rifle Range Flats	3699	212
10.	Taman Jesselton	106	6
11.	Forest Field Apartment	52	3
12.	Kampung Jalan Air Terjun	70	4
TOTAL		6162	362



Figure 6.58 Photos Captured During the Questionnaire Survey

6.4.2.3 Analysis of Study Findings

i. Social Profile of Respondents

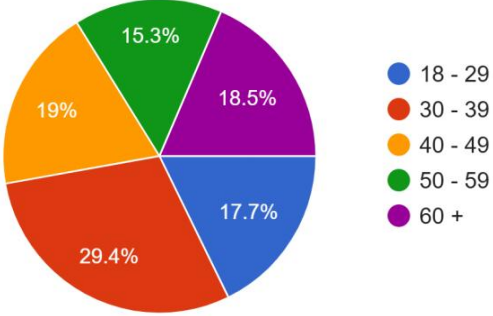
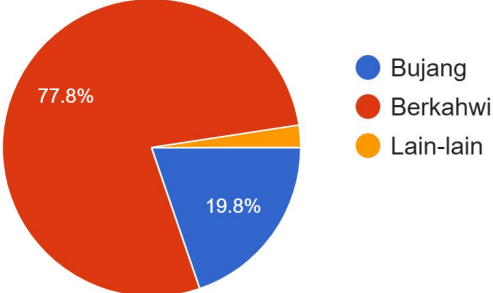
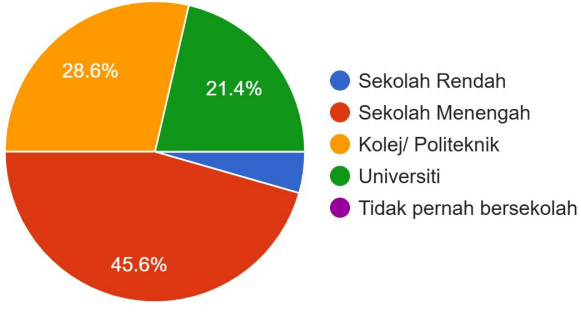
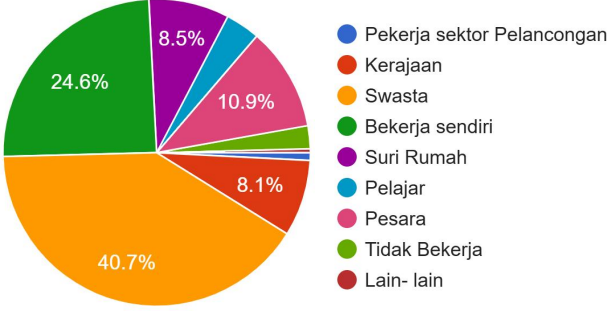
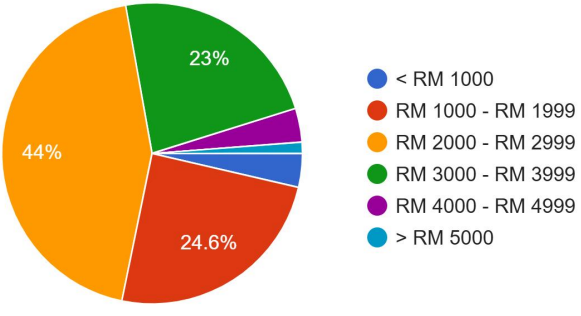
Table 6.30 shows the three categories of respondents, while the overview of the social profile of all categories of respondents is shown in **Table 6.31**.

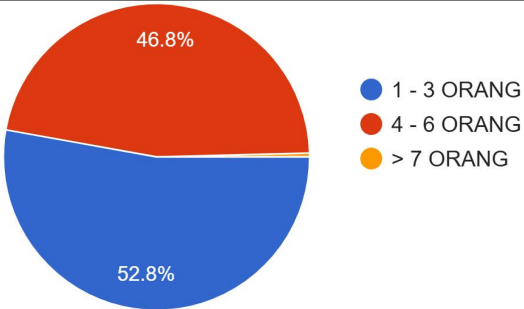
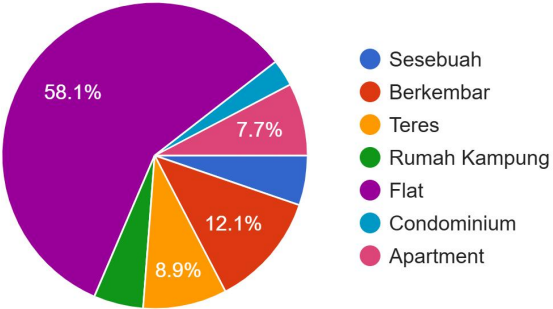
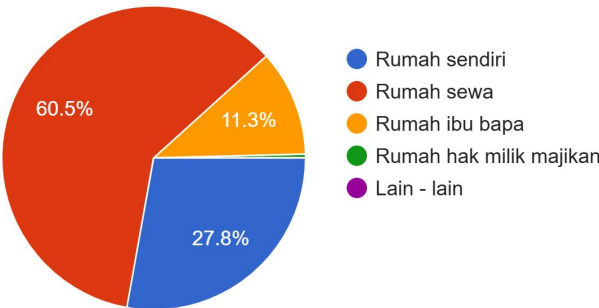
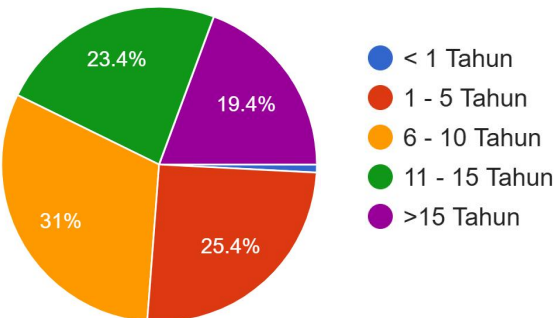
Table 6.30: Social Profiling of Respondents

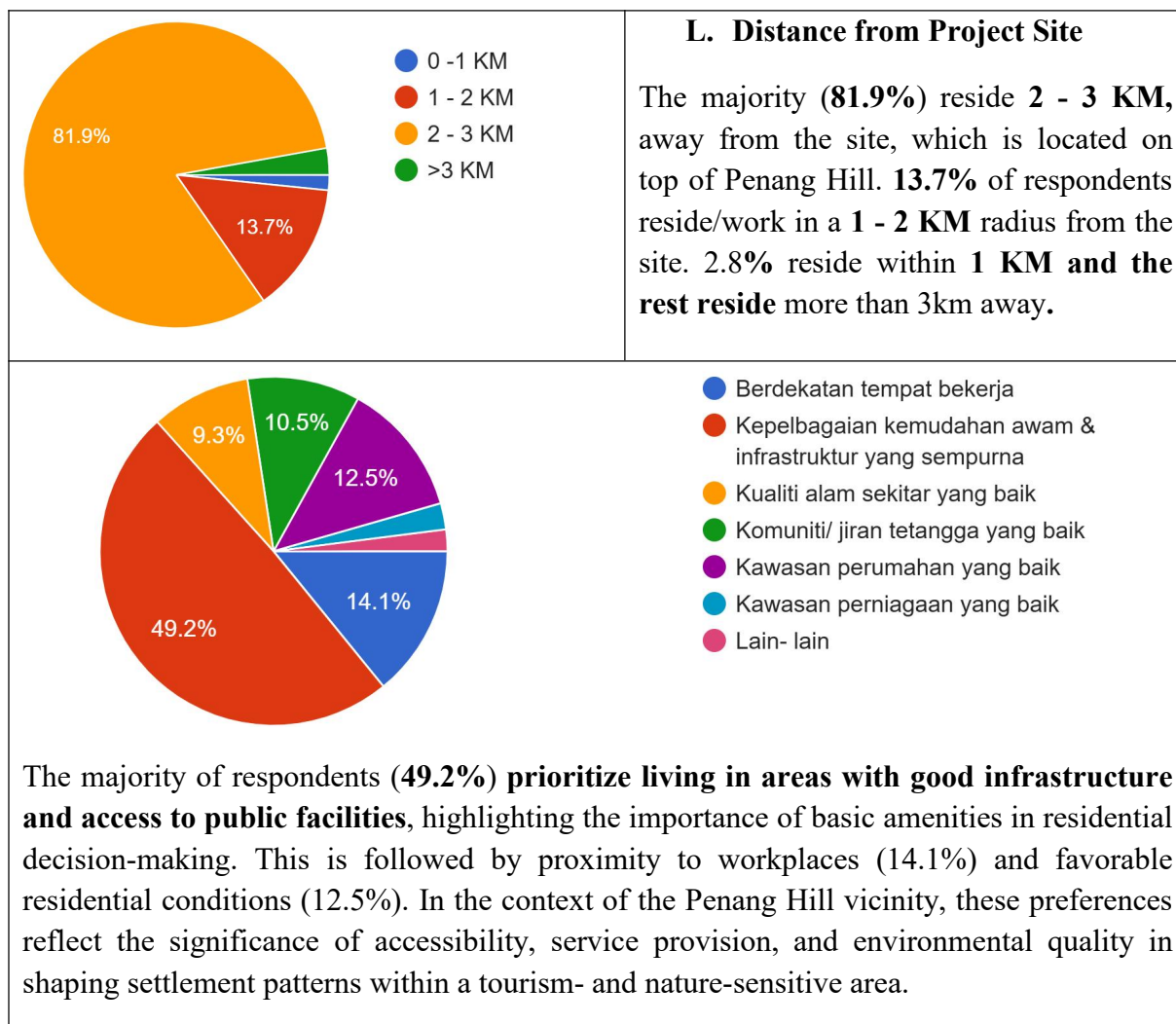
Charts and Graphs Analysis	Description
● Penduduk tempatan ● Peniaga ● Pelancong	A. Category of Respondents Out of the total 362 respondents surveyed, the majority (68.3%) are local residents, followed by 13.5% who represent commercial business owners and workers, while the remaining 18.2% are tourists visiting the Penang Hill area.

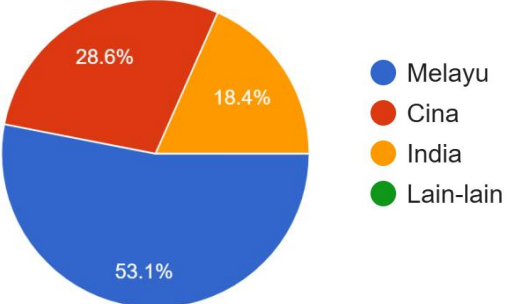
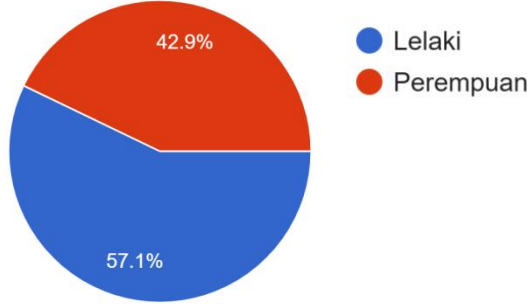
Table 6.31 Social Profiling of Respondents under all 3 categories

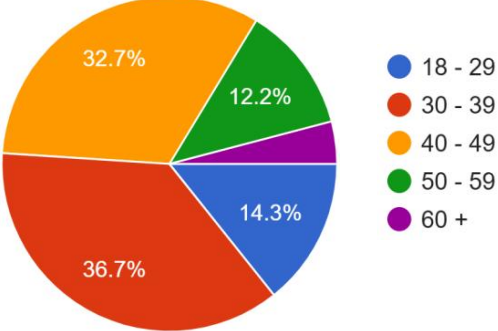
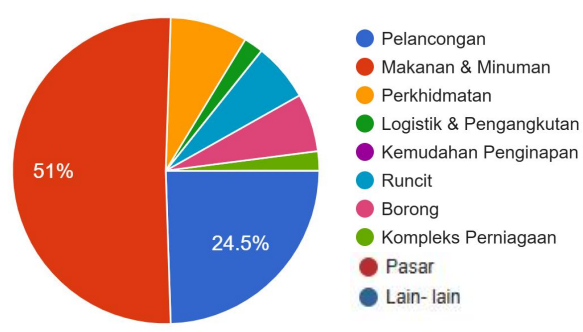
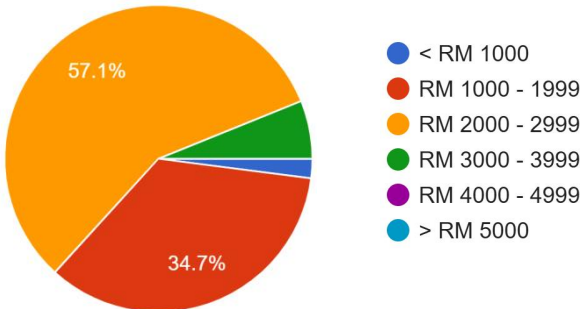
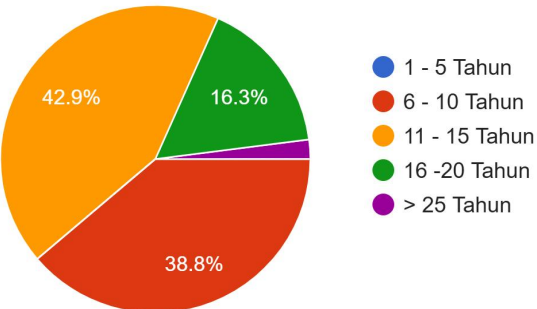
LOCAL RESIDENTS	
Charts and Graphs Analysis	Description
● Melayu ● Cina ● India ● Lain-lain	A. Race of Population The majority of the local population comprises individuals of Malay ethnicity (55.6%), followed by Chinese (32.3%) and Indian (12.1%) communities, reflecting a diverse and multicultural demographic composition within the study area.
● Lelaki ● Perempuan	B. Gender of Population Male respondents constitute the majority of the sample, accounting for 69% of the total, while female respondents represent the remaining 31%.

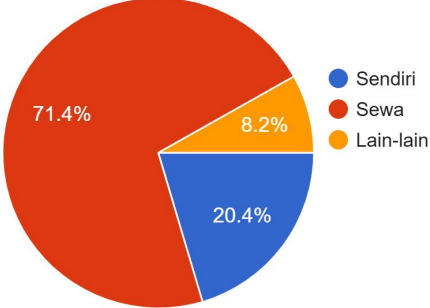
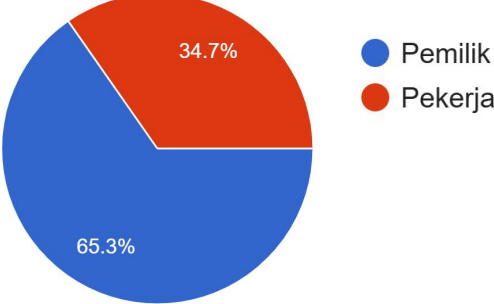
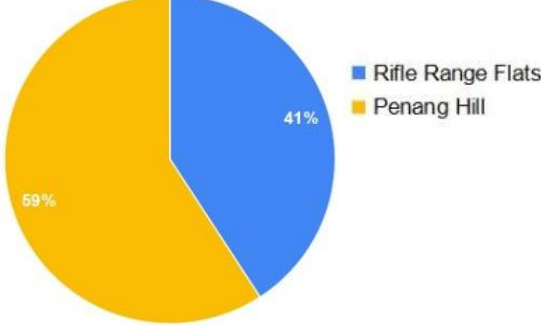
 ● 18 - 29 ● 30 - 39 ● 40 - 49 ● 50 - 59 ● 60 +	C. Age The age distribution of respondents spans from young adults to senior citizens, with the largest proportion comprising middle-aged individuals, particularly those between 30 and 39 years old (29.4%).
 ● Bujang ● Berkahwin ● Lain-lain	D. Marital Status A majority of respondents (77.8%) are married, followed by 19.8% who are single, while the remaining 2.4% fall under other marital-status categories.
 ● Sekolah Rendah ● Sekolah Menengah ● Kolej/ Politeknik ● Universiti ● Tidak pernah bersekolah	E. Education Level The majority of respondents have attained at least secondary school education (45.6%), followed by those with College/Polytechnic qualifications (28.6%) and university-level education (21.4%).
 ● Pekerja sektor Pelancongan ● Kerajaan ● Swasta ● Bekerja sendiri ● Suri Rumah ● Pelajar ● Pesara ● Tidak Bekerja ● Lain- lain	F. Occupation The majority of respondents are employed in the private sector (40.7%), followed by those who are self-employed (24.6%), while 10.9% are retired. This distribution reflects the socio-economic dynamics of the Penang Hill area, where livelihoods are largely influenced by small businesses and private sector.
 ● < RM 1000 ● RM 1000 - RM 1999 ● RM 2000 - RM 2999 ● RM 3000 - RM 3999 ● RM 4000 - RM 4999 ● > RM 5000	G. Monthly Income The majority (44%) of respondents earn between RM 2000 - RM2999, 24.6% of individuals earn between RM 1000 - RM1999 followed by 23% earning RM 3000-RM 3999.

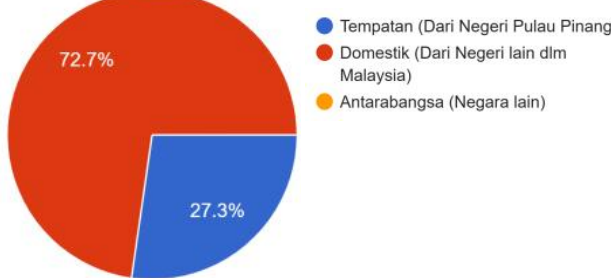
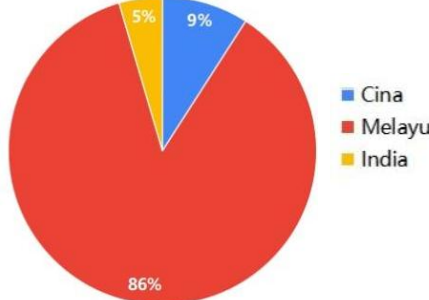
 ● 1 - 3 ORANG ● 4 - 6 ORANG ● > 7 ORANG	H. Number of Households The majority (52.8%) of households consist of 1-3 people, indicating that smaller-sized families are the most common. 46.8% of households have 4-6 people, and a very small percentage (0.4%) of households have more than 7 people.
 ● Sesebuah ● Berkembar ● Teres ● Rumah Kampung ● Flat ● Condominium ● Apartment	I. Type of Housing The majority (58.1%) of respondents live in flats. 12.1% of respondents reside in semi-detached houses, 8.9% live in terrace houses, 7.7% in apartments and the remaining live in single houses, traditional houses and condominiums.
 ● Rumah sendiri ● Rumah sewa ● Rumah ibu bapa ● Rumah hak milik majikan ● Lain - lain	J. Housing Ownership The majority (60.5%) of respondents live in rented houses. 27.8% of respondents own their houses. Another 11.3% reside in their parents' house, and the rest reside in employer-owned housing.
 ● < 1 Tahun ● 1 - 5 Tahun ● 6 - 10 Tahun ● 11 - 15 Tahun ● > 15 Tahun	K. Period of Living The largest proportion of respondents (31%) have resided in their current location for 6 to 10 years, followed by 25.4% who have lived in the area for 1 to 5 years. A further 23.4% have been residents for 11 to 15 years, while the remaining respondents have lived in the area for more than 15 years, indicating a relatively stable and established community within the Penang Hill vicinity.

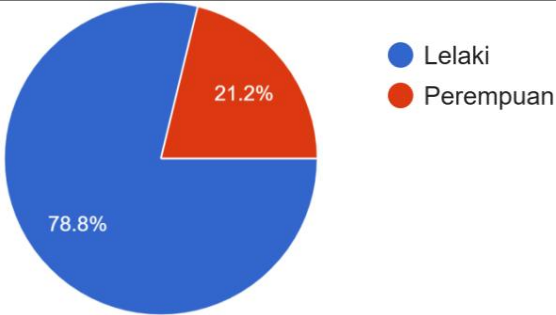
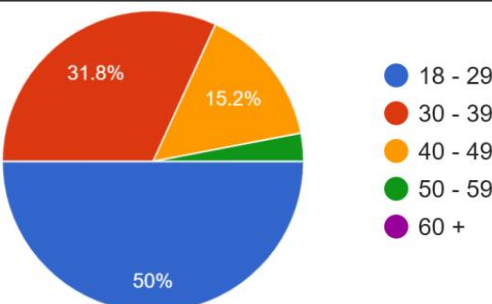
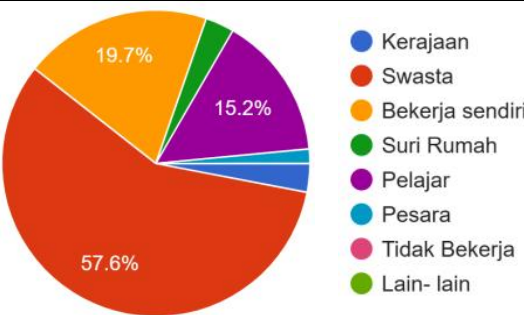
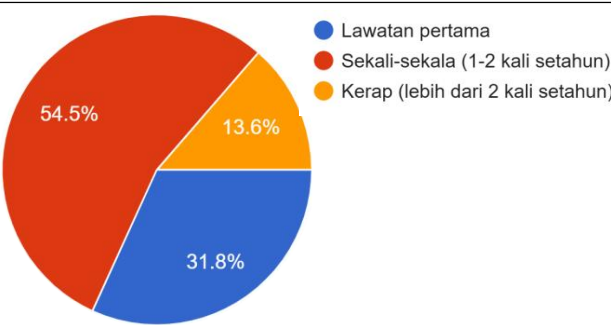
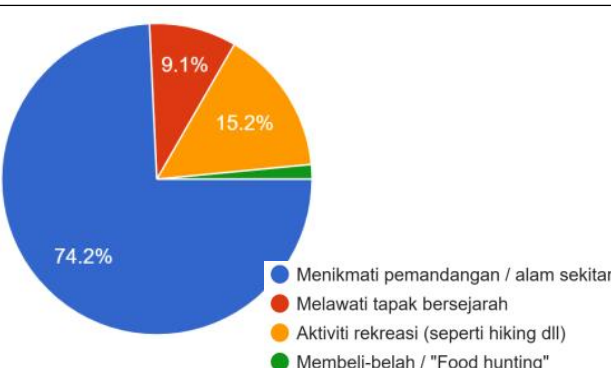


COMMERCIAL	
Charts and Graphs Analysis	Description
 ● Melayu ● Cina ● India ● Lain-lain	A. Race of Population The majority of those in commercial are Malay (53.1%), followed by Chinese (28.6%) and Indians (18.4%).
 ● Lelaki ● Perempuan	B. Gender of Population Majority of those in commercial are men (57.1 %), with the remaining 42.9 % consisting of women.

 18 - 29 30 - 39 40 - 49 50 - 59 60 +	C. Age The age of those in commercial businesses varies, with the majority being middle-aged, specifically those between the ages of 30-39 (36.7%), followed closely by those of ages of 40-49 (32.7%).
 - Sekolah Rendah - Sekolah Menengah - Kolej/ Politeknik - Universiti - Tidak pernah bersekolah	D. Education Level Secondary School level education has the highest percentage (75.5%), indicating that most individuals completed secondary education followed by those who studied at Colleges or Polytechnics (16.3%).
 - Pelancongan - Makanan & Minuman - Perkhidmatan - Logistik & Pengangkutan - Kemudahan Penginapan - Runcit - Borong - Kompleks Perniagaan - Pasar - Lain-lain	E. Types of Commercial Businesses Most of the commercial businesses are in the food and beverage category (51%), followed by tourism (24.5%), with the remaining quarter a mix of services providers, grocery shops, warehouses, logistics and business centres.
 < RM 1000 - RM 1000 - 1999 - RM 2000 - 2999 - RM 3000 - 3999 - RM 4000 - 4999 > RM 5000	F.Monthly Income The majority (57.1%) of respondents earn between RM 2000 - RM2999, followed closely by those who earn between RM 1000 - RM1999 at 34.7%.
 1 - 5 Tahun 6 - 10 Tahun 11 - 15 Tahun 16 -20 Tahun > 25 Tahun	G. Years in Operation The majority of the commercial businesses surveyed have been in operation for 11-15 years (42.9%), followed closely by those in operation for 6-10 years at 38.8%. 16.3% have been operating for 16-20 years while the rest have been operating for more than 25 years.

 ● Sendiri ● Sewa ● Lain-lain	H. Status of Business Premise Ownership The majority of the respondents (71.4%) in this category own their business premises, while the rest mostly rent (20.4%).
 ● Pemilik ● Pekerja	I. Owner or Worker The majority of the respondents (65.4%) are the owners, while the rest (34.7%) are employees.
 ■ Rifle Range Flats ■ Penang Hill	M. Location of Project Site The majority (59%) of the commercial businesses are located on top of Penang Hill (within 1km from the site). The remaining 41% of surveyed commercial businesses are located in Rifle Range Flats (2-3km away).

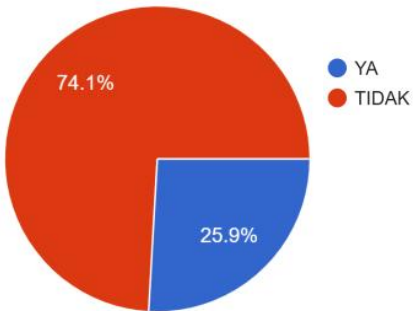
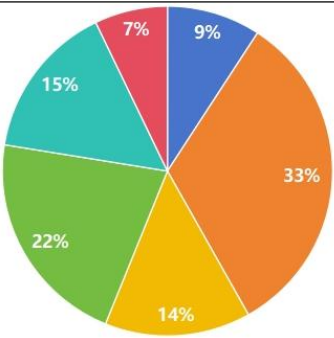
TOURIST	
Charts and Graphs Analysis	Description
 ● Tempatan (Dari Negeri Pulau Pinang) ● Domestik (Dari Negeri lain dlm Malaysia) ● Antarabangsa (Negara lain)	A. Tourist Category 72.7% of the surveyed tourists are from other states in Malaysia, while 27.3% are from Penang. All tourists surveyed are Malaysians.
 ■ Cina ■ Melayu ■ India	B. Race of Population Majority of the tourists are Malay (86%). 9% are Chinese while the remaining 5% are Indian.

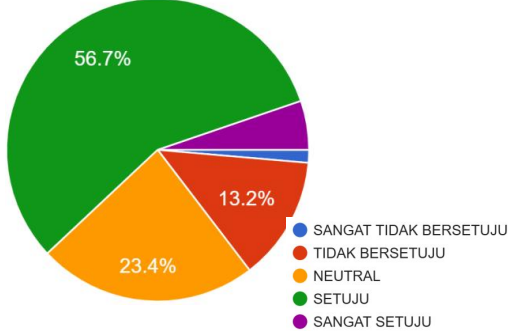
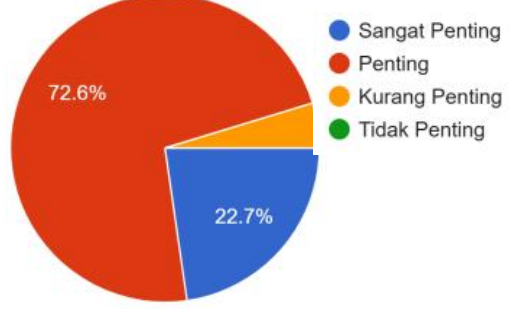
 ● Lelaki ● Perempuan	C. Gender of Population 78.8% of the respondents are male, while 21.2 % are female.
 ● 18 - 29 ● 30 - 39 ● 40 - 49 ● 50 - 59 ● 60 +	D. Age Half of the respondents are young people aged 18-29. That is followed by middle-aged respondents; 31.8% are aged 30-39 and another 15.2% are aged 40-49. The rest are senior citizens.
 ● Kerajaan ● Swasta ● Bekerja sendiri ● Suri Rumah ● Pelajar ● Pesara ● Tidak Bekerja ● Lain- lain	E. Jobs Majority (57.6%) stated they work in private sectors. 19.7% are self employed, followed by 15.2% who are students. The remaining responses are a mix of housewives, retirees, and government workers.
 ● Lawatan pertama ● Sekali-sekala (1-2 kali setahun) ● Kerap (lebih dari 2 kali setahun)	F.Frequency of Visiting Penang Hill Majority of the respondents (54.5%) visit Penang Hill occasionally (1-2 times a year), 31.8% are visiting for the first time and 13.6% are frequent visitors (more than twice a year).
 ● Menikmati pemandangan / alam sekitar ● Melawati tapak bersejarah ● Aktiviti rekreasi (seperti hiking dll) ● Membeli-belah / "Food hunting"	G. Objective to visit Penang Hill 74.2% of tourists visit Penang Hill to enjoy the view and nature. 15.2% stated they visit to engage in recreational activities such as hiking, while 9.1% stated they are here to visit historical sites. The rest have stated they visit to food hunt and shop.

ii. **Resident Understanding of The Proposed Project**

Table 6.32 shows residents' understanding and agreement of the proposed development, along with thoughts on the benefits of the proposed project.

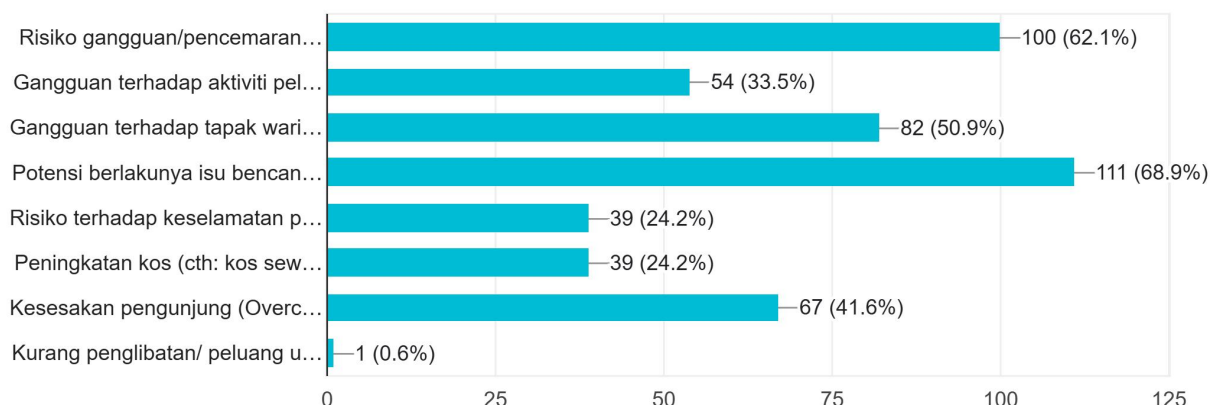
Table 6.32: Resident Understanding to the Proposed Project

Charts and Graphs Analysis	Description
 Legend: ● YA ● TIDAK	A. Respondents' Knowledge of the Proposed Project The findings indicate that a majority of respondents are not aware of the proposed development by the project proponent. Only 25.9% of respondents reported having prior knowledge of the project, while the remaining respondents were unaware of its existence. This may be attributed to the fact that the project has been in the planning pipeline for an extended period but was previously placed on hold due to factors such as the COVID-19 pandemic and other implementation constraints. With recent developments, including renewed infrastructure initiatives in the area, such as the cable car project, the proposed development is now being reactivated and brought forward for implementation.
 Legend: ■ Dimaklumkan oleh pihak pemaju ■ Hebahan kawan-kawan/keluarga/jiran ■ Hebahan kerajaan ■ Hebahan wakil rakyat/penduduk ■ Media sosial / surat khabar ■ Sumber lain	B. Sources of information for residents who know about the Proposed Project Among respondents who were aware of the proposed development, the primary source of information was informal community networks, with 33% reporting that they first heard about the project through friends, neighbours, or family members. This highlights the strong role of local social interaction in disseminating project-related information within the community. This is followed by local politicians and community leaders (22%), indicating the influence of grassroots leadership in shaping public awareness. Media sources accounted for 15%, while 14% of respondents obtained information directly from local authorities. A smaller proportion

	(9%) reported receiving information directly from the developer, and the remaining 7% cited other sources. Overall, the findings suggest that project information is primarily circulated through informal and community-based channels rather than direct official communication.												
 <table border="1"> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Sangat Tidak Bersektu</td> <td>1.4%</td> </tr> <tr> <td>Tidak Bersektu</td> <td>13.2%</td> </tr> <tr> <td>Neutral</td> <td>23.4%</td> </tr> <tr> <td>Setuju</td> <td>56.7%</td> </tr> <tr> <td>Sangat Setuju</td> <td>5.2%</td> </tr> </tbody> </table>	Category	Percentage	Sangat Tidak Bersektu	1.4%	Tidak Bersektu	13.2%	Neutral	23.4%	Setuju	56.7%	Sangat Setuju	5.2%	C. Residents' preliminary consent to the Proposed Project Overall, the findings indicate a generally positive level of acceptance towards the proposed development. A combined 61.9% of respondents expressed agreement (56.7% agree and 5.2% strongly agree), reflecting encouraging community support for the project at this preliminary stage. This suggests a favourable perception of the development and its potential contribution to the local area. In addition, 23.4% of respondents remained neutral, which may indicate openness to the project pending further information, clarification, or continued engagement on specific aspects of the development. Meanwhile, a smaller proportion of respondents (13.2%) expressed disagreement, with only 1.4% strongly disagreeing. Overall, these findings demonstrate a broadly positive community outlook, while also highlighting the importance of sustained stakeholder engagement to further strengthen understanding and support moving forward.
Category	Percentage												
Sangat Tidak Bersektu	1.4%												
Tidak Bersektu	13.2%												
Neutral	23.4%												
Setuju	56.7%												
Sangat Setuju	5.2%												
 <table border="1"> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Sangat Penting</td> <td>22.7%</td> </tr> <tr> <td>Penting</td> <td>72.6%</td> </tr> <tr> <td>Kurang Penting</td> <td>3.4%</td> </tr> <tr> <td>Tidak Penting</td> <td>1.3%</td> </tr> </tbody> </table>	Category	Percentage	Sangat Penting	22.7%	Penting	72.6%	Kurang Penting	3.4%	Tidak Penting	1.3%	D. Importance of Implementation of Green Design and Green Energy into proposed development The findings indicate a strong consensus among respondents on the importance of incorporating green design principles and the use of green energy within the proposed development. The majority of respondents view these sustainable design elements as essential, reflecting a clear preference for environmentally responsible development. In the context of the Penang Hill area, which is recognised for its ecological sensitivity, biodiversity		
Category	Percentage												
Sangat Penting	22.7%												
Penting	72.6%												
Kurang Penting	3.4%												
Tidak Penting	1.3%												

value, and status as a key eco-tourism destination, the emphasis on green design is particularly significant. Integrating energy-efficient systems, low-impact construction methods, and renewable energy solutions is seen as crucial to ensuring that future development is compatible with the surrounding natural environment while preserving the area's landscape quality and tourism appeal.

E. Reasons for disagreeing with project implementation



Respondents who expressed disagreement with the proposed development were further asked to identify their main concerns. The findings indicate that the **key issues raised are primarily environmental and geotechnical in nature**. The most significant concern is **risk of natural disasters such as landslides (68.9%)**, followed by **potential environmental pollution (62.1%)** and **potential disturbance to heritage elements within the area (50.9%)**.

These concerns are closely associated with the sensitive environmental and topographical conditions of the Penang Hill area, which is characterised by steep terrain, high rainfall intensity, and ecological sensitivity. It is important to note that the Geotechnical Report for the proposed development has already been reviewed and approved by the relevant authority, confirming that the proposed slope mitigation and foundation design comply with the required safety standards.

From a technical and planning perspective, these identified risks are well understood and can be effectively managed through established engineering and environmental control measures. This includes implementation of erosion and sediment control measures in accordance with MSMA guidelines, comprehensive stormwater management systems, and strict Environmental Management Plan (EMP) execution supported by continuous monitoring of water quality, air quality, and slope stability.

With these approved technical foundations and mitigation measures in place, the identified risks can be reduced to acceptable and manageable levels, thereby supporting the feasibility of proceeding with the proposed development in a controlled, sustainable, and environmentally responsible manner.

In summary, the socio-economic survey within the vicinity of Crag Hotel indicates a stable and established local community profile within the broader Penang Hill area, influenced by residential, tourism, and small-scale commercial activities. Public awareness of the proposed redevelopment is relatively low, mainly due to the project's long planning timeline and previous deferment. Information is largely disseminated through informal community networks.

Despite limited awareness, overall perception is moderately positive, with:

- Majority expressing support
- Significant proportion remaining neutral
- Minority expressing opposition

Most of the concerns recorded are **typical of hillside developments** and reflect the environmental sensitivity of Penang Hill rather than project-specific anomalies. **Key concerns among dissenting respondents** are:

- Environmental pollution and protection
- Slope stability / landslide risk
- Sensitivity of highland and surrounding setting

The redevelopment of Crag Hotel is considered **strategically important** as it revitalises an underutilised historical asset and supports controlled development within a sensitive tourism landscape. Furthermore the development will be able to strengthen sustainable tourism development by enhancing visitor experience and boosting local economic activity.

From a technical compliance perspective, the **Geotechnical Report has been reviewed and approved by the relevant authority**, confirming slope stability and structural safety compliance. Environmental risks will be managed through proper erosion and sediment control measures, comprising of MSMA-compliant stormwater management systems and implementation of Environmental Management Plan (EMP) during construction.

In conclusion, while environmental concerns must be continuously managed, the socio-economic findings indicate **general community acceptance**. With approved engineering safeguards and environmental controls in place, the Crag Hotel redevelopment is **feasible, justified, and can proceed in a controlled and sustainable manner** consistent with the objectives of Penang Hill.

iii. *Respondents' Opinions of The Proposed Project*

Table 6.33 shows the respondents' opinions on the potential benefits of the proposed development. All benefits scored 4, which shows that the respondents agree that the proposed development is beneficial and are generally supportive.

Table 6.33 Residents' Thoughts on the Benefits of the Proposed Project

BENEFIT OF PROPOSED PROJECT	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Economic and employment opportunities	Frequency, f	0	2	81	211	69	4
	Percent, %	0.0	0.6	22.3	58.1	19.0	
	Cum. Percent, C%	0.0	0.6	22.9	81.0	100.0	
Growth of tourism industry	Frequency, f	1	47	56	193	66	4
	Percent, %	0.3	12.9	15.4	53.2	18.2	
	Cum Percent C%	0.3	13.2	28.7	81.8	100.0	
Utilizing existing land/buildings	Frequency, f	7	39	94	170	53	4
	Percent, %	1.9	10.7	25.9	46.8	14.6	
	Cum Percent C%	1.9	12.7	38.6	85.4	100.0	
Preservation of existing heritage areas	Frequency, f	1	21	98	180	63	4
	Percent, %	0.3	5.8	27.0	49.6	17.4	
	Cum Percent C%	0.3	6.1	33.1	82.6	100.0	
In line with local development plans (RKK Bkt Bendera)	Frequency, f	0	28	90	187	58	4
	Percent, %	0.0	7.7	24.8	51.5	16.0	
	Cum Percent C%	0.0	7.7	32.5	84.0	100.0	
Improvement of public facilities	Frequency, f	3	30	98	175	57	4
	Percent, %	0.8	8.3	27.0	48.2	15.7	
	Cum Percent C%	0.8	9.1	36.1	84.3	100.0	

iv. Respondents' Opinions on Issues in Existing Environment

Table 6.34 shows the overview of respondents' thoughts on existing issues within the ZOI.

Table 6.34 Respondents' Thoughts on Issues in Existing Environment

Issues in Existing Environment	Percentage (%)/ Frequency (f)	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
TRAFFIC							
Traffic congestion	Frequency, f	19	56	121	159	8	3
	Percent, %	5.2	15.4	33.3	43.8	2.2	
	Cum.Percent , C%	5.2	20.7	54.0	97.8	100.0	
Lots of heavy vehicles	Frequency, f	24	119	185	32	3	3
	Percent, %	6.6	32.8	51.0	8.8	0.8	
	Cum.Percent , C%	6.6	39.4	90.4	99.2	100.0	
INFRASTRUCTURE							
The road is damaged and dirty	Frequency, f	21	128	97	115	2	3
	Percent, %	5.8	35.3	26.7	31.7	0.6	
	Cum.Percent , C%	5.8	41.0	67.8	99.4	100.0	
The drains and ditches are clogged	Frequency, f	31	161	157	13	1	2
	Percent, %	8.5	44.4	43.3	3.6	0.3	
	Cum.Percent , C%	8.5	52.9	96.1	99.7	100.0	
Water and electricity supply disruptions	Frequency, f	28	237	89	9	0	2
	Percent, %	7.7	65.3	24.5	2.5	0.0	
	Cum.Percent , C%	7.7	73.0	97.5	100.0	100.0	
The provision of public facilities is insufficient (schools, clinics, etc.).	Frequency, f	42	166	128	27	0	2
	Percent, %	11.6	45.7	35.3	7.4	0.0	
	Cum.Percent , C%	11.6	57.3	92.6	100.0	100.0	
The provision of parking spaces is insufficient	Frequency, f	38	110	113	100	2	3
	Percent, %	10.5	30.3	31.1	27.5	0.6	
	Cum.Percent , C%	10.5	40.8	71.9	99.4	100.0	
Mismanagement of solid waste	Frequency, f	39	163	128	33	0	2
	Percent, %	10.7	44.9	35.3	9.1	0.0	
	Cum.Percent , C%	10.7	55.6	90.9	100.0	100.0	

ENVIRONMENTAL/NATURAL DISASTER							
Issues of disease and public health	Frequency, f	35	228	82	18	0	2
	Percent, %	9.6	62.8	22.6	5.0	0.0	
	Cum.Percent , C%	9.6	72.5	95.0	100.0	100.0	
Natural disasters such as landslides	Frequency, f	22	168	80	92	1	2
	Percent, %	6.1	46.3	22.0	25.3	0.3	
	Cum.Percent , C%	6.1	52.3	74.4	99.7	100.0	
Soil erosion issues, and land subsidence.	Frequency, f	28	166	148	20	1	2
	Percent, %	7.7	45.7	40.8	5.5	0.3	
	Cum.Percent , C%	7.7	53.4	94.2	99.7	100.0	
ENVIRONMENTAL POLLUTION							
Noise disturbances	Frequency, f	29	120	107	106	1	3
	Percent, %	8.0	33.1	29.5	29.2	0.3	
	Cum.Percent , C%	8.0	41.0	70.5	99.7	100.0	
Water pollution	Frequency, f	41	158	156	8	0	2
	Percent, %	11.3	43.5	43.0	2.2	0.0	
	Cum.Percent , C%	11.3	54.8	97.8	100.0	100.0	
Air pollution	Frequency, f	42	221	86	14	0	2
	Percent, %	11.6	60.9	23.7	3.9	0.0	
	Cum.Percent , C%	11.6	72.5	96.1	100.0	100.0	
Odour pollution	Frequency, f	41	149	167	6	0	2
	Percent, %	11.3	41.0	46.0	1.7	0.0	
	Cum.Percent , C%	11.3	52.3	98.3	100.0	100.0	
SOCIAL							
Increase in foreigners	Frequency, f	38	126	145	52	2	3
	Percent, %	10.5	34.7	39.9	14.3	0.6	
	Cum.Percent , C%	10.5	45.2	85.1	99.4	100.0	
Unsatisfactory quality of life	Frequency, f	35	200	121	7	0	2
	Percent, %	9.6	55.1	33.3	1.9	0.0	
	Cum.Percent , C%	9.6	64.7	98.1	100.0	100.0	
High rate of social issues and crime	Frequency, f	29	83	109	139	3	3
	Percent, %	8.0	22.9	30.0	38.3	0.8	
	Cum.Percent , C%	8.0	30.9	60.9	99.2	100.0	

The respondents were questioned about issues in the current environment within the ZOI they have faced or observed. The questions were separated into 5 categories, which are traffic, infrastructure, environmental/ natural disasters, environmental pollution, and social issues.

The responses are summarized below:

i. Traffic

- Both issues (traffic congestion and the presence of heavy vehicles) scored neutral, indicating that these might be occasional problems but not major issues.

ii. Infrastructure

- Traffic-related issues, such as insufficient parking areas and damaged roads, scored neutral, indicating that these might be occasional problems but not major issues.
- Other potential infrastructure issues related to drainage, public facilities, and waste management scored a median score of 2, indicating there are no major issues and that such facilities are in adequate condition.

iii. Environmental/ Natural Disasters

- Concerns related to environmental disasters and public health scored a median score of 2, indicating that such incidents are not major issues and are rare.

iv. Environmental Pollution

- Noise disturbances scored neutral, indicating that these might be occasional problems but not major issues.
- All other forms of pollution, such as air, water and odour scored a median score of 2, indicating that these are not significant problems faced by respondents.

v. Social

- Increase in foreigners and a high rate of social issues scored neutral, indicating that these might pose some concern among respondents but ultimately are not considered significant problems.
- Responses also indicate that the majority of respondents feel that the quality of life within the ZOI area is satisfactory, with no major issues.

CHAPTER 7

IMPACT ASSESSMENT

7.1 INTRODUCTION

This chapter outlines and summarizes the potentially significant environmental impacts caused by the proposed project mainly focused on construction activities and during project implementation.

7.2 PROJECT MAIN ACTIVITIES

Table 7.1 outlines the typical activities for a construction-related project, grouped into pre-construction, construction, operation phases, and closure. These activities form the basis for assessing possible significant environmental impacts due to the project.

Table 7.1: Typical Activities for Construction-Related Projects

Project Stage	Project Activities	Key Environmental Impacts
Pre-Construction	Site access, site surveys including topography & soil investigation - Minimal vegetation & land clearing - Survey works - Determination of subsoil layers - Obtain soil samples - Lab analysis of soil	- Ecology - Safety and health
	Environmental Assessment - Site assessment - Monitoring of collection of samples for water, air, noise & vibration - Analysis of samples - Current site condition & surrounding area - Impact identification - Mitigation recommendations	Environmental impact
Demolition	Demolition Works - Site Assessment & Survey - Establish BMPs - Demolition activities - Management of Demolition Waste	- Air quality (fugitive dusts) - Noise pollution - Water quality (sediment in surface runoff) - Waste generation (demolition waste)
Construction	Establish access road - Cut new path or make good old path - Establish BMPs	- Air quality (fugitive dusts) - Noise pollution - Water quality (sediment in surface runoff) - Soil erosion and sedimentation

	Site clearing/ biomass removal ▪ <i>Cut, removal & disposal of vegetation</i> ▪ <i>Establish LD-P2M2</i>	• Ecology • Erosion risk • Waste generation (biomass) • Water quality (sediment in surface runoff) • Air quality (fugitive dusts)
	Site facilities establishment ▪ <i>Construct site office, stockpile areas, storage facilities, etc.</i> ▪ <i>Establish utilities and infrastructure: power supply, water, telecommunications, etc.</i> ▪ <i>Provide temporary treatment systems</i>	• Water quality (sewage) • Waste generation (solid waste)
	Site preparation and earthworks ▪ <i>Site clearing</i> ▪ <i>Platform formation</i> ▪ <i>Maintenance of LD-P2M2</i>	• Water Quality (sediment in surface runoff) • Air Quality (fugitives) • Noise Pollution • Waste generation (unsuitable materials) • Traffic
	Worker recruitment, mobilization of equipment & materials ▪ <i>Employ workers</i> ▪ <i>Transport equipment & materials</i>	• Socio-economic • Creation of spin-off businesses • Conflicts with local cultures • Air Quality (fugitives) • Noise Pollution • Traffic congestion/ road safety
	Structural works & facilities establishment ▪ <i>Construction works</i> ▪ <i>Mechanical and electrical works</i>	• Noise Pollution • Air Quality • Waste generation (scheduled waste, solid waste)
	Establishment of permanent access ▪ <i>Construction of permanent access road</i> ▪ <i>Closure of temporary access</i> ▪ <i>Removal of temporary structures</i>	• Noise Pollution • Air Quality
	Final finishing and landscaping ▪ <i>Field testing</i> ▪ <i>Handover</i> ▪ <i>Surface covers or revegetation and landscaping</i>	• Visual/aesthetics
Operation	Occupation & operation of the project ▪ <i>Hotel & spa operation</i> ▪ <i>Traffic management</i> ▪ <i>Solid waste & scheduled waste</i>	• Air Quality (emissions) • Water Quality (sewage) • Noise Pollution • Waste generation (scheduled waste, solid waste)

	<i>management</i> ▪ <i>Sewage management</i>	• Safety & Health • Socio-economy
	Infrastructure, utility, amenities maintenance ▪ <i>Maintenance of sewage treatment facility</i> ▪ <i>Maintenance of infrastructure; roads, drainage, etc.</i> ▪ <i>Maintenance of landscaping</i>	• Air Quality (emissions) • Water Quality (sewage) • Noise Pollution • Waste generation (scheduled waste, solid waste)
Abandonment (Optional)	Site Decommissioning ▪ <i>Demolition of unwanted temporary structures & buildings</i> ▪ <i>Removal of machinery, materials & workers from the site</i> ▪ <i>Removal of wastes</i>	• Waste generation (construction & demolition wastes) • Socio-economy • Visual impact
	Rehabilitation Works ▪ <i>Erect hoardings</i> ▪ <i>Establishing protection measures for exposed areas</i> ▪ <i>Revegetation or landscaping</i>	• Waste generation (construction & demolition wastes) • Socio-economy • Visual impact

7.3 IDENTIFICATION AND PREDICTION ASSESSMENTS OF IMPACT

7.3.1 Pre-Construction Phase

The pre-construction phase will involve the overall planning and design prior to project implementation, including preparing the project development layout, detailed engineering designs, and obtaining legal approvals from relevant authorities. These activities are limited to administrative and technical preparations and thus do not involve any physical alterations to the site or affect the environment directly.

Some of the study scopes included in this phase involve reconnaissance surveys and soil investigations, primarily for documentation and preparation of plans related to the proposed development. These studies are highly localized and are not anticipated to cause any significant disturbances to the existing environment. The reconnaissance survey, which covers the entire project site, serves to assess the suitability of the current site conditions and determine the feasibility of the proposed land use, particularly regarding the siting and selection of developmental components as outlined by the project proponent.

Additionally, there will be detailed studies conducted on the existing site conditions, including field surveys and investigations by engineering and environmental consultants. Although these activities involve on-site work, such as site surveys and soil testing, the impacts are minimal and localized. Furthermore, the pre-construction phase presents certain beneficial impacts, such as the creation of job opportunities for consultants, surveyors, associated workers, and laboratory analysts. These activities contribute to minor, localized effects and are not expected to cause significant environmental impacts.

Thus, the activities carried out during the pre-construction phase are largely confined to the planning, surveying, and investigative stages, with no significant disruptions to the environment expected. Any environmental impacts are considered negligible and manageable.

7.3.2 Demolition and Construction Phase

i. Demolition Phase

The demolition phase will be the first part of the construction works for this project as the proposed site contains several existing buildings. This phase will involve systematic dismantling or removal of the existing structures while keeping in line with local regulations. Prior to the commencement of demolition, a site survey and building inspection will be carried out to ascertain valuable data required for ensuring smooth and safe execution of works. In the site survey, prior drawings of the structures would be scrutinized to locate and identify existing services such as water mains, sewer lines and electrical cables to be disconnected. The termination of live utilities will be done concurrently with soft stripping

works, using basic hand tools. Materials and debris produced as a result of the demolition will be salvaged to be recycled or sold. Some of the key factors that need to be considered during this phase are proper planning of the process, determining the best demolition techniques, identifying the type of waste that will be produced and the impact on the surroundings along with mitigation measures. The expected potential impacts during the demolition phase are further discussed in **Table 7.2**.

ii. Construction Phase

The construction phase represents the most critical period for potential environmental impacts, as it involves significant physical alteration of the project site. Slope and hill projects cover a variety of terrain which poses many constraints compared to development in lowland areas. The site clearing and earthwork will be executed in phases once all necessary approvals have been obtained. Site clearing involves the removal of trees, vegetation, and any existing surface cover. Given the scale of these activities, the key concerns of significant environmental impacts includes air quality, water quality, soil erosion and sedimentation, geotechnical consideration, geological hazards and others. However, these impacts will be managed through the implementation of appropriate best management practices (BMPs) and proper compliance with environmental regulations.

Although the environmental impacts may be significant, proper planning and mitigation measures will help to reduce their extent and duration, ensuring that the project is run with minimal disruption to the surrounding and local communities. Potential impacts during the construction phase are shown in **Table 7.2** as well.

Table 7.2: Potential Impacts during Demolition and Construction Phase

No	Environmental Components	Significant Sources of Potential Impacts	Magnitude	Duration	Frequency
Project Activities: Site Preparation, Demolition Activities, Earthworks & Construction Work					
1.	Air Quality	a) <u>Site clearing, demolition activities and earthworks</u> - During site clearing and earthworks, suspended particulate matter (PM10 and PM2.5) is the primary pollutant of concern, largely generated by fugitive dust from exposed soil area and demolition activities. As vegetation is removed and soil is disturbed by activities such as grading, excavation, and levelling, fine particles become airborne and can remain suspended in the air, particularly under dry and windy conditions. - However, the dust emissions fluctuate depending on the nature of site activity, type of equipment in use, and weather conditions. b) <u>Fugitive dust emissions from transportation activities</u> - Transportation activities on construction sites are a significant source of fugitive dust emissions. These emissions primarily arise from the movement of vehicles and equipment over unpaved roads, exposed soil, and other loose surfaces. Key factors contributing to these emissions include: Heavy Vehicle Traffic: Frequent movement of trucks, loaders, bulldozers, and other heavy machinery on unpaved or temporary roads stirs up dust from exposed surfaces Uncovered Loads: Transporting materials like soil, gravel, or sand in uncovered trucks can lead to dust being blown off during	Low	Short term	Occasional occurrence

		transit, adding to local air pollution 3. Loading and Unloading Materials: Dust emissions can also occur during loading or unloading of construction materials, particularly if the materials are dry and finely graded. PM10 emissions calculations show that fugitive dust has the potential to be a significant issue; however, the impact can be reduced through proper mitigation measures. The calculations for the emissions are detailed in Subsection 7.7. The baseline data for ambient air quality are within the limits as well and are detailed in Chapter 6.																					
2.	Noise Level and Vibration	a) <u>Site clearing, demolition and earthworks</u> ▪ Various equipment and plants will be used during the construction stage that will generate noise. These includes excavators, backhoes, bulldozers, pilling machines and cranes, lorries and other related machinery. The operation of these machinery will result in temporary disturbances to the surrounding area cause annoyance to the residents staying nearby this area. These machinery and equipment generate noise typically as shown in Table 7.3. Table 7.3 Typical noise levels generated by construction machinery <table><tr><th>Equipment</th><th>Operating Condition</th><th>Sound Power Level @ 15m</th></tr><tr><td>Bulldozer</td><td>Clearing vegetation</td><td>~ 84 dBA</td></tr><tr><td>Backhoe</td><td>Digging</td><td>70 - 80 dBA</td></tr><tr><td>Excavator</td><td>General operation</td><td>81 - 85 dBA</td></tr><tr><td>Crawler Crane</td><td>Lifting</td><td>81 - 85 dBA</td></tr><tr><td>Impact Pile Driver</td><td>Piling</td><td>95 - 101 dBA</td></tr></table> Source: EIA Guidelines for Petrochemical Industries, DOE	Equipment	Operating Condition	Sound Power Level @ 15m	Bulldozer	Clearing vegetation	~ 84 dBA	Backhoe	Digging	70 - 80 dBA	Excavator	General operation	81 - 85 dBA	Crawler Crane	Lifting	81 - 85 dBA	Impact Pile Driver	Piling	95 - 101 dBA	Low	Short term	Occasional occurrence
Equipment	Operating Condition	Sound Power Level @ 15m																					
Bulldozer	Clearing vegetation	~ 84 dBA																					
Backhoe	Digging	70 - 80 dBA																					
Excavator	General operation	81 - 85 dBA																					
Crawler Crane	Lifting	81 - 85 dBA																					
Impact Pile Driver	Piling	95 - 101 dBA																					

		<i>b) Noise from transportation activities</i> ▪ Transportation activities at construction sites, including the movement of trucks, lorries, and heavy machinery, contribute to significant noise emissions, which can impact both workers on-site and nearby communities. The key noise sources from transportation activities include of: - 1. Heavy Vehicles on Site: Frequent movement of trucks, dumpers, and lorries for transporting materials can create continuous noise, especially as they move over unpaved road 2. Material Loading and Unloading: Loading or unloading materials such as gravel, sand, or debris generates loud noise, particularly when materials are dropped onto hard surfaces. 3. Traffic on Access Roads: Construction traffic along access roads, especially if they pass through residential areas, can cause disturbances to local communities, particularly if heavy vehicles operate during early or late hours <i>c) Impact of vibration from Demolition Activities</i> ▪ The vibration of structures may occur caused by the demolition activities. Any vibrations produced will be localized, of low magnitude, and are expected to attenuate rapidly with distance. Therefore, the risk of vibration-related disturbance to nearby structures or receptors is considered minimal. <i>d) Impact of vibration from Piling Method</i> ▪ The use of micro piles as the proposed piling method is not			
--	--	---	--	--	--

		expected to generate significant vibration impacts. Micro pile installation involves rotary drilling and grouting rather than impact hammering, resulting in substantially lower vibration levels. - Any vibrations produced will be localized, of low magnitude, and are expected to attenuate rapidly with distance. Therefore, the risk of vibration-related disturbance to nearby structures or receptors is considered minimal. - Typical vibration levels, often measured in Peak Particle Velocity (PPV), are generally very low because the drilling and grouting process produces minimal ground-borne vibration. For residential areas, the recommended vibration limits are 0.8–1.6 mm/s during daytime and 0.4 mm/s during night time, in accordance with the Guidelines for Environmental Vibration Limits and Control (2021), Third Schedule: Recommended Vibration Limits for Human Response and Annoyance from Intermittent Vibrations indicating that properly managed micro pile works are unlikely to cause significant disturbance to nearby occupants. - Overall, the risk of vibration impacts from micro pile installation is minimal, making this method highly suitable for construction in sensitive environments. <i>e) <u>Impact of vibration from Operation of Construction Machinery</u></i> - Besides piling activities, minor vibrations may also be generated during general construction operations, particularly from the movement and operation of heavy construction machinery such as excavators, cranes, compactors. Compaction works for backfilling, may also induce short-term, low-level ground-borne vibrations. - However, these vibration sources are typically non-impulsive and of			
--	--	---	--	--	--

		relatively low. The vibrations produced are generally localized and attenuate rapidly with distance from the source due to natural soil damping. As such, the resulting ground-borne vibration is expected to be minimal and unlikely to cause structural damage to nearby buildings, including residential structures. ▪ Vibrations from construction machinery are more likely to be perceptible to occupants, particularly when the equipment operates very close to property boundaries. These effects are temporary, intermittent, and limited to active working hours. ▪ Overall, vibration impacts from the operation of construction machinery and minor compaction activities are anticipated to be low, short-term, and well within acceptable limits under normal construction practices. The baseline noise and vibration levels at the project site and nearest sensitive receptors are found to be well below the standard guidelines (Spectroscience Laboratories, 2025) (Refer to Chapter 6). The estimated noise levels to be generated from construction activities are detailed in Subsection 7.8.			
3.	Water Quality	<u>a) Site clearing, demolition and earthworks</u> ▪ A large area of land is exposed after clearing, demolition works and platform formation which can disrupt the natural vegetation and soil structure increasing susceptible to erosion. ▪ The prolonged exposure of bare soil before cover crops are established can lead to significant deterioration of water quality in adjacent water bodies and drains.	Moderate to High (With Assumption no ESCP/LD-P2M2 on-site)	Short term	Occasional occurrence

		<i>b) <u>Runoff from demolition debris & construction activities and drainage</u></i> ▪ The surface runoff and drainage from material stockpile areas, excavated areas and temporary drainage systems might contain water quality contaminants that are from the demolition debris. ▪ Surface runoff from the project site drains out into temporary earth drains and eventually drains into existing monsoon drain. Erosion, siltation, and pollution of the water bodies will occur if the stormwater is not managed sufficiently during the land-disturbing activities ▪ The increased runoff can lead to changed flow regimes in the downstream waterways of the project site. <i>c) <u>Sewage</u></i> ▪ Sewage effluents generated from the sanitary facilities (temporary toilet/portable toilet) for onsite construction workers may lead to water pollution ▪ The water quality impact would happen immediately if the direct discharge of untreated sewage into waterways happened without proper mitigation measures. This may lead to an increase in BOD loading and E. coli in the waterway.			
4.	Erosion and sedimentation	<i>a) <u>Site clearing, demolition and earthwork</u></i> ▪ The soil, geology and terrain of steep slopes pose challenges whereby any land disturbing activities will result in significant soil erosion and sedimentation ▪ Erosion risks are higher during site clearing and earthwork activities when the land is cleared and exposed for a period of	Moderate to High (With Assumption no ESCP/LD-P2M2 on-site)	Short term	Occasional occurrence

		time. The seriousness of soil erosion will depend on the size and location of land cleared and the period and phasing of exposure. ▪ Hilly terrain requires grading and earthmoving activities to level the land. These activities can disrupt the soil structure and increase its susceptibility to erosion. ▪ The clearing of the existing structures and vegetation on site will potentially increase turbidity and suspended solids in the receiving drains and the potential of on-site water ponding if surface runoffs are not controlled. Soil erosion and sediment would cause water quality changes due to the high concentration of suspended solids discharged from the site. b) <u>Site Access</u> ▪ Due to the hilly terrain, accessing the site poses logistics problems. The project may require construction of temporary access, which cuts into the hill slopes, causing erosion, water pollution and slope stability issues. c) <u>Improper implementation of BMPs</u> ▪ During these land-disturbing activities, soil erosion and sedimentation are issues of concern. This will cause deterioration in the water quality of the existing waterway crossing to the project site without proper implementation of land-disturbing pollution prevention and mitigation measures (LD-P2M2) on site. ▪ Inadequate erosion control and sediment management can result in increased runoff of sediment and pollutants into nearby water bodies. It is crucial to ensure that BMPs are effectively applied to mitigate these risks and protect water quality.			
--	--	---	--	--	--

		The Revised Universal Soil Loss Equation (RUSLE) and Modified Universal Soil Loss Equation (MUSLE) are used to estimate the annual soil loss and sediment yield. The details of RUSLE and MUSLE assessment are illustrated in sub-section 7.10 .			
5.	Waste generation	a) Biomass Waste - During the site clearing works, the removal of existing vegetation generates a significant amount of biomass waste. - The biomass from the site clearing activities will be temporarily stockpiled at site for further disposal to an approved landfill site. - Improper disposal or stockpiling of biomass can lead to soil contamination.	Moderate	Short term	One-off occurrence
		b) Overburden Materials - Earthwork activities generally involve the generation of overburden materials, mainly excess soil materials, which require proper disposal. - Overburden and disposal sites can be a significant source of erosion and sediment discharges if the disposal site is not properly located and managed.	Low	Short term	One-off occurrence
		c) Sewage - The project site is temporarily occupied with construction workers where the temporary site office and toilet facility is established. - If untreated sewage is discharged from these temporary facilities, it could pollute nearby waterways.	Low	Short term	One-off occurrence

		d) Solid Waste/Construction Waste - The solid waste generated from construction activities and site office typically include papers, cans, garbage, bottles, cement bags, discarded steel bars and miscellaneous office waste - Improper management of these wastes can cause disease vector breeding and cause health hazards.	Low	Short term	One-off occurrence
		e) Demolition Waste - Waste produced from demolition works of existing buildings and structures on site, typically consisting of materials such as concrete, rebar, timber, tiles, plaster and bricks etc. (Cheen et.al, 2018) - For the proposed project, it is roughly estimated that a total of 2209 m³ of debris would be produced from the existing unoccupied bungalow buildings on site. Estimation was done using an online demolition debris calculator (Brackenbox, 2024). - Improper management of demolition waste may lead to pollution issues on site and can pose a safety risk to on-site personnel and machinery.	Low	Short term	One-off occurrence
		f) Scheduled Waste (Demolition & Construction) - Scheduled wastes generated during the demolition period are mainly from the debris resulting from the demolition activities and machinery maintenance work. The general scheduled waste expected from construction activities is listed in the Code of Scheduled Wastes (Regulation 2) as shown in Table 7.2(a). - Machinery maintenance will not take place at the project site, hence	Low	Short term	One-off occurrence

some wastes (SW 305 & SW 306) will be insignificant.

Table 7.4(a): Types of Scheduled Waste Expected to be Generated from Demolition Activities

Expected Waste	Waste Code	Waste Description
Asbestos	SW201	Asbestos waste in sludge, dust or fibre forms
Heavy metal contamination	SW104	Dust containing heavy metals
Oils & Lubricants from Machinery	SW305	Spent lubricating oil
	SW306	Spent hydraulic oil
Chemical Residue	SW 303	Adhesive or glue waste containing organic solvents excluding solid polymeric materials
Contaminated soil, debris, containers & rags	SW 408	Contaminated soil, debris or matter resulting from cleaning up of a spill of chemical, mineral oil or scheduled wastes
	SW 409	Rags, plastics, papers or filters contaminated with chemicals, pesticides, mineral oil or scheduled wastes
	SW410	Rags, plastics, papers or filtes contaminated with scheduled wastes
Paints, Varnish, Solvents	SW 417	Waste of inks, paints, pigments, lacquer, dye or varnish
	SW 418	Discarded or off-specification inks, paints, pigments, lacquer, dye or varnish products containing organic solvent
Electrical & Electronic Waste	SW110	Waste from electrical and electronic assemblies containing components such as accumulators, mercury-switches, glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors or contaminated with

		cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, manganese or polychlorinated biphenyl
Mixed Waste	SW421	A mixture of scheduled wastes
	SW422	A mixture of scheduled and non-scheduled wastes

- Scheduled wastes generated during the **construction period** are mainly from machinery maintenance works. The general scheduled waste expected from construction activities is listed in the Code of Scheduled Wastes (Regulation 2) as follows:

Table 7.4 (b): Types of Scheduled Waste Expected to be Generated from Construction Activities

Waste Code	Type of Scheduled Wastes	Potential Source
SW 305	Spent lubricating oil	Maintenance & machinery
SW 306	Spent hydraulic oil	Maintenance & machinery
SW 408	Contaminated soil, debris or matter resulting from cleaning up of a spill of chemical, mineral oil or scheduled wastes.	Spillage from machinery maintenance
SW 409	Disposed containers, bags or equipment contaminated with chemicals, pesticides, mineral oil or scheduled wastes.	Scheduled waste storage, Spillage from machinery maintenance
SW 410	Rags, plastic, paper or filters	Spillage from

		<table><tr><td></td><td>contaminated with scheduled wastes.</td><td>machinery maintenance</td></tr><tr><td>SW 421</td><td>A mixture of scheduled wastes.</td><td>Contamination from machinery maintenance</td></tr><tr><td>SW 422</td><td>A mixture of scheduled and non-scheduled wastes</td><td>Contamination from machinery maintenance</td></tr></table> ▪ However, for this proposed project, machinery maintenance area will not take place at the project site. As such, the wastes (SW 408, SW 409, SW 410, SW 421, SW 422) are insignificant. ▪ Spillage and leakage of oils and lubricants (SW 305, SW 306) resulting from accidental or improper handling through the use of machinery on site may lead to pollution issues and can be hazardous to the ground.		contaminated with scheduled wastes.	machinery maintenance	SW 421	A mixture of scheduled wastes.	Contamination from machinery maintenance	SW 422	A mixture of scheduled and non-scheduled wastes	Contamination from machinery maintenance			
	contaminated with scheduled wastes.	machinery maintenance												
SW 421	A mixture of scheduled wastes.	Contamination from machinery maintenance												
SW 422	A mixture of scheduled and non-scheduled wastes	Contamination from machinery maintenance												
6.	Traffic	▪ The heavy vehicles will use the existing road to access the Project site via Jeep Track Road. Thus, the traffic volume is expected to increase slightly during the demolition and construction phase due to the number of lorries entering and leaving the project site for site clearing and preparation. ▪ Traffic creates noise and dust and affects the existing traffic flows, particularly along the access roads. ▪ Heavy trucks transporting materials and debris to and from the project site can create a nuisance in the surrounding area during normal working hours and affect traffic flows, possibly causing dirt to accumulate on the roads and causing damage to the roads. ▪ The movement and use of construction vehicles could pose risks, including potential road damage (overrun by heavy vehicles) and hazards during the loading and unloading of materials.	Moderate	Long term	Continuous occurrence									

7.	Safety and health	▪ Safety to the construction workers is the main concern, whereby various factors can cause accidents at the construction sites. This includes insufficient safety provisions, supervision of safety requirements, unsafe working environment, etc. ▪ For workers, possible impacts on their safety and health in the line of work shall be assessed, e.g. working in high noise areas, handling hazardous materials, confined spaces, at height, etc. ▪ Safety risks to road users and communities.	Low	Long term	Continuous occurrence
8.	Land-use, Landscape and Visual	▪ Landscape and visual impacts will occur in the short term as a result of alterations to the landscape throughout construction period. The impacts will be phased temporary and restricted to the construction period, thus the duration of the resulting landscape and visual impact will also be temporary. ▪ Visual impact will be changed to the appearance of the landscape and the subsequent effects on the view. ▪ Removal of vegetation and exposure of the bare areas will have a negative visual impact compared to natural scenery with greenery. However, the design of buildings and landscaping can help to blend in with the natural environment to provide a positive visual appeal. ▪ Changing land use will naturally decrease the pervious surface and an increase in impervious surface. However, temporary and minor landscape and visual effects will cause by site clearing and excavation. ▪ The visual impact is a subjective issue that depends on the scale of development, the context of the surrounding land use and the presence or absence of sensitive receptors. It should note that the visual appearances of the site may be unpleasant due to the	Low	Short term	One-off occurrence

		stockpiling area and biomass wastes on-site. However, this impact is short term only. Subsequently, this impact is only as much as the duration of the construction clearing activities, and therefore, the impact is low.			
9.	Flora and fauna	- Fauna survey found 2 endangered, 1 critically endangered, along with 1 near-threatened and 4 protected species of avifauna. No threatened or endangered flora species were recorded. - Direct threats, primarily vegetation clearing, will be most intense during the construction phase. Indirect threats are secondary impacts resulting from the development. These threats can affect areas beyond the immediate project site and persist throughout the operational life of the project. - The clearing of trees will displace forest-dwelling fauna, except for species tolerant of human presence. This displacement inevitably leads to human-wildlife conflict as animals seek shelter and food resources in human-occupied areas. Furthermore, the resulting smaller, fragmented forest areas intensify competition among wildlife for essential resources like food, nesting sites, territory, and mates. - There will also be impact to the surrounding environment from potential issues such as noise and dust generation, contamination from construction materials, possible erosion issues. - There is also a risk of introduction of invasive species through construction materials or landscaping choices.	Moderate	Long term	Continuous occurrence
10.	Socio-economic	The project will generate positive impacts for the local community by creating employment opportunities and stimulating economic	Beneficial	Long term	Continuous

		activity. - Construction activities will involve hiring both skilled and unskilled workers, providing a boost to the local labor market. - Temporary construction jobs will lead to further employment in the local economy through indirect or supply chain effects. - A socio-economic study has been conducted to assess these impacts and ensure the project's benefits are maximized (Refer to sub-section 7.6)			occurrence
11.	Potential Geohazards	<i>Slope Hazards/Slope Failure</i> - The steeper the slope the more geotechnical and engineering measures are required to maintain slope stability. - Improperly protected slopes or badly drained slopes may undermine slope protection, resulting in slope failure and landslides, endangering nearby land use and communities. <i>Potential Geohazards</i> - According to the Geohazard Assesment Report, the landslide risk score of the project is expected to be less than 25, which is Low Risk to Moderate Risk. - About 56.17% of the project area is located in Low Risk zone and 42.83% is located in Moderate Risk zone. - Further details can be referred from the Geohazard Risk Map, which is shown in Figure 6.14 (Chapter 6) or can be referred to in <i>Softcopy Attachments - GTM Report.</i>	Low to Medium	Short term	One-off occurrence

7.3.3 Operation Phase

During the operational phase of the proposed project, the activities involved are mainly on maintaining the building and associated facilities. This includes routine maintenance of the drains, ponds, amenities, and other constructed facilities. As the proposed development is a hotel, the sewage and domestic waste generated will require regular treatment, management and disposal works. In addition, the new development might generate additional vehicle trips or crowds that could impact the existing roads and infrastructure in the surrounding area. The activities during operation, that might significantly impact the surrounding environment are as discussed in **Table 7.5**.

Table 7.5 Potential Impacts during Operation Phase

No	Environmental Components	Significant Sources of Potential Impacts	Magnitude	Duration	Frequency
Project Activities: Operation, Occupation and Maintenance of Buildings					
1.	Air Quality	- During the operational phase of the project, the sources of fugitive emissions are expected to be minimal. Vehicles allowed to drive up to Penang Hill require permits from the relevant authorities and are controlled. Hence fugitive emissions are expected to be minimal. - There are no other expected sources that would majorly sully the air quality.	Low	Short term	Occasional occurrence
2.	Noise Level and Vibration	- The typical noise levels which would be generated from vehicle movement and personal noise from the staff and visitors are expected to be minimal. - These noise levels are not assessed to be a nuisance to adjacent residents and communities. - Vibration mainly occurs from construction activities, hence no significant vibration impact is expected during the operational phase.	Low Insignificant	Short term Insignificant	Occasional occurrence Insignificant
3.	Water Quality	- During the operational phase of the project, the stormwater discharges and surface runoffs from the project area will be channeled to the permanent drainage system constructed on-site (detention ponds, concrete drains). - Sewage will be generated from the staff and visitors once the development phase is completed. The sewage will be treated by a private small sewage treatment plant on-site.	Low	Short term	Occasional occurrence

		However, untreated sewage discharge from these occupied buildings could pollute the waterways.			
4.	Erosion and sedimentation	- During the operational stage, there will be no discharges into open watercourses. The designed surface water network will effectively manage and convey all runoff to a centralized detention pond, ensuring that water is properly contained. - The exposed area will also be permanently stabilized with appropriate control measures (e.g., main concrete drain, close turfing, planting of trees, etc.). Thus, the estimated soil loss will be reduced significantly.	Insignificant	Short term	Occasional occurrence
5.	Waste generation	Domestic Wastes - The operational stage is estimated to generate a significant amount of domestic waste about 199 kg/day of waste, assuming 199 kg/person/day for 199 PE. This requires proper management and disposal to avoid any unpleasant odour and aesthetic effects. These compositions of wastes include of food wastes, paper, plastic, bottles, aluminum cans, etc. - Thus, the domestic waste will have to be managed and disposed of in a proper manner. Currently, the nearest disposal site is Pulau Burung Sanitary Landfill (PBSL). Sewage - The estimated population for the entire development is about 199 PE. Sewage will be generated from the population occupying the area once the proposed project	Low	Short term	One-off occurrence

		is occupied. The sewage network of the site will be connected to the new proposed private SSTs on site to cater for sewage generated from the area.			
6.	Traffic	▪ This shall be dependent on the location of the building's entry/exit, traffic control measures, the number of tenants/visitors to the building, the nature of businesses within the building etc. ▪ The new development might generate some additional vehicle trips that could impact the existing traffic volume in the surrounding area. ▪ However the traffic at the top of the hill is expected to be minimally impacted as the volume is controlled by the relevant authorities.	Low	Long term	Continuous occurrence
7.	Safety and health	▪ The operational stage of the development is unlikely to have any significant impacts in terms of safety and health. The design of the proposed project has been formulated to provide a safe environment for future visitors and staff.	Insignificant	Short term	One-off occurrence
8.	Land-use, Landscape and Visual	▪ Once fully developed, the proposed project will provide a hotel with a spa and related facilities. ▪ The site will also be landscaped accordingly. The landscaping will be improved to enhance overall aesthetics in line with the vision of the proposed project concept. Furthermore landscaping works will also be done in a complementary way to the existing surroundings at Penang Hill.	Beneficial	Long term	Continuous occurrence

©SENVIRO RESOURCES, 2026	7-25	SRI NISUH SDN BHD
--------------------------	------	-------------------

7.3.4 Abandonment/ Post Closure Phase (Optional)

The abandonment/post-closure phase is when the construction works are permanently or temporarily stopped due to certain circumstances. It is inconceivable that the proposed project will be abandoned after spending so much time, effort, and money on various studies that have been conducted for planning. In the remote possibility that the project is abandoned, few measures have been outlined to address abandonment issues as provided in the Abandonment Plan. An abandonment plan will form part of the EMP that will be established to outline the procedures and appropriate measures to be taken to restore, rehabilitate, or make safe those components of the project that will be abandoned or decommissioned. This is to ensure that environmental, safety, and other concerns will not arise in the future. The project proponent is required to prepare a Closure Abandonment Plan for submission to DOE in three (3) months prior to the actual closure or abandonment. In line with this and the fact that changes may take place during the development period, it is premature to outline such a plan within the present scope of the study.

However, if the abandonment occurs, there will be some significant impact to the environment as shown in **Table 7.6**.

Table 7.6 Potential Impacts during Abandonment/Post Closure Phase

No	Typical Impacts	Potential Impacts	Magnitude	Duration	Frequency
Project Activities: Removal of Facilities/Structures, Removal of Materials, Removal of Wastes, Rehabilitation Works					
1)	Air Quality	- Fugitive dust will be generated during demolition works. This will mainly affect demolition workers. - In addition, the soil used in rehabilitation and reinstatement to pre-project status will add to the amount of dust that will be generated during rehabilitation. However, it will be minimal. - Exhaust emissions will also be experienced during decommissioning from the trucks that will be transporting the demolished objects to the disposal sites and storage areas. Large quantities of dust will be generated during demolition works.	Low	Short term	One-off occurrence
2)	Noise and Vibration levels	The demolition works will significantly deteriorate the acoustic environment within the Project site and its surrounding areas. This will be because of the noise that will be experienced during demolition.	Low	Short term	One-off occurrence
3)	Water Quality	Sediment runoff from exposed soil due to demolition activities.	Low	Short term	One-off occurrence
4)	Erosion and Sedimentation	Sediment runoff from exposed soil due to demolition activities.	Low	Short term	One-off occurrence
5)	Waste generation	- Large amounts of demolition debris (concrete, metal, tiles, wood). - Potentially hazardous waste (old paints, asbestos,	Moderate	Short term	One-off occurrence

		chemicals).			
6)	Traffic	- Increased traffic congestion from heavy machinery and debris trucks. - Potential safety hazards for public	Moderate	Short term	One-off occurrence
7)	Safety and Health	Safety and health of construction workers during demolition works	Low	Short term	One-off occurrence
8)	Land-use, landscape and Visual	- The abandonment project will lead to incompatible future land use within the surrounding area. - The aesthetic value of the project site would be severely affected.	Low	Short term	One-off occurrence
9)	Ecology	No significant impact is anticipated.	Insignificant	None	None
10)	Socio-Economic	Abandonment would result in economic loss, e.g., in terms of money, working hours, labour cost, etc.	Low	Short term	One-off occurrence

7.4 MATRIX SUMMARY OF IMPACT

The summary of the potential impacts from the proposed projects is shown in **Table 7.7** which outlines the activities in each stage of project implementation.

Table 7.7 Summary of Potential Impacts

				Site Investigation			Site Preparation					Construction					Occupancy & Maintenance							
Activities Identification				Site Survey	Soil investigation	Land acquisition	Demolition	Access Road	Site clearing	Excavation, Earthworks	Drainage	Transportation materials	Piling Works	Building works	Infrastructure works	Utility	Waste Disposal	Operation	Solid waste collection	Drainage System	Maintenance services	Abandonment		
Environment Components	Physico-Chemical	Land	Landforms				O		O	O	O		O	O	O									
			Soil Profiles							O														
			Slope Stability							S														
			Flood plains									O				O							O	
			Landuse																					
		Surface Water	Flow Variation								O										O			
			Water Quality				T	T	T	T	T				T	T	T	T		T	T	T	T	
			Drainage				T	T	T	T	T				T	T	T	T		T	T	T	T	
		Atmosphere	Air Quality				T	T	T	T	T	T			T	T	T	T		T	T	T	T	
			Air Flow				T	T	T	T	T	T			T	T	T	T	T	T	T	T	T	
		Noise	Intensity				T	T	T	T		T	T	T	T	T				T			T	T
			Duration				T	T	T	T		T	T	T	T	T				T			T	T
			Frequency				T	T	T	T		T	T	T	T	T				T			T	T
	Biological	Species	Terrestrial Vegetation						S										P					
			Other Terrestrial Fauna						S				S	S					P					
	Human	Health & Safety	Physical Safety						S	S		S	S	S	S	S						S		
			Communicable Disease								S										S			
		Social & Economic	Employment	S	S			S	S	S										S		S		
			Housing																					
			Utilities														S		S			S		
		Aesthetic & Cultural	Landforms				O		O	O	O			O	O	O								
			Atmospheric Quality					T	T	T	T	T			T	T	T	T			T	T	T	T
			Community Structures												O	O						O	O	
			Landscape						O	O					O	O						O		

Note:

- X** ■ Insignificant and excluded from Matrix
- T** ■ Environmental impact that is potentially but on a temporary basis and will assume equilibrium after certain period of time
- P** ■ Environmental impact that is potentially significant but there is insufficient data to make reliable prediction. Close monitoring and control is recommended.
- O** ■ Potentially significant adverse environmental impact for which a design solution has been identified
- R** ■ Residual and significant adverse environmental impact
- S** ■ Significant environmental enhancement

7.5 RESIDUAL IMPACTS

Residual impacts of the Project are those impacts that could potentially persist in the long term even after all practicable mitigation measures have been implemented. A summary of the residual impacts is listed in **Table 7.8**. Analyses of the impacts that will likely arise from the proposed Project show that a few areas need special attention in view of the potential residual impacts that potentially result from this development. The extent to which this residual impact is significant in the long term depends on the measures taken to mitigate it.

Table 7.8 Residual Impacts

Description	Nature of impact (Significant, Beneficial, or Insignificant)	Significance (Negligible, Minor, Moderate, Major)
CONSTRUCTION PHASE		
Air Pollution		
Air emission from vehicular traffic	Significant	Minor
Water Pollution		
Sewage discharge	Insignificant	Negligible
Noise Level		
Nuisance from vehicular traffic	Significant	Minor
Nuisance from human activities	Significant	Minor
Erosion and Sediment		
Surface runoff discharge	Insignificant	Negligible
Wastes		
Solid wastes	Significant	Minor
Sewage	Significant	Minor
Schedule wastes	Significant	Minor
Demolition waste	Significant	Moderate
Land Traffic		
Heavy vehicle access along public roads	Significant	Minor
Traffic congestion main access road	Significant	Minor
OPERATION PHASE		
Air Emission		
Air emission from vehicular traffic	Insignificant	Minor
Water Quality		
Surface runoff discharge	Insignificant	Negligible
Sewage discharge	Insignificant	Negligible
Noise		
Nuisance from vehicular traffic	Significant	Minor
Nuisance from human activities	Significant	Minor
Waste		
Domestic wastes	Significant	Minor
Sewage	Significant	Minor
Schedule wastes	Significant	Minor
Traffic		
Heavy vehicle access along public roads	Insignificant	Minor
Traffic congestion main access road	Insignificant	Minor

7.6 SOCIO ECONOMIC EVALUATION

7.6.1 Expected Impact by residents, businesses, institutions, tourists, and the broader community within the zone of impact (Pre-Construction of Project)

The projected impacts on residents, businesses, tourists, and all individuals within the zone of impact associated with the project development during the preconstruction phase are detailed in **Table 7.9** and **Table 7.10**.

Table 7.9 highlights respondents' perspectives on the anticipated positive impacts of the proposed project. These include the creation of economic opportunities, improved utilisation of existing structures, and alignment with broader local development and tourism planning objectives. Such responses reflect a generally favourable perception, particularly in the context of Penang Hill as a key tourism destination where developments that enhance economic activity and visitor experience are typically well supported.

A portion of respondents also expressed neutral views regarding potential property value appreciation. This is likely influenced by the land tenure characteristics of Penang Hill, where a significant proportion of land is state-owned, thereby limiting direct private ownership benefits and reducing immediate perception of property value impacts.

Overall, the findings suggest that the proposed redevelopment is broadly viewed as a positive initiative that supports sustainable tourism development, optimises existing built assets, and contributes to the long-term socio-economic enhancement of the area.

Table 7.9 Expected Positive Impacts During Pre-Construction

Expected Positive Impact During Pre-Construction Phase	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Increase in job and business opportunities	Frequency, f	2	3	116	203	39	4
	Percent, %	0.6	0.8	32.0	55.9	10.7	
	Cum.Percent, C%	0.6	1.4	33.3	89.3	100.0	
Increase in property value	Frequency, f	3	66	141	138	15	3
	Percent, %	0.8	18.2	38.8	38.0	4.1	
	Cum.Percent, C%	0.8	19.0	57.9	95.9	100.0	
Modification/ utilization of existing buildings	Frequency, f	15	52	89	177	30	4
	Percent, %	4.1	14.3	24.5	48.8	8.3	
	Cum.Percent, C%	4.1	18.5	43.0	91.7	100.0	
In line with local	Frequency, f	3	42	123	168	27	4
	Percent, %	0.8	11.6	33.9	46.3	7.4	

developmental plans (RKK Bkt Bendera)	Cum.Percent, C%	0.8	12.4	46.3	92.6	100.0	
---------------------------------------	-----------------	-----	------	------	-------------	-------	--

Table 7.10 reflects respondents' concerns regarding potential negative impacts during the pre-construction phase. Overall, responses indicate a generally neutral stance across key impact indicators, including potential disturbance to heritage areas, tourism activities, and acceptance among local communities.

This neutral response suggests that stakeholders do not perceive significant immediate socio-economic disruption associated with pre-construction activities. This may be attributed to the project site's location, which is situated at a reasonable distance from the main tourism concentration areas within Penang Hill, thereby minimising direct interaction with high visitor flow zones and sensitive public activity nodes.

It can be concluded that the anticipated pre-construction negative impacts are minor, localized, and manageable, with no significant socio-economic constraints expected. With the implementation of appropriate mitigation measures and proactive stakeholder engagement, the proposed redevelopment is considered feasible and acceptable, supporting its progression into subsequent project phases in a controlled and sustainable manner.

Table 7.10 Expected Negative Impacts During Pre-Construction

Expected Negative Impact During Pre-Construction Phase	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Disturbance to heritage areas	Frequency, f	2	77	163	114	7	3
	Percent, %	0.6	21.2	44.9	31.4	1.9	
	Cum.Percent, C%	0.6	21.8	66.7	98.1	100.0	
Disturbance to tourism activities	Frequency, f	4	97	237	24	1	3
	Percent, %	1.1	26.7	65.3	6.6	0.3	
	Cum.Percent, C%	1.1	27.8	93.1	99.7	100.0	
Issues with acceptance among locals	Frequency, f	4	166	149	42	2	3
	Percent, %	1.1	45.7	41.0	11.6	0.6	
	Cum.Percent, C%	1.1	46.8	87.9	99.4	100.0	

In general, the socio-economic impacts during the pre-construction phase are considered minor, temporary, and manageable, with no significant adverse socio-economic constraints to project implementation.

Importantly, the redevelopment of the Crag Hotel represents a strategic opportunity to revitalise an underutilised historical asset, strengthen Penang Hill's position as a premier eco-tourism destination, and enhance local economic resilience through improved tourism offerings and supporting services.

With appropriate mitigation measures, proactive stakeholder engagement, and controlled project planning, the proposed development is considered feasible, socially acceptable, and aligned with sustainable development objectives, supporting its progression to the subsequent project phases in a controlled and responsible manner.

7.6.2 Expected Impact by residents, businesses, institutions, and the broader community within the zone of impact (During Project Construction)

The anticipated social impacts that residents and the broader community may experience during the project's construction phase are outlined in **Table 7.11 – Table 7.12**.

As shown in **Table 7.11**, respondents generally expressed agreement regarding the expected positive economic and infrastructural benefits arising from the project. From an economic perspective, the proposed hotel redevelopment is anticipated to generate increased employment opportunities and stimulate local business activities, particularly within the surrounding tourism and service sectors.

In addition, respondents responded favourably towards the renovation and adaptive reuse of an existing historical building, reflecting strong support for the conservation and revitalisation of heritage assets within the Penang Hill area. Another key perceived benefit is the improvement and upgrading of existing infrastructure and utilities, including drainage systems, which are expected to enhance overall service efficiency and environmental performance within the site and its surroundings.

To optimise these anticipated benefits and ensure sustained community acceptance, it is important that project implementation is supported by continuous stakeholder engagement, transparent communication, and the incorporation of appropriate design elements that align with both functional requirements and the surrounding environmental and aesthetic context.

Table 7.11 Expected Positive Impacts During Project Construction

Expected Positive Impact During Construction Phase	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Increase in job opportunities	Frequency, f	0	4	101	208	50	4
	Percent, %	0.0	1.1	27.8	57.3	13.8	
	Cum.Percent, C%	0.0	1.1	28.9	86.2	100.0	
Increase in business	Frequency, f		68	66	183	46	4
	Percent, %	0.0	18.7	18.2	50.4	12.7	

opportunities	Cum.Percent , C%	0.0	18.7	36.9	87.3	100.0	
Upgrading of infrastructure facilities (e.g., drainage system, etc.)	Frequency, f	3	31	113	179	37	4
	Percent, %	0.8	8.5	31.1	49.3	10.2	
	Cum.Percent , C%	0.8	9.4	40.5	89.8	100.0	
Renovation of existing historical buildings	Frequency, f		39	104	181	39	4
	Percent, %	0.0	10.7	28.7	49.9	10.7	
	Cum.Percent , C%	0.0	10.7	39.4	89.3	100.0	
Increase of value of surrounding properties	Frequency, f		34	171	132	26	3
	Percent, %	0.0	9.4	47.1	36.4	7.2	
	Cum.Percent , C%	0.0	9.4	56.5	92.8	100.0	

Table 7.12 presents the respondents' perspectives on the anticipated negative impacts of the project. Neutral responses were recorded for all the issues, indicating that the listed potential impacts are not considered significant by the surrounding community. However, it remains important to address potential apprehensions related to environmental issues, tourism matters, and long-term site management.

Despite this generally neutral perception, it remains important to acknowledge and proactively address potential concerns related to environmental protection, tourism activities, and long-term site management within the Penang Hill area. This ensures that any emerging sensitivities are appropriately managed throughout the construction period.

From an environmental perspective, potential impacts include risks of environmental pollution, ecosystem disturbance, and increased susceptibility to slope-related hazards if not properly controlled. From a socio-economic standpoint, possible impacts include temporary disruption to tourism activities, increased social pressure on nearby communities, as well as secondary impacts such as increased traffic congestion and drainage-related issues.

To mitigate these concerns, the project should incorporate stringent environmental controls, such as dust suppression measures, proper drainage systems, and careful traffic management planning. Furthermore, engaging with stakeholders through transparent communication and addressing cultural sensitivities in the design and operational aspects of the columbarium will be crucial in fostering community trust and ensuring the project's long-term success.

Table 7.12 Expected Negative Impacts During Project Construction

Expected Negative Impact During Construction Phase	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Environmental pollution (air, water, noise etc)	Frequenc y, f	1	31	190	113	28	3
	Percent, %	0.3	8.5	52.3	31.1	7.7	
	Cum.Perc ent, C%	0.3	8.8	61.2	92.3	100.0	
Disturbance to the ecosystem (flora & fauna)	Frequenc y, f	1	103	131	100	28	3
	Percent, %	0.3	28.4	36.1	27.5	7.7	
	Cum.Perc ent, C%	0.3	28.7	64.7	92.3	100.0	
Disruption of tourism activities	Frequenc y, f	14	64	185	84	16	3
	Percent, %	3.9	17.6	51.0	23.1	4.4	
	Cum.Perc ent, C%	3.9	21.5	72.5	95.6	100.0	
Disruption of ecotourism activities	Frequenc y, f	13	90	164	69	27	3
	Percent, %	3.6	24.8	45.2	19.0	7.4	
	Cum.Perc ent, C%	3.6	28.4	73.6	92.6	100.0	
Drainage and irrigation issues	Frequenc y, f	12	100	161	79	11	3
	Percent, %	3.3	27.5	44.4	21.8	3.0	
	Cum.Perc ent, C%	3.3	30.9	75.2	97.0	100.0	
Increase in traffic and road damage	Frequenc y, f	19	82	111	121	30	3
	Percent, %	5.2	22.6	30.6	33.3	8.3	
	Cum.Perc ent, C%	5.2	27.8	58.4	91.7	100.0	
Higher risk of natural disasters (flash floods, landslides, etc.)	Frequenc y, f	20	77	121	130	15	3
	Percent, %	5.5	21.2	33.3	35.8	4.1	
	Cum.Perc ent, C%	5.5	26.7	60.1	95.9	100.0	
Social issues (e.g., crime, theft, etc.)	Frequenc y, f	13	91	222	33	4	3
	Percent, %	3.6	25.1	61.2	9.1	1.1	
	Cum.Perc ent, C%	3.6	28.7	89.8	98.9	100.0	

7.6.3 Expected impact by residents, businesses, institutions, and the broader community within the zone of impact (After Project Completed and Operational)

The anticipated impacts on residents, businesses, institutions, and the broader community within the zone of impact following the completion and operational phase of the columbarium project are outlined in **Table 7.13 – Table 7.14**.

Respondents expressed agreement with the expected positive outcomes associated with the hotel and its related components, including a hotel, spa and other facilities as tabulated in **Table 7.13**. The proposed project will renovate the existing abandoned Crag Hotel, preserving the historical building. This will attract tourists, boosting the tourism industry in the area.

Furthermore, the proposed project is expected to boost the economy as well by creating new jobs and business opportunities and also simultaneously increasing the value of surrounding properties near and on top of Penang Hill. To maximize these benefits, the restoration of Crag Hotel should be designed with accessibility, environmental sustainability, and heritage preservation in mind.

Table 7.13 Expected Positive Impacts After Project Completed and Operational

Expected Positive Impact During Operational Phase	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Boost in economy	Frequency, f	0	2	41	266	54	4
	Percent, %	0.0	0.6	11.3	73.3	14.9	
	Cum.Percent, C%	0.0	0.6	11.8	85.1	100.0	
Increase in job opportunities	Frequency, f	1	9	105	205	43	4
	Percent, %	0.3	2.5	28.9	56.5	11.8	
	Cum.Percent, C%	0.3	2.8	31.7	88.2	100.0	
Preservation of heritage areas and historical buildings	Frequency, f	2	62	70	184	45	4
	Percent, %	0.6	17.1	19.3	50.7	12.4	
	Cum.Percent, C%	0.6	17.6	36.9	87.6	100.0	
Attracts tourists	Frequency, f	6	9	97	187	64	4
	Percent, %	1.7	2.5	26.7	51.5	17.6	
	Cum.Percent, C%	1.7	4.1	30.9	82.4	100.0	
Growth of tourism industry	Frequency, f	3	14	92	187	67	4
	Percent, %	0.8	3.9	25.3	51.5	18.5	
	Cum.Percent, C%	0.8	4.7	30.0	81.5	100.0	
Increase of value	Frequency, f	2	13	123	197	28	4

of surrounding properties	Percent, %	0.6	3.6	33.9	54.3	7.7	
	Cum.Percent, C%	0.6	4.1	38.0	92.3	100.0	

Table 7.14 indicates that respondents acknowledged potential challenges such as increased traffic congestion in the surrounding area once the project becomes operational. However, it is important to note that congestion and other negative impacts are not expected to occur on a daily basis but probably during peak periods, such as weekends and long holidays.

Response has been neutral on overcrowding issues, which indicates the local community still believes that the facilities (existing and new) will be able to support any increased volume of visitors.

Table 7.14 Expected Negative Impacts After Project Completed and Operational

Expected Negative Impact During Operational Phase	SCALE	STRONGLY DISAGREED	DISAGREED	NEUTRAL	AGREED	STRONGLY AGREED	Median
	SCORE	1	2	3	4	5	
Traffic congestion issues	Frequency, f	6	32	91	205	29	4
	Percent, %	1.7	8.8	25.1	56.5	8.0	
	Cum.Percent, C%	1.7	10.5	35.5	92.0	100.0	
Overcrowding issues	Frequency, f	7	42	171	120	23	3
	Percent, %	1.9	11.6	47.1	33.1	6.3	
	Cum.Percent, C%	1.9	13.5	60.6	93.7	100.0	

7.6.4 Summary of Positive Impacts of Proposed Development

The proposed development is expected to generate several positive social and economic impacts for residents, businesses, institutions, tourists, and the broader community within the zone of impact. During the pre-construction phase, respondents anticipate increased economic opportunities, better utilization of existing structures, and alignment with local development plans. During the construction phase, the project is expected to create employment and business opportunities while also contributing to improvements in infrastructure and facilities such as drainage systems. The renovation of existing historical structures is also viewed positively by the community.

Once completed and operational, the project is expected to boost tourism by restoring the historic Crag Hotel and introducing new facilities such as a hotel and spa. This is anticipated to strengthen the local tourism industry, stimulate economic growth through job creation and business activities, and potentially increase property values in the surrounding area. In general, it can be concluded that respondents are favourable towards the proposed development and that it will be beneficial to the surrounding community.

7.7 AIR QUALITY ASSESSMENT DURING DEMOLITION & CONSTRUCTION PHASE

Air pollution is significant only during the demolition and construction phase (especially during **site clearing and earthworks of the project**), as on completion of the project, the air pollutants emitted become insignificant. The only significant air pollutant of concern is particulate matter PM10.

Suspended particulate matter (PM) is expected to be generated during the demolition phase, during the clearing of the project area and any other earthworks operations required for the construction of the proposed housing development including access and internal roads. Stockpiles of topsoil, uncovered loads on construction vehicles and unprotected cleared areas are other potential PM sources. In addition, PM could be generated during unsealed road use by construction traffic. PM emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

7.7.1 Emission of Particulate Matter PM10

In general, emissions calculations were referred from **Section 13, in “Compilation of Air Pollutant Emission Factors (Vol 1, 5th Ed)”** and its subsequent revisions, published by United States Environmental Protection Agency (USEPA) in 1995. Details of the emission calculations are discussed in the following sections.

Construction consists of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected i) to have a definable beginning and an end and ii) to vary substantially over different phases of the construction process. This is in contrast to most other fugitive suspended PM sources, where emissions are either relatively steady or follow a discernible annual cycle. Furthermore, there is often a need to estimate area wide construction emissions, without regard to the actual plans of any individual construction project. For these reasons it is very difficult to estimate the potential PM emissions from the sources. However, it can be said that the quantity of PM emissions from construction operations are i) proportional to the area of land being worked and to the level of construction activity, ii) positively correlated with the silt content of the soil, iii) dependant on the speed and weight of the average vehicle and iv) negatively correlated with the soil moisture content. Based on these limitations and a set of field studies which attempts to relate the emissions from construction directly to an emission factor, the approximate emission factor for construction activity operations is (USEPA, 1995): -

$$E = 2.69 \text{ megagrams (Mg)/hectare/month of activity}$$

This value is most useful for developing estimates of overall emissions from construction scattered throughout a geographical area. The value is most applicable to construction operations with: i) medium activity level, ii) moderate silt contents, and iii) semi-arid climate.

The project covers an area of **3.112 ha** in which the construction process (including demolition, installation of BMPS, earthworks etc) will encompass **14 months**. Applying the above formula, **E = 2.69 megagrams (Mg)/hectare/month of activity** and based on a construction process of **14 months** (7 months of setting up BMPS, 6 months of demolition work & 1 month of earthwork activities), the total amount of **dust emitted without control measures** is: -

$$E = 2.69 \times 3.112 \text{ ha} \times 14 \text{ month} = 117.2 \text{ Mg}$$

Based on a total estimated emission of **117.2 Mg** during the **14-month construction period**, with operating hours of **10 hours per day** and **6 working days per week**, the average emission rate is estimated to be **34.88 kg/hr**, equivalent to **9.69 g/s**.

However, in the case when there are control measures such as keeping exposed surfaces moist and covered, the emission rate can be reduced by almost **90%**. Thus, with dust control measures, **the total emission rate is estimated to be 0.97 g/s** which is concluded to be a manageable rate.

7.7.2 Emissions from Transportation of Material/Waste on Paved Road

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust smoke, fugitive dust if materials transported are not secured properly, brake wear and tire wear emissions and resuspension of loose material on the road surface. In general terms, resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface (i.e., the surface loading).

The quantity of particulate emissions from resuspension of loose material on the road surface due to vehicle travel on a dry paved road may be estimated using **USEPA AP-42 (Section 13.2.1: Paved Roads)**:

$$E = k (sL)^{0.91} \times (W)^{1.02}$$

Where:

- E = Particulate emission factor (g/VKT)
- k = Particle size multiplier for particle size range and units of interest adopted as per Table 13.2.1-1. (USEPA, 1995)
- sL = Road surface silt loading (g/m²),
- W = Average weight (tons) of the vehicles travelling the road

Table 13.2.1-1. PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Size range ^a	Particle Size Multiplier k ^b		
	g/VKT	g/VMT	lb/VMT
PM-2.5 ^c	0.15	0.25	0.00054
PM-10	0.62	1.00	0.0022
PM-15	0.77	1.23	0.0027
PM-30 ^d	3.23	5.24	0.011

^a Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

^b Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.

^c The k-factors for PM_{2.5} were based on the average PM_{2.5}:PM₁₀ ratio of test runs in Reference 30.

^d PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Source: Table 13.2.1-1 in *Compilation of Air Pollutant Emission Factors (Vol 1, 5th Ed)* by USEPA (1995)

The assumptions are as follows:

Parameter	Value	Remarks
Road type	Paved	Public road
Silt loading, sL	0.20 g/m ²	Typical low-traffic paved road
Average vehicle weight, W	20 tons	Laden condition
Particle size multiplier, k	PM10	0.62

In the context of this proposed project, the calculations for emissions during material transportation are done for 2 scenarios:

- **Scenario A:** Emissions for transporting all waste to landfill **without considering any alternate waste management methods** such as reusing and recycling
- **Scenario B:** Emissions for transporting the remaining waste **after utilising waste management methods** such as reusing and recycling.

7.7.2.1 Calculation of Emission Factor (PM10) Without Waste Management

$$E = k (sL)^{0.91} \times (W)^{1.02}$$

$$E = 0.62(0.20)^{0.91} \times (20)^{1.02} = \underline{\underline{3.04 \text{ g/VKT}}}$$

The Emission Factor (E) for emission during material transportation is calculated to be **3.04 g per VKT (Vehicle Kilometer Travelled)**. In this scenario, all debris and excess soil will be transported to **Pulau Burung Landfill**, located **64 km** away.

Thus, the **Emission Factor (E) for PM10 for the distance travelled for one trip (64km)** is calculated to be **194.56 g/per trip**.

The working days for this project are expected to be **10 hrs a day, 6 days a week**. The total debris to be transported out for this development is estimated to be 2614 m³ (2209 m³ from demolition activities and 405 m³ from earthwork activities).

Assuming lorries with a capacity of 5m are used, there will be a **total of 523 trips spread over a period of 7 months**. **442 trips** are expected during the **6 months of demolition activities**, while another **81 trips** are expected during the **one month of earthwork activities**.

i. Calculation of Emission during Demolition Phase

As calculated above, the Emission Factor (E) for one trip is **194.56 g/per trip**. 442 trips are expected during the 6 months/144 days of demolition activities, which results in 3 trips per day. Hence the **E for a day will be 584.4g per day**, equivalent to **0.016 g/s**.

ii. Calculation of Emission during Earthwork Phase

As calculated earlier, the Emission Factor (E) for one trip is **194.56 g/per trip**. 81 trips are expected during the 1 month /24 days of earthwork activities, which results in approximately 4 trips per day. Hence the **E for a day will be 778.24g per day**, equivalent to **0.022 g/s**.

7.7.2.2 Calculation of Emission Factor (PM10) With Waste Management

The amount of materials and waste that need to be transported out can be reduced significantly through efficient waste management methods such as recycling and reusing. These are further discussed below in respect to the waste materials produced in each phase.

i. Calculation of Emission during Demolition Phase

Majority of waste generated during demolition activities can be reused or sold. **Table 7.15** shows the estimated material composition of the 22 units to be demolished (*refer Appendix F - Demolition Plan*), along with waste management actions. The estimation of material composition was done based on direct observation on site, resources from Georgetown World Heritage Inc (GTWHI), and a study by Callegher et.al (2023) focusing on building materials used in European structures. Data for multifamily houses built before 1945 were referred to. Waste management actions are referred from Demolition Method Statement (*Appendix F*).

Table 7.15 Estimated Material Composition of Demolition Waste

Material Category	Estimated % of Total Demolition Waste	Actions Taken
Timber	35	Reused on site for formwork, propping, temporary storage, temporary working platforms, and etc
Concrete, Stone, Granite, Lime	25	Crushed and processed into aggregates for new foundations/roads.
Clay Bricks	15	- Crushed and processed into aggregates for new foundations/roads. - Reused in new structures
Scrap Metal & Glass/ Window Panes	15	- Reused on site for temporary working platforms and structures - Reused in new structures
Residual Waste (Unsalvageable /non-recyclable materials)	10	Cleared and taken-away from site using RORO Bin (registered under MBPP) to be eventually dumped at landfills.
Materials with Heritage Value	Depends on further assessment	If any materials are deemed to have heritage value, then they will be salvaged to be reused in new structures or will be sold to local heritage contractors (as listed by GTWHI) or to private collectors

Approximately only 10% of materials are estimated to be unsalvageable or non-recyclable and have to be disposed off at landfills. Hence, the number of expected lorry trips will be reduced to 45 trips (from originally 442 trips). Thus, the E for transportation of demolition debris is estimated to be **1459 g per month** throughout the 6 months of demolition activities, equivalent to **0.002 g/s**.

ii. Calculation of Emission during Earthwork Phase

Approximately 405 m³ of excess soil will be generated from earthwork activities. The project proponent plans to reuse the excess soil as topsoil for landscaping activities on the project site. Hence, this negates any need for material transportation, and no emissions are generated.

7.7.3 Summary of Emission Rates

As there are no Malaysian standards for emission rates, the rates were referred to **US Environmental Protection Agency (EPA) Regulations for Prevention of Significant Deterioration (PSD) of Air Quality [Title 40 CFR; §52.21(b)(23)(i)]**, which states a significant rate of emissions would equal or exceed **15 ton per year (tpy) for PM10**.

Table 7.16 shows the summary of expected emission rates from direct site emissions and transport emissions for both phases.

Table 7.16 Summary of Expected Emission Rates

NO	POLLUTANT SOURCE	PHASE	UNMITIGATED	MITIGATED 90% with BMPs	WITH WASTE MINIMISATION
1.	Direct Site Emissions	Demolition, BMPs, Earthworks (14 mths)	9.69 g/s	0.97 g/s	-
			305.79 tn/yr	30.6 tn/yr	
2.	Transport Emission (From project site to Pulau Burung landfill - 64km)	Demolition (6 mths)	0.016 g/s	-	0.002 g/s
			0.505 tn/yr		0.631 tn/yr
		Earthwork (1mth)	0.022 g/s	-	None (all reused)
			0.694 tn/yr		

The estimated values above correspond to site activities in which significant emissions are expected during 14 months, of demolition, construction of BMPs and earthworks on the project site. With mitigation measures, PM10 emissions can be reduced by 90%, resulting in 0.97 g/s or 30.6 ton per year. This is slightly above the permissible limit of 15 tons per year.

The estimated values are the sum of daily site activities, which can be controlled through monthly air quality monitoring and frequent use of water bowser together with other onsite proposed mitigation measures, PM10 emission levels can be reduced as per acceptable limits.

The transport of materials does not have any significant impact as shown in Table 7.15. With the implementation of **proper housekeeping and vehicle management practices** such as **covering of transported materials, speed limit control**, the impact on ambient air quality is expected to be minimal. Furthermore, with good waste management practices such as reusing and recycling, the potential emissions from transport of waste and materials can be even more minimized.

7.7.4 Sensitive and Discrete Receptors

Air quality impact contour map for the proposed project visualizes PM10 dispersion across a 5 km radius (**Figure 7.1**). Using data from the Bayan Lepas Meteorological Station, the wind predominantly originates from the North (22.4%), pushing the highest concentration of particles toward the southern interior of the Hill. Beside that significant wind from the Southwest (17.3%) carries particles toward the Northeast during site clearing and earthworks.

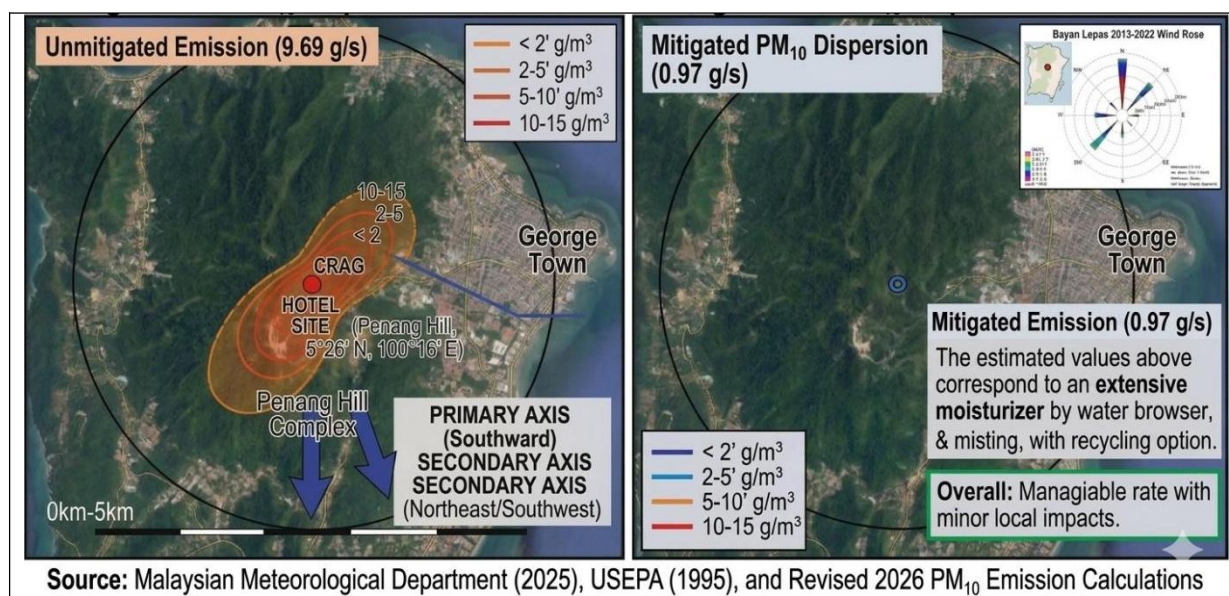


Figure 7.1 PM10 Dispersion Scenarios

7.8 NOISE LEVEL ASSESSMENT

7.8.1 Noise Level Impact

Construction activities can be a source of nuisance for residents living near the site, particularly those within 100 meters of the construction area. The frequent movement of heavy vehicles transporting equipment and materials via existing roads will inevitably elevate noise and vibration levels in the surrounding areas. The operation of heavy vehicles and machinery during construction may generate noticeable noise and vibration effects on nearby receptors. This effect can be more pronounced if the affected buildings or structures are located within 30 meters of the vehicle pathways. As a result, neighbouring receptors are likely to experience increased disturbance throughout the construction phase. Noise limits for the construction phase are outlined in **Schedule 6 of the Guidelines for Environmental Noise Limits and Control Third Edition 2019 (Reprint 2021)**, as detailed in **Table 7.17**.

Table 7.17 Sixth Schedule: Maximum Permissible Sound Levels (Percentile L₁₀ and L_{max}) Of Construction, Maintenance and Demolition Work by Receiving Land use

Receiving Land Use Category	Noise Parameter	Day 7.00 am - 7.00 pm	Evening 7.00 pm - 10.00 pm	Night 10.00 pm - 7.00 am
Residential, Sensitive Areas (Note 2 **)	L ₁₀	75 dBA	70 dBA	70 dBA
	L _{max}	90 dBA	85 dBA	85 dBA
	L _{Aeq}	-	-	*Note 1
Commercial, Mixed Development	L ₁₀	80 dBA	80 dBA	75 dBA
Industrial	L ₁₀	80 dBA	80 dBA	80 dBA

Note

*1. At night time, the maximum permissible levels as stipulated in Schedule 3 for respective residential density type shall apply.

**2. Limits for daytime L_{Aeq} or reduction of L₁₀ levels in vicinity of sensitive premises (such as schools and hospitals) may be exercised by the Local Authority or Department of Environment. In such situations, limits for daytime L_{Aeq} +3 dBA based on Schedule 3 may apply.

3. There are no prescribed limits for L_{max} and L_{Aeq} levels for construction noise for commercial and industrial land use. Assessment of L_{Aeq} levels if required shall be based on comparison against prevailing ambient noise (Schedule 3).

Source: *Guidelines for Environmental Noise Limits and Control Third Edition 2019 (Reprint 2021)*

Based on Federal Transit Administration, 2018. U.S. Department of Transportation, sound pressure level, L_p , for typical noise levels associated with construction equipment usage during construction activities are provided in **Table 7.18**.

Table 7.18 Construction Equipment Noise Emission Levels

Equipment	Typical Noise Level 15.24 m (50 ft) from Source, dBA
Air Compressor	80
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	82
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	80
Paver	85
Pile-driver (Impact)	101
Pile-driver (Sonic)	95
Pneumatic Tool	85
Pump	77
Rail Saw	90
Rock Drill	95
Roller	85
Saw	76
Scarifier	83
Scraper	85
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Insertter	85
Truck	84

Source: Federal Transit Administration, 2018. U.S. Department of Transportation

Construction activities have the potential to generate significant noise impacts in the surrounding area during site preparation and piling work. Piling activities are one of the highest noise level producers among the listed sources. An average noise **power level of 90 dBA** is used as the input (L_p source) for simulating the construction noise environment, representing both piling activities and continuous operation of heavy-duty construction equipment along the project site boundary.

7.8.2 Expected Sound Propagation from Point Sources

Noise propagation is the transmission of sound waves through a certain medium. The Sound Pressure Level (SPL) is the most commonly used indicator of the acoustic wave strength. It correlates well with human perception of loudness and is measured easily with relatively inexpensive instrumentation (Clement Acoustics, 2025). SPL tends to reduce with distance from the source, with the reduction levels depending on the type of sound source.

There are three general types of sources which are point source, line source and plane source. Point source noise is usually associated with a source that remains in one place for extended periods of time, such as with most construction activities (WSDOT, 2012 & Clement Acoustics, 2025). Sound attenuation from a point source can be estimated using the Inverse Square Law (Clement Acoustics, 2025), where:

$$L_{p(\text{receiver})} = L_{p(\text{source})} - 20 \times \log_{10} (R_2/R_1)$$

Where;

$L_{p(\text{receiver})}$ = calculated SPL at receiver

$L_{p(\text{source})}$ = SPL at source

R_1 = distance from sound source to $L_{p(\text{source})}$

R_2 = distance from $L_{p(\text{source})}$ to location of $L_{p(\text{receiver})}$

In this case, $L_{p(\text{Source})}$ represents the expected noise level from construction activities. Based on the earlier **Table 7.19**, the sound level (L_{max}) is given at a distance of **15 m** from the source; therefore, $R_1 = 15\text{m}$. The distances to the **nearest sensitive receivers (R_2)** are **163 m**, **510 m**, and **198 m**, respectively, as shown in **Figure 7.2**.

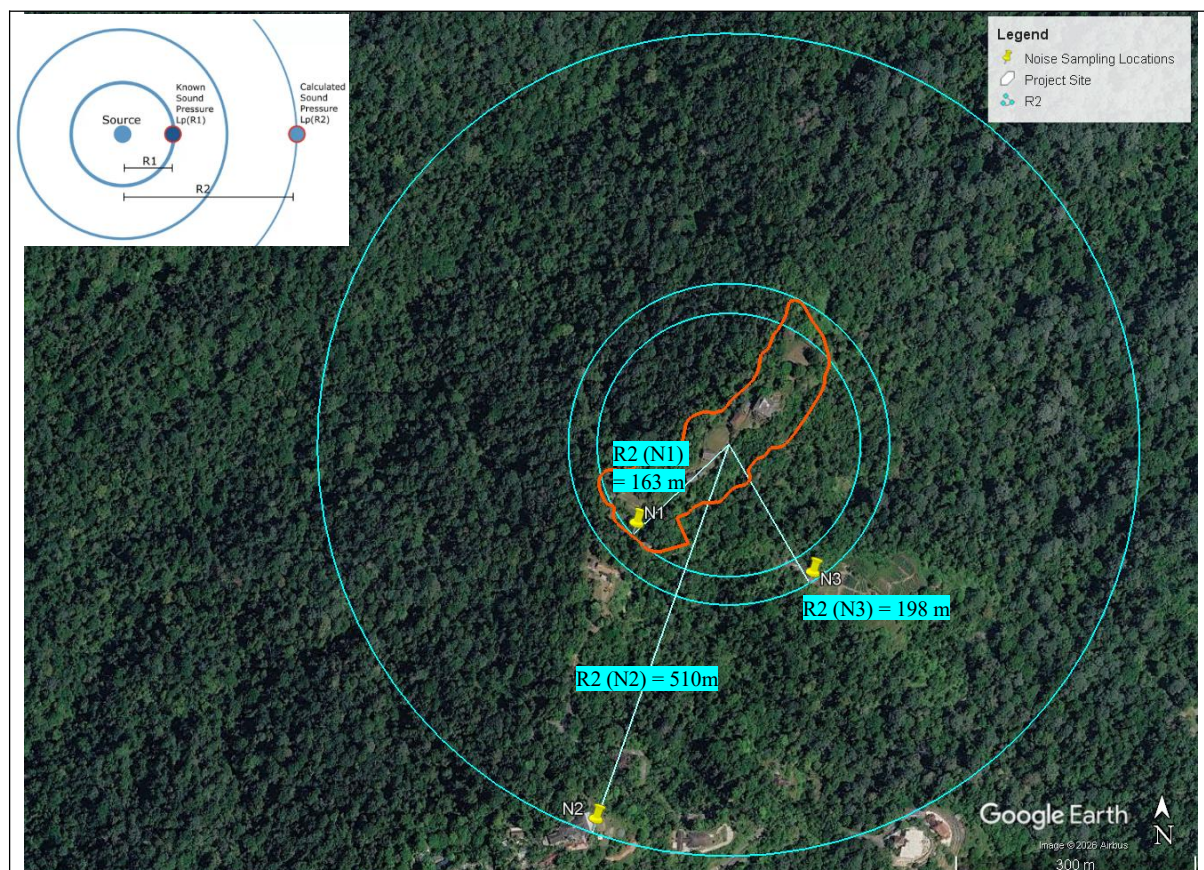


Figure 7.2: Distance from Site to the Sensitive Receptors

Construction activities are expected to generate noise levels between **80 to 95 dB(A)** for **general construction plant**. Noise predictions were undertaken based on typical sound power levels adopted from **BS 5228-1:2009+A1:2014**. Assuming a source noise level of **90 dBA**, the predicted noise levels at the nearest sensitive receptors, located approximately **163 m, 510 m, and 198 m** from the project site are detailed in **Table 7.19**.

The results indicate that noise levels at all receptors are **well below 80 dB(A)**, as outlined in **Schedule 6 of the DOE Noise Guidelines**, indicating that the **noise impact is low**.

Table 7.19 Predicted Noise Attenuation with Distance for Point Source

		Nearest sensitive receptors / Noise sampling locations		
		N1	N2	N3
Noise Levels at Source	R1 (m)	15		
	SPL of Source (dB)	90		
Predicted Noise Levels at Sensitive Receptors	R2 (m)	163	510	198
	SPL at R2 (dB)	69.3	59.4	67.6
	Distance Attenuation (dB)	-20.7	-30.6	-22.4

The simulations in **Figure 7.3** present the predicted noise impact scenarios for the proposed project. The simulations are made using established data for sound levels and specific distances for sensitive receptors (N1, N2, N3) that were also used in establishing baseline conditions.

The simulation on the left for the "Mitigated Scenario" is based on the principle of acoustic shielding. When a physical barrier (like a temporary wall or hoarding) is placed between a noise source and a receiver, it creates a "sound shadow" that reduces the noise level (in this case, by 10 dB), ensuring the noise levels remain within permissible levels. The unmitigated (Right), by comparison shows a large core area of severe noise (red, >80 dBA).

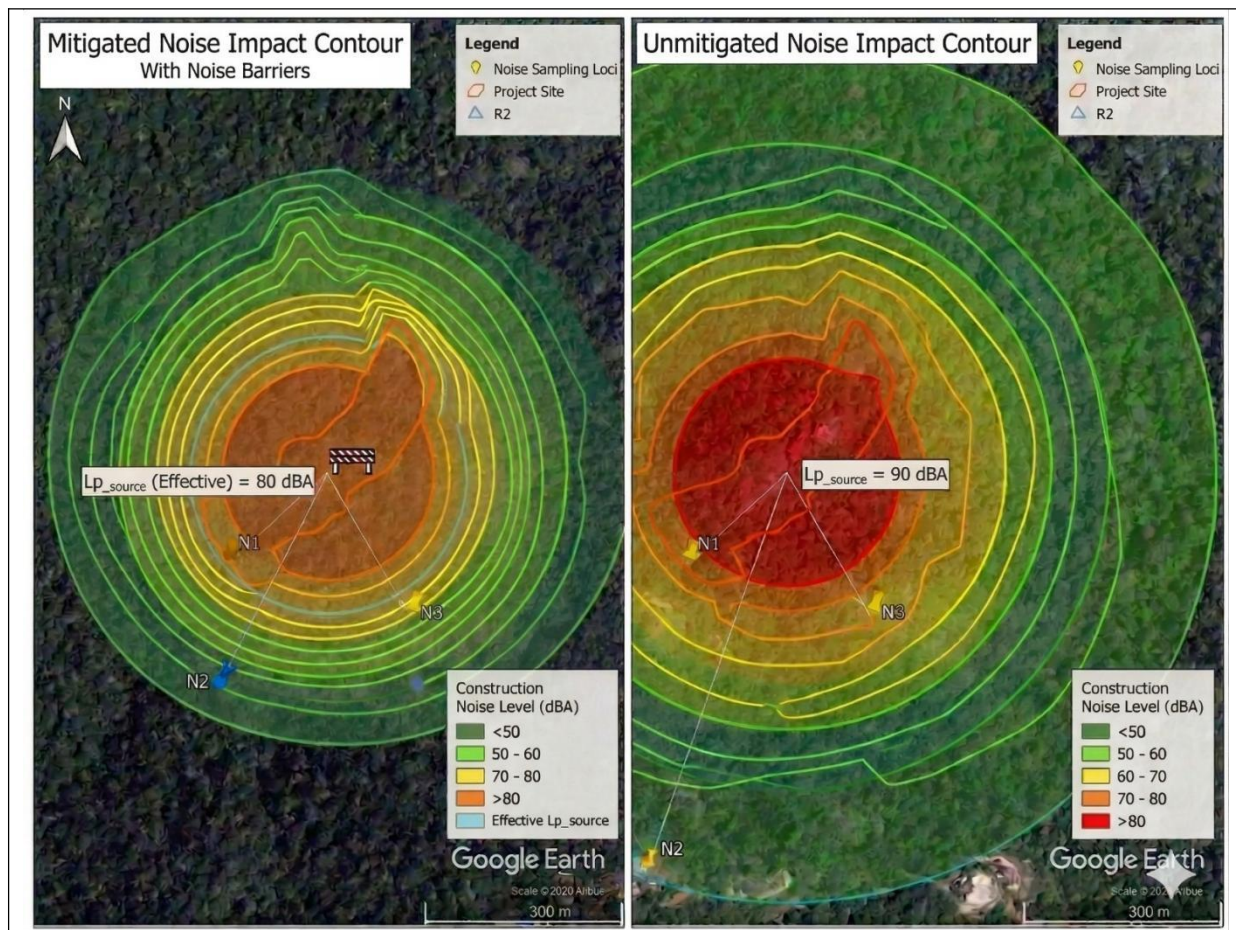


Figure 7.3 Noise Impact Scenarios: Mitigated (left) and Unmitigated (right)

7.9 WATER QUALITY MODELLING

7.9.1 Introduction

The project site is located within the Sungai Air Terjun catchment. Sungai Air Terjun (also known as the Waterfall River) is one of the most critical and historic raw water resources on Penang Island. Located within the lush greenery of the Penang Botanical Gardens, it serves as a primary source for the Waterfall Water Treatment Plant (WTP). Preserving the Sungai Air Terjun catchment in Penang is vital for ensuring a sustainable and reliable water supply for the region. Covering approximately 12.4 square kilometers, this catchment area serves as a primary source of raw water that supports domestic, agricultural, and industrial needs. The natural vegetation and forested landscape within the catchment play a crucial role in maintaining water quality by filtering pollutants and reducing surface runoff, which helps prevent contamination and lowers treatment costs. Protecting this area also safeguards the ecological balance, supporting local biodiversity and environmental health. Furthermore, a healthy catchment enhances climate resilience by buffering against extreme weather events such as heavy rains and droughts, ensuring water availability even during challenging conditions. Overall, the preservation of Sungai Air Terjun's catchment is essential for maintaining water security, ecological stability, and sustainable development for Penang's future.

The discharge from the project site may further degrade the water quality of Sungai Air Terjun, attributable to earthworks during the construction phase and STP discharge during operation phase. Due to this reason, the water quality modelling was undertaken to assess anticipated contamination levels from this development. The modelling predicts pollutant dispersion and concentrations, supporting the design of effective mitigation measures to protect the riverine ecosystem and downstream users.

7.9.2 Methodology

In this study, the QUAL2K software was employed to simulate water quality. QUAL2K is a one-dimensional stream water quality model that operates under steady flow conditions. The river was divided into "reaches" and each reach was further segmented for analysis. The proposed final discharge points from the project site are displayed in **Figure 7.4** while **Figure 7.5** illustrates the schematic structure of the simulation conducted using the QUAL2K software. The selection of water sampling locations aimed to cover both upstream and downstream areas of affected river final discharge points respectively.

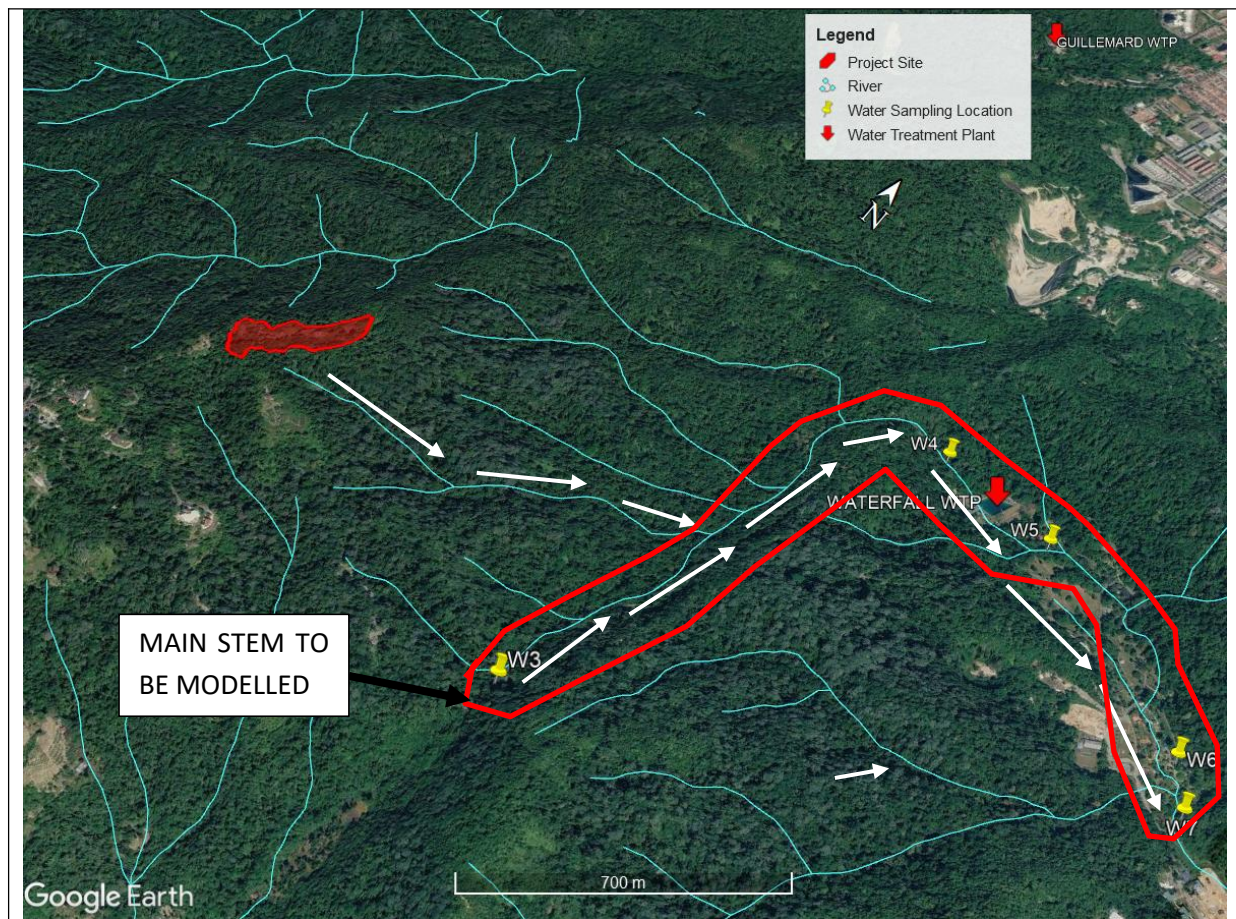


Figure 7.4: Water Sampling Point for Water Quality Modelling

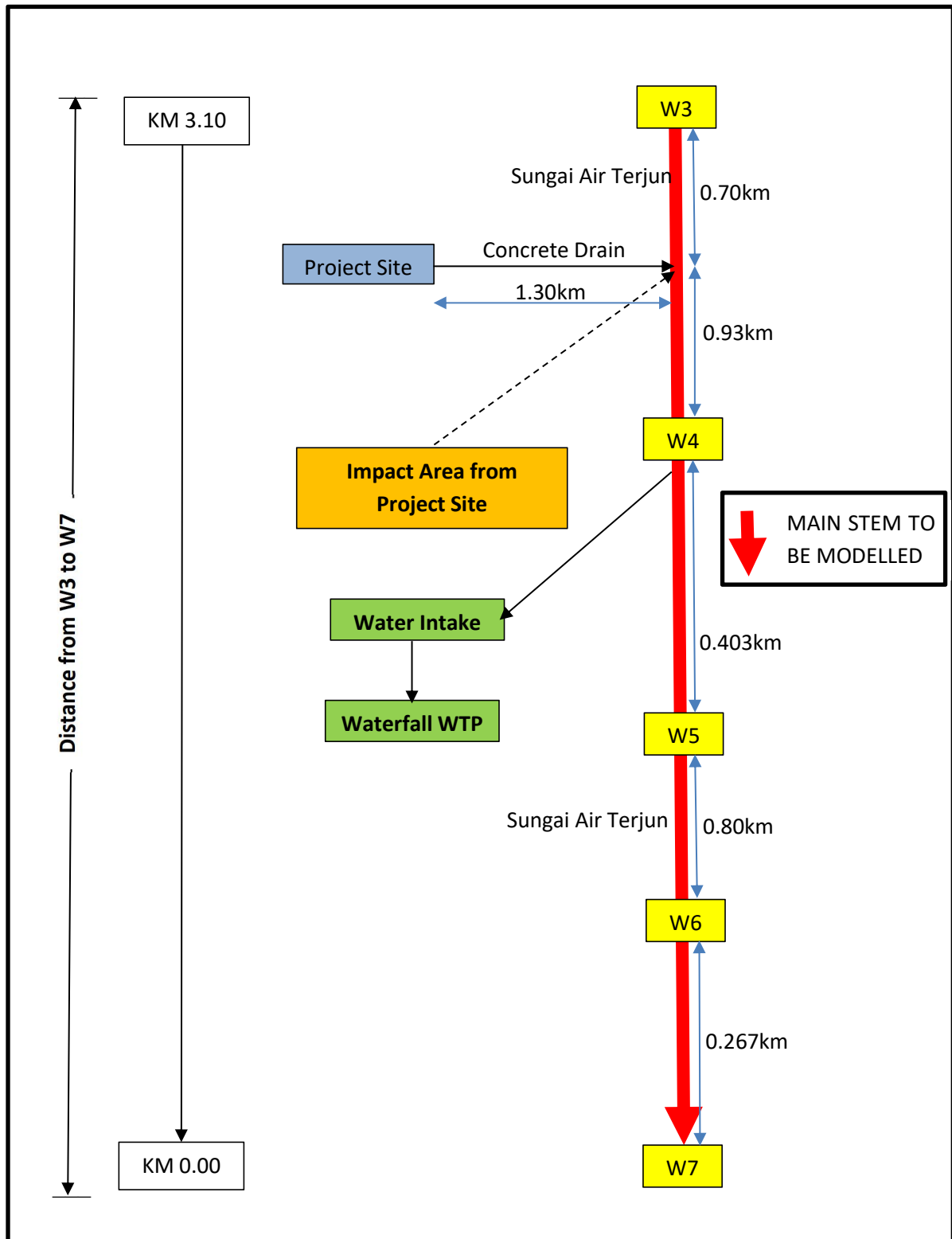


Figure 7.5 Schematic Diagram for Qual2k Simulation

7.9.3 Baseline Data Results

The water quality at five different locations (W3 to W7) has been assessed, and it generally appears to be good, particularly for potential water intake purposes (**Table 7.20**). Key measurements like dissolved oxygen are healthy at all sites, which is important for drinking water. While some tests, like for fecal coliform, show differences between locations, the overall water quality score for each site is high (scoring above 85) and is classified as “Clean.” Most other tested items like pH, suspended solids, and temperature are also within good ranges at most locations, which are favorable conditions for treating water for intake. This suggests that the water at these five sites is generally clean and suitable for potential intake and treatment, though some differences between the sites are noted and warrant continued observation.

Table 7.20 Summary of Baseline Water Quality Data

Parameters	Unit	BASELINE									
		W3		W4		W5		W6		W7	
		Result	Class	Result	Class	Result	Class	Result	Class	Result	Class
pH Value @25C	unitless	6.7	Class II	6.3	Class II	6.7	Class II	6.8	Class II	6.8	Class II
BOD - 5 days test @ 20°C	mg/L	5	Class III	3	Class III	ND<2	Class V	ND<2	Class V	3	Class III
COD, mg/l	mg/L	16.9	Class II	12.5	Class II	ND<2	Class I	ND<2	Class I	9.4	Class I
Total Suspended Solids	mg/L	4	Class I	1	Class I	5	Class I	6	Class I	7	Class I
Ammonical Nitrogen	mg/L	0.4	Class III	ND<0.1	Class I	0.4	Class III	0.4	Class III	ND<0.1	Class I
Dissolved Oxygen (DO)	mg/L	7.33	Class I	8.35	Class I	8.45	Class I	8.15	Class I	7.17	Class I
Fecal Coliform	MPN/100ml	79	Class IIA	2800	Class III	17	Class IIA	490	Class III	1700	Class III
Temperature	°C	26.6	Class II	23.4	Class II	26.4	Class II	26.3	Class II	26.4	Class II
Turbidity	NTU	8.8	Class II	7.1	Class II	4.1	Class I	3.4	Class I	3.9	Class I
Oil&Grease	mg/l	ND<0.2	-	ND<0.2	-	ND<0.2	-	ND<0.2	-	ND<0.2	-
Conductivity	uS/cm	-	-	12.4	Class I	-	-	-	-	-	-
Iron	mg/l	-	-	0.2	Class I	-	-	-	-	-	-
WATER QUALITY INDEX (WQI)	SCORE	85.77		92.59		93.88		93.85		93.59	
	CLASS	Class II		Class II		Class I		Class I		Class I	
	STATUS	Clean		Clean		Clean		Clean		Clean	

The simulation scenarios analyzed in this study are presented in **Tables 7.21-7.23**. The design discharge values employed in the simulations were provided by EDP CONSULTING GROUP SDN. BHD. During earthworks phase, one unit of sediment basin will be constructed to manage runoff and sediment from the project site. For the earthworks phase, only the TSS parameter was simulated, given that no other contaminants are anticipated during cut-and-fill operations. The TSS compliance limit is set at 50 mg/L, in accordance with Class Ila of Malaysia's National Water Quality Standards, which constitutes the minimum acceptable quality for potable water. Meanwhile, during the operation phase, the possible contamination might come from STP discharge. The treated effluent from the STP will be discharge at existing concrete drain and eventually connected with Sungai Air Terjun at downstream area. As such, the water quality simulation during operation period was carried out for STP effluent for parameters TSS, BOD, COD, Oil & Grease and NH₃-N.

Table 7.21 Project Site Water Discharge Quality Scenario (Construction Phase)

Parameter	Unit	Compliance Limit	Untreated Site Discharge
Earthwork Phase			
TSS	mg/L	50 ¹	598 ²

Source: 1) *Class Ila Water Quality Standard*-Department of Environment Malaysia (DOE) (2008). *National Water Quality Standards for Malaysia (NWQS)*. Ministry of Natural Resources and Environment.

2) Andy, K. & Adnan, M.S. (2023). A Study on Efficiency of Sediment Basin. *Recent Trends in Civil Engineering and Built Environment Vol. 4* No. 1 (2023) 423-429

Table 7.22 Sewage Effluent Quality Scenario (Operation Phase)

Parameter	Unit	Sewage Effluent (DOE, 2009)	Domestic Sewage (SPAN, 2009)
		Standard A	Untreated Effluent
BOD	mg/L	20	250
AN	mg/L	10	30
COD	mg/L	120	500
TSS	mg/L	50	300
Oil & Grease	mg/L	5	50

Table 7.23 Qual2k Simulation Scenario

Development Phase	Scenario Number	Project Phasing	Effluent from Proposed Project	Effluent Discharge	Effluent Quality Standard
Baseline	1		No discharge	-	Baseline
During Construction	2	One-Go	$Q_{\text{riser}} = 0.22\text{m}^3/\text{s}$	Sediment Basin	Class IIa (TSS=50 mg/L)
	3				Untreated Site Discharge (TSS=598 mg/L)
	4		$Q_{\text{spillway}} = 0.96\text{m}^3/\text{s}$		Class IIa (TSS)
	5				Untreated Site Discharge (TSS)
Operation	6	-	$Q_{\text{STP}} = 0.00196\text{m}^3/\text{s}$	STP	Standard A
	7				Untreated Effluent

7.9.4 Qual2k Simulation Results

7.9.4.1 TSS

Figures 7.6 and **Figure 7.7** depict the projected concentrations of suspended solids during the earthwork and operation phases. The baseline condition (purple line) represents the natural background TSS levels along Sungai Air Terjun, which remain consistently low (generally <10 mg/L, within Class I–II) with only a slight increase nearer to the downstream end. This indicates good existing water quality and minimal sediment influence under non-disturbed conditions.

When compared to the earthwork scenarios, both treated and untreated discharges show a clear deviation from this baseline. Under untreated conditions, TSS concentrations rise drastically at the discharge point and remain significantly elevated (≈ 73 – 173 mg/L), far exceeding baseline levels and shifting the river condition to Class III–IV. This represents a substantial deterioration from natural conditions, with high sediment loads persisting downstream and directly affecting the water intake.

Under treated discharge conditions, although TSS levels still increase above the baseline at the point of discharge, the magnitude of impact is much smaller (≈ 15 – 30 mg/L). The TSS concentrations are only moderately elevated relative to the baseline and tend to stabilize downstream, remaining within Class II–III. This indicates that while the project introduces some level of disturbance compared to natural conditions, the implemented mitigation measures effectively limit the increase in sediment load.

At the water intake location, the baseline condition reflects low and stable TSS, whereas treated discharge results in a moderate but controlled increase, and untreated discharge leads to a significant exceedance. The comparison clearly demonstrates that sediment control measures play a critical role in maintaining water quality closer to baseline conditions and ensuring that deviations remain within acceptable and manageable limits for downstream users.

With the introduction of STP discharge during operation phase, both treated and untreated scenarios show only a slight increase above the baseline. For the treated discharge, TSS at the water intake is approximately 5.12 mg/L, which is very close to baseline levels and remains well within Class I–II, indicating negligible impact. Even under treatment failure (untreated discharge), the TSS concentration at the intake increases marginally to about 5.8 mg/L, which is still only slightly above baseline and remains within acceptable limits.

Compared to the earlier earthwork scenario, the deviation from baseline here is minimal, and the TSS profile remains relatively stable. The small difference between treated and untreated conditions also suggests that the STP discharge has a low sediment contribution and that the river's assimilative capacity is sufficient to dilute the additional load effectively.

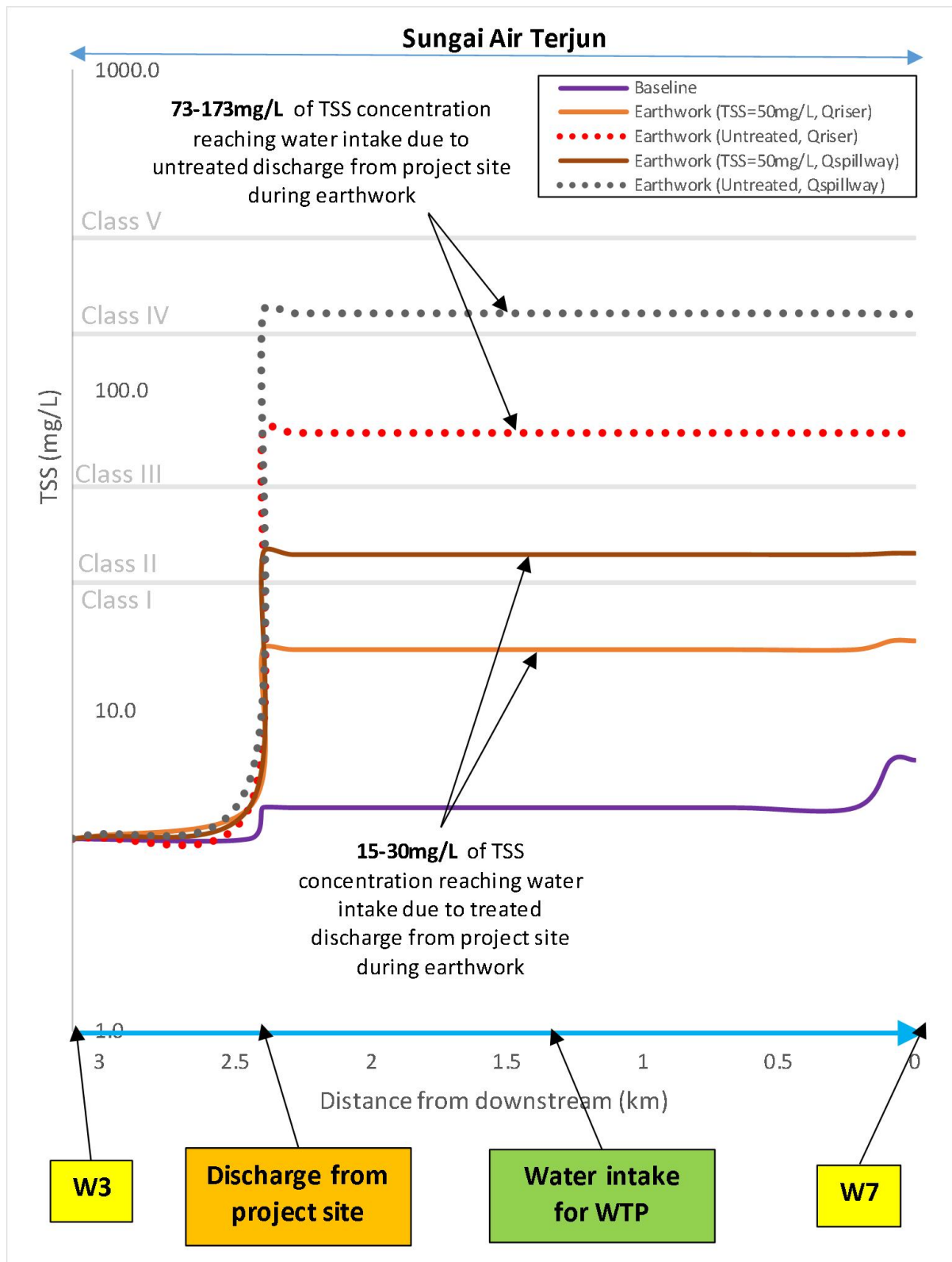


Figure 7.6: Total Suspended Solids (TSS) Contamination Level (Earthwork Phase)

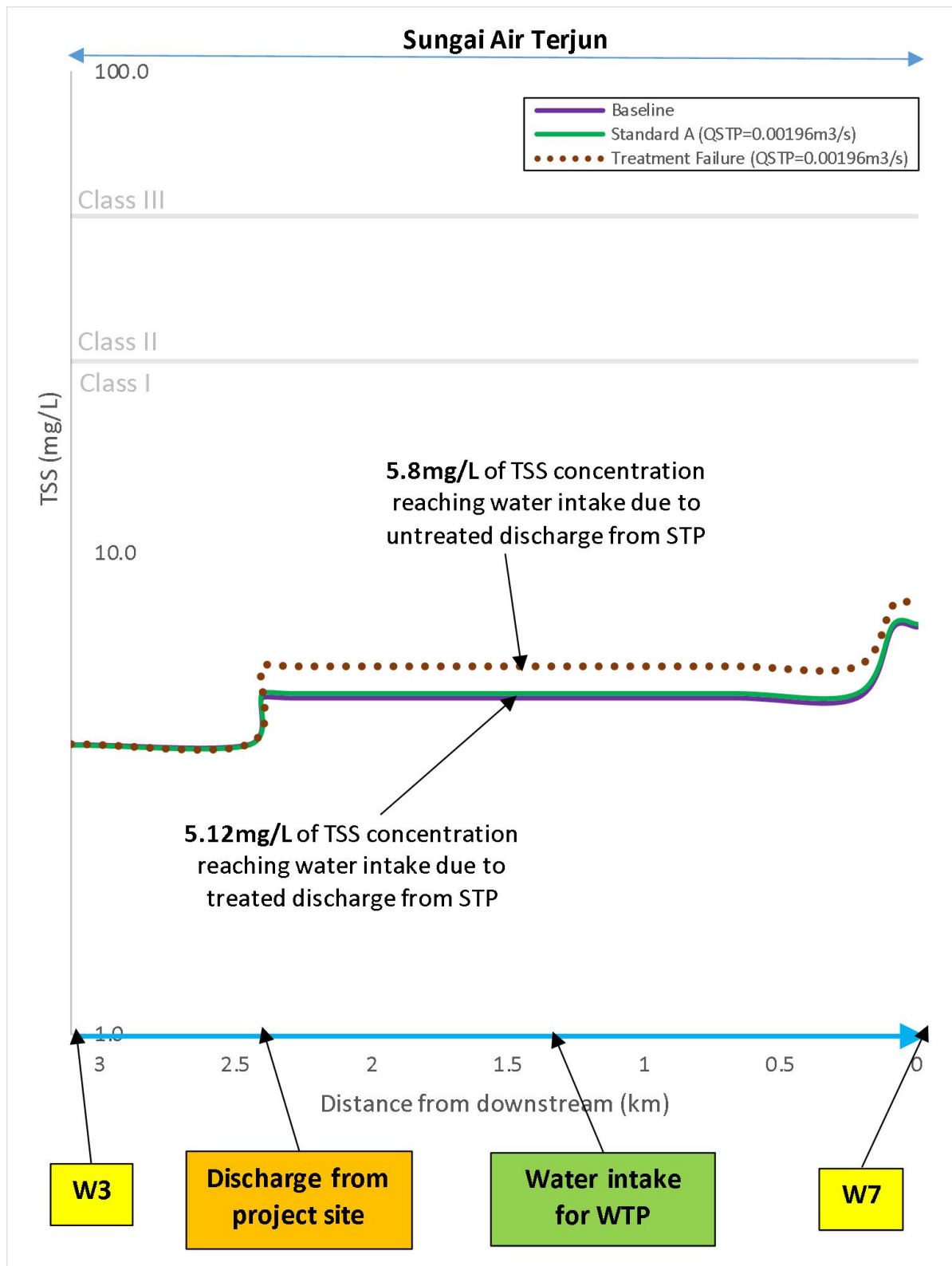


Figure 7.7: Total Suspended Solids (TSS) Contamination Level (Operation Phase)

7.9.4.2 BOD

Figures 7.8 depict the projected concentrations of Biochemical Oxygen Demand (BOD) during the operation phase. The baseline profile shows BOD levels stabilizing at around ~3.0 mg/L (Class II) toward the water intake, reflecting good existing water quality conditions.

With treated STP discharge (post-development), BOD at the intake increases marginally to ~3.05 mg/L, which is identical to the baseline. This indicates that the treated effluent is effectively controlled, with negligible organic loading entering the river and no meaningful deterioration in water quality. The BOD trend quickly stabilizes downstream, remaining within Class II.

Under treatment failure (untreated discharge), BOD rises slightly higher to ~3.67 mg/L at the intake. Although this represents an increase compared to baseline, the magnitude is still small and remains within the Class II–III boundary, suggesting that the river has sufficient assimilative capacity to dilute the organic load.

Overall, comparison with the baseline demonstrates that during post-development, the STP discharge results in only minor and localized increases in BOD, with treated conditions showing negligible impact and even worst-case conditions remaining within acceptable limits for downstream water use.

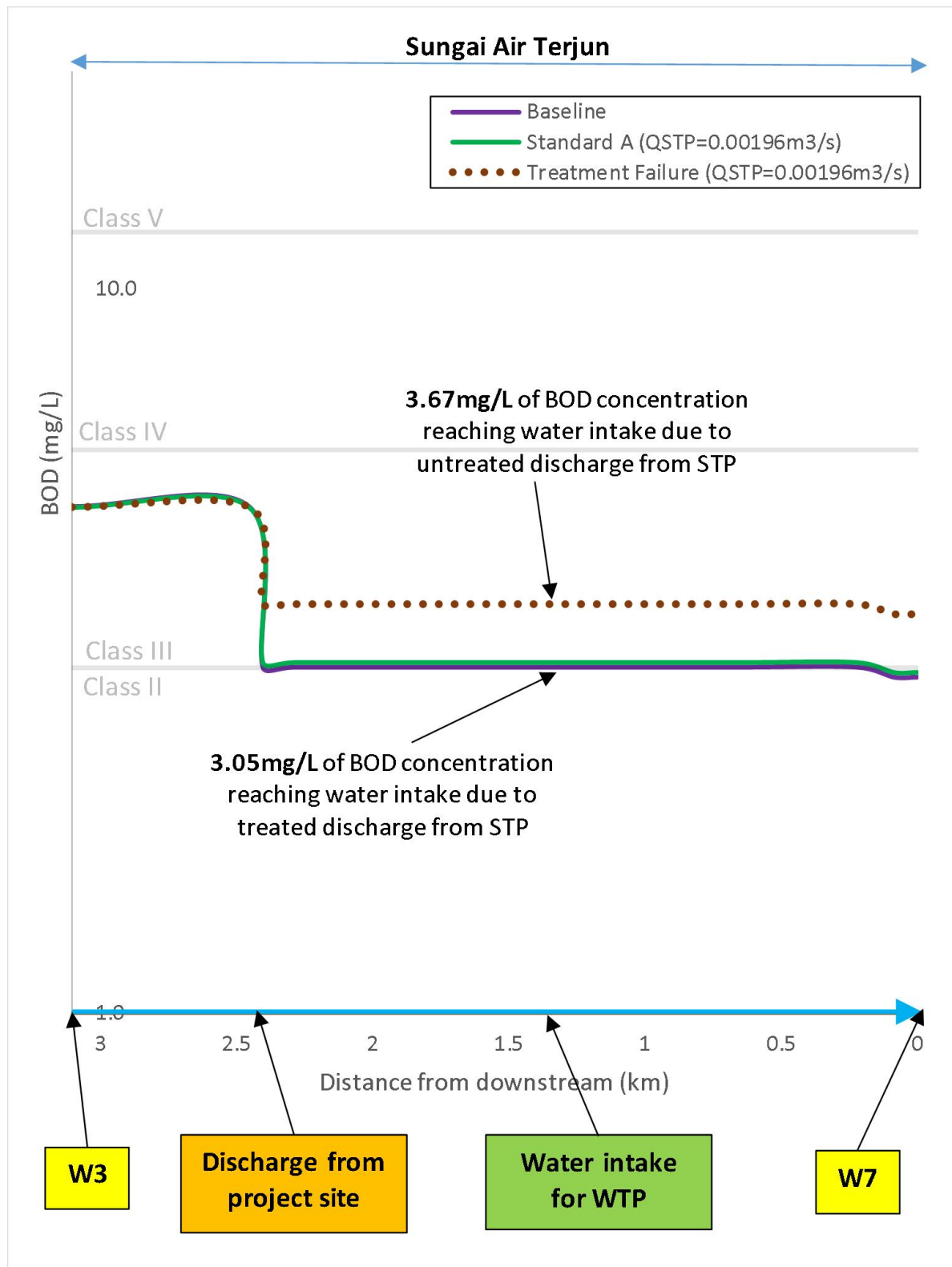


Figure 7.8: Biochemical Oxygen Demand (BOD) Contamination Level (Operation Phase)

7.9.4.3 COD

Figures 7.9 depict the projected concentrations of Chemical Oxygen Demand (COD) during the operation phase. The longitudinal water quality profile for Sungai Air Terjun indicates that the river currently maintains a high baseline standard, with COD levels consistently falling within the Class I category. Upon the introduction of effluent from the proposed project site, there is a distinct and immediate increase in organic loading across all simulated scenarios. Under normal operating conditions (Standard A), the COD concentration at the critical Water Treatment Plant (WTP) intake is maintained at a low level of 0.35 mg/L, representing a minimal impact on raw water quality.

In the event of a worst-case "Treatment Failure" scenario, the untreated discharge causes the COD concentration at the water intake to rise to 1.38 mg/L. While this represents a significant relative increase compared to treated discharge, the resulting concentration remains well below the Class I threshold, suggesting that the river possesses sufficient assimilative capacity to dilute the untreated effluent before it reaches the intake point.

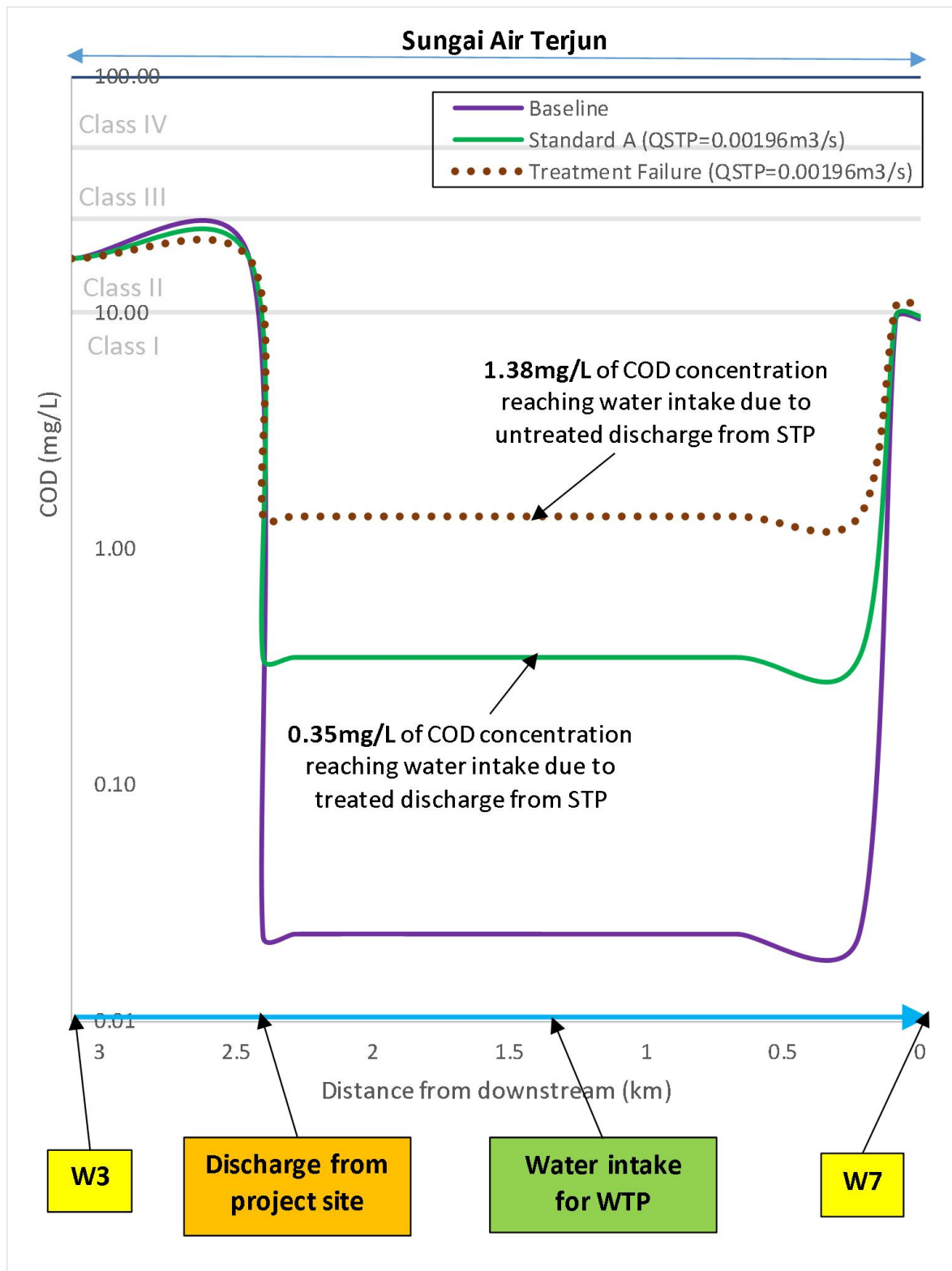


Figure 7.9: Chemical Oxygen Demand (COD) Contamination Level (Operation Phase)

7.9.4.4 *NH₃-N*

Figures 7.10 depict the projected concentrations of Ammoniacal Nitrogen (NH₃-N) during the operation phase. The water quality profile for NH₃-N in Sungai Air Terjun indicates that the river maintains a very high standard of purity, with baseline concentrations remaining well within the Class I threshold. Upon effluent discharge, the ammonia levels exhibit a marginal increase across all assessed scenarios, yet they consistently stay below the Class I limit of 0.100 mg/L. Under normal operations following Standard A, the NH₃-N concentration at the Water Treatment Plant (WTP) intake is recorded at 0.014 mg/L, representing a negligible impact on the raw water quality.

In a worst-case "Treatment Failure" scenario, the concentration at the intake rises to 0.025 mg/L. While this is nearly double the concentration of the treated scenario, it remains significantly below the sensitive regulatory thresholds for raw water. The downward trend in concentration observed as the water moves further downstream toward the W7 marker suggests effective natural nitrification and dilution processes within the river system. Consequently, the discharge from the Sewage Treatment Plant (STP) is not expected to pose a risk of ammonia toxicity or interfere with downstream water treatment processes, provided that standard mitigation and monitoring protocols are maintained.

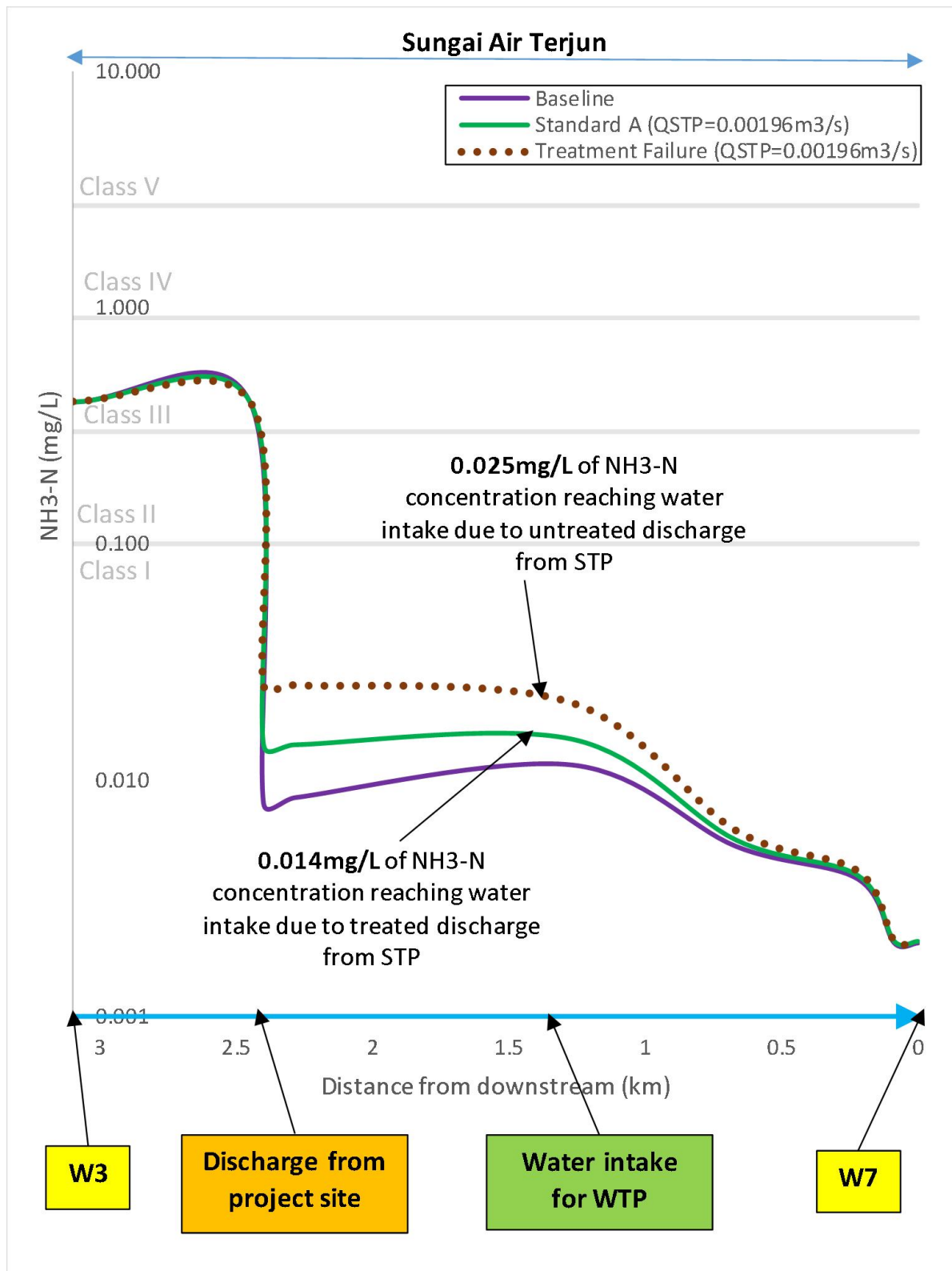


Figure 7.10: Ammoniacal Nitrogen ($\text{NH}_3\text{-N}$) Contamination Level (Operation Phase)

7.9.4.5 Oil & Grease

Figures 7.11 depict the projected concentrations of Oil & Grease during the operation phase. During the baseline condition, no Oil & Grease was detected in Sungai Air Terjun, indicating that the water was free from this pollutant prior to any wastewater discharge from the project site. Upon the introduction of effluent from the proposed Sewage Treatment Plant (STP) at the 2.4 km mark, the river's Oil & Grease concentration exhibits a measurable increase. Under normal operating conditions, where Standard A is strictly met, the Oil & Grease concentration at the water intake (located 1.3 km downstream) is projected to reach 0.014 mg/L. This concentration represents a minimal increment over the baseline.

In a worst-case scenario involving a Treatment Failure, the concentration at the intake point is projected to rise to 0.136 mg/L. While this represents a nearly ten-fold increase compared to the treated scenario, the absolute value remains low and safe for raw water.

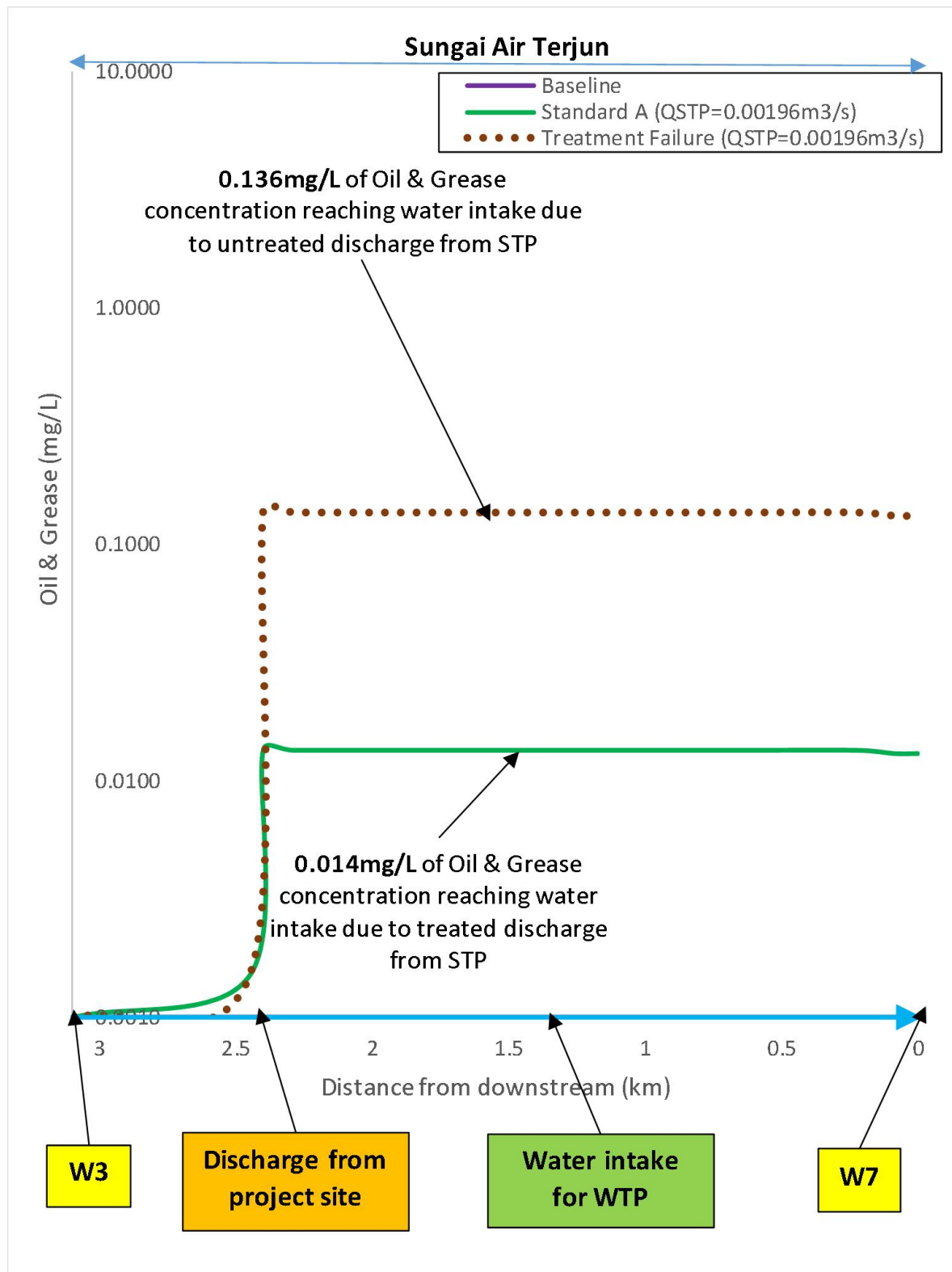


Figure 7.11: Oil & Grease Contamination Level (Operation Phase)

7.9.5 Waste Load Allocation (WLA)

In this study, waste load allocation values were derived through assessment of effluent discharges from the proposed project on downstream segments of the receiving river. Such allocations are vital for curtailing the influence of site effluents on the receiving water body. For the earthworks phase, a TSS WLA of 50 mg/L is sufficient to sustain prevailing concentrations in Sungai Air Terjun. During operation phase, maintaining the effluent discharge quality from STP using standard A class is sufficient to safeguard the water intake facility at downstream area.

7.9.6 Conclusion

The receiving effluent river is not anticipated to experience significant water quality issues due to the project's site discharge, provided it adheres to the recommended site discharge requirement. It is crucial to ensure the sedimentation pond operates at its optimal capacity during the construction phase to prevent non-compliance, particularly during rainfall events.

7.10 EROSION ASSESSMENT AND EVALUATION

7.10.1 Soil Erosion Assessment and Evaluation on Site

Prior to implementing any conservation or remedial measures on-site, it is essential to conduct analytical or numerical modeling to forecast the extent of soil loss and sediment yield. In this study, the assessment of soil erosion was carried out using the Revised Universal Soil Loss Equation (RUSLE), while the Modified Soil Loss Equation (MUSLE) was employed to estimate sediment yield. The following documents were employed in the assessment: -

- Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in EIA Report as per Appendix 3 EGIM 2016;
- Malaysia Standard- Urban Stormwater Management (MS 2526-1:14, MS 2526-2:14, MS 2526-3:14, MS 2526-12:14) (SIRIM, 2014);
- Urban Storm Water Management of Malaysia, MSMA 2nd Edition. 2012, DID Malaysia (2012);
- Hydraulic calculation and LD-P2M2 Plan
- Soil Investigation (SI) Report

The estimation of soil loss and sediment yield for this project was conducted in accordance with the earthwork phasing plan, as shown in **Figure 7.12**. The assessment scenario was based on 5 distinct scenarios, which are as follows: -

- 1) Existing condition – The original condition of site before construction start
- 2) Pre-bulk grading stage (without BMPs) – During earthwork without control measure
- 3) Pre-bulk grading stage (with BMPs) – During earthwork with control measure
- 4) Post-bulk grading stage (with BMPs) – Major earthwork complete with control measure (after all platform level achieved)
- 5) Post development stage (fully operation) – When the development starts its operation

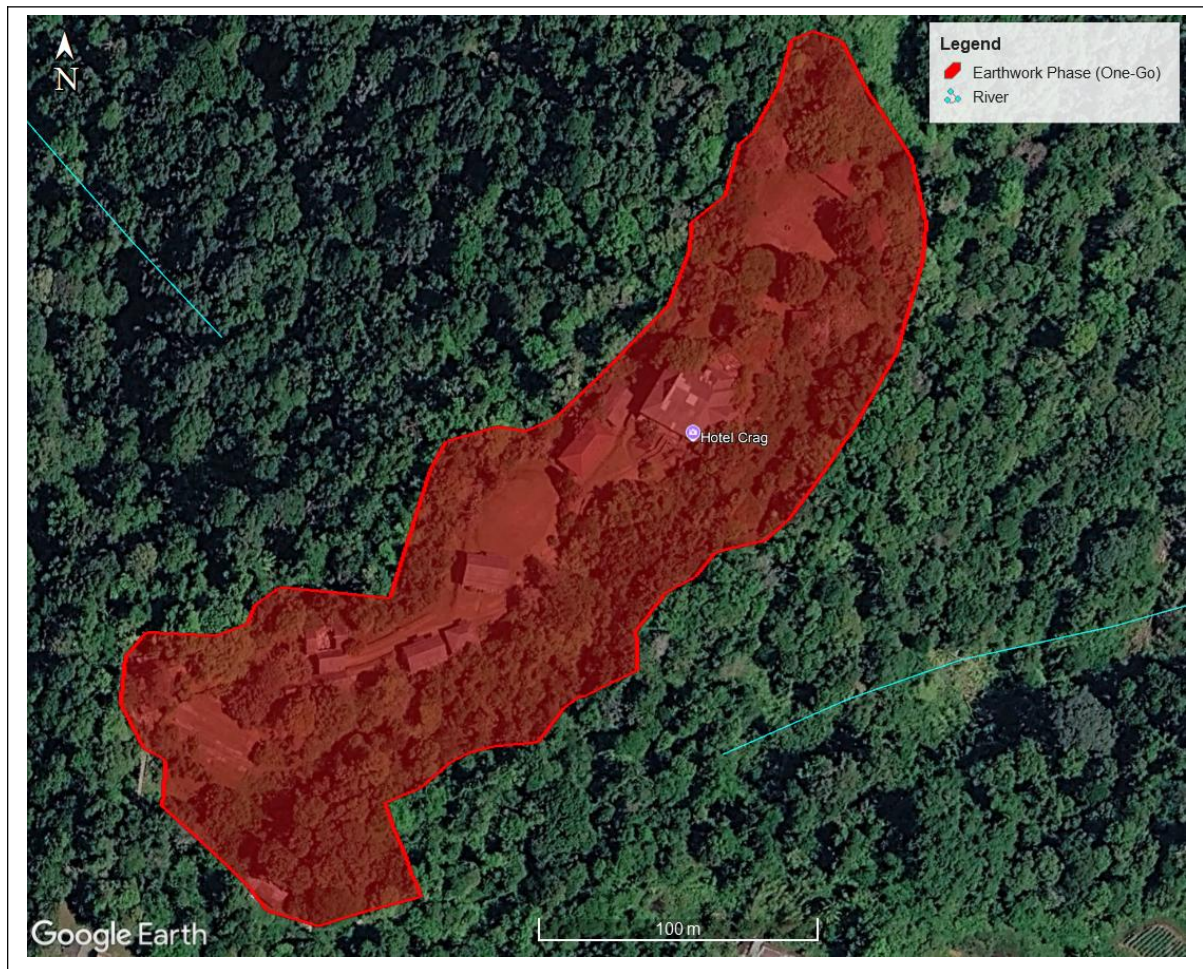


Figure 7.12: Division for Soil Loss Estimation based on Earthwork Phasing

7.10.2 Soil Loss Estimation with RUSLE

RUSLE model developed by Renard et al., 1991, was used to quantify and estimate the annual soil erosion rate that happens on site. Using details from the development, a soil loss assessment is to be carried out to determine the erosion risk at the site. The assessment shall examine erosion risk before development took place, during earthwork without control, during earthwork with control and post-development.

The RUSLE is expressed in MSMA 2nd Edition (2012) (refer to Table 12.1 page 12-5) as follows:

$$A=R.K.LS.C.P$$

Where;

A	=	Annual Soil Loss (tonnes/ha/year)
R	=	Rainfall Erosivity Factor - an erosion index for the given storm period in MJ.mm/ha/h
K	=	Soil erodibility factor, the erosion rate for a specific soil in continuous fallow condition on a 9% slope having a length of 22.1 m in tonnes/ha/(MJ.mm/ha/h)
LS	=	Topographic factor, which represents the slope length and slope steepness. It is the ratio of soil loss from a specific site to that from a unit site having the 9% slope with a slope length of 22.1 m when other parameters are held constant;
C	=	Cover Management factor, which represents the protective coverage of canopy and organic material in direct contact with the ground. It is measured as the ratio of soil loss from land cropped under specific conditions to the corresponding loss from tilled land under clean-tilled continuous fallow (bare soil) conditions.
P	=	Support practice factor, which represents the soil conservation operations or other measures that control erosion, such as contour farming, terraces, and strip cropping. It is expressed as the ratio of soil loss with a specific support practice to the corresponding loss with up and-down slope culture.

Based on **Figure 7.13**, the R factor for this project area is 17,500 MJ.mm/ha.hr.yr. Meanwhile, the summary of determination of K factor, LS factor, C factor and P factor are given in **Table 7.24-7.26**.

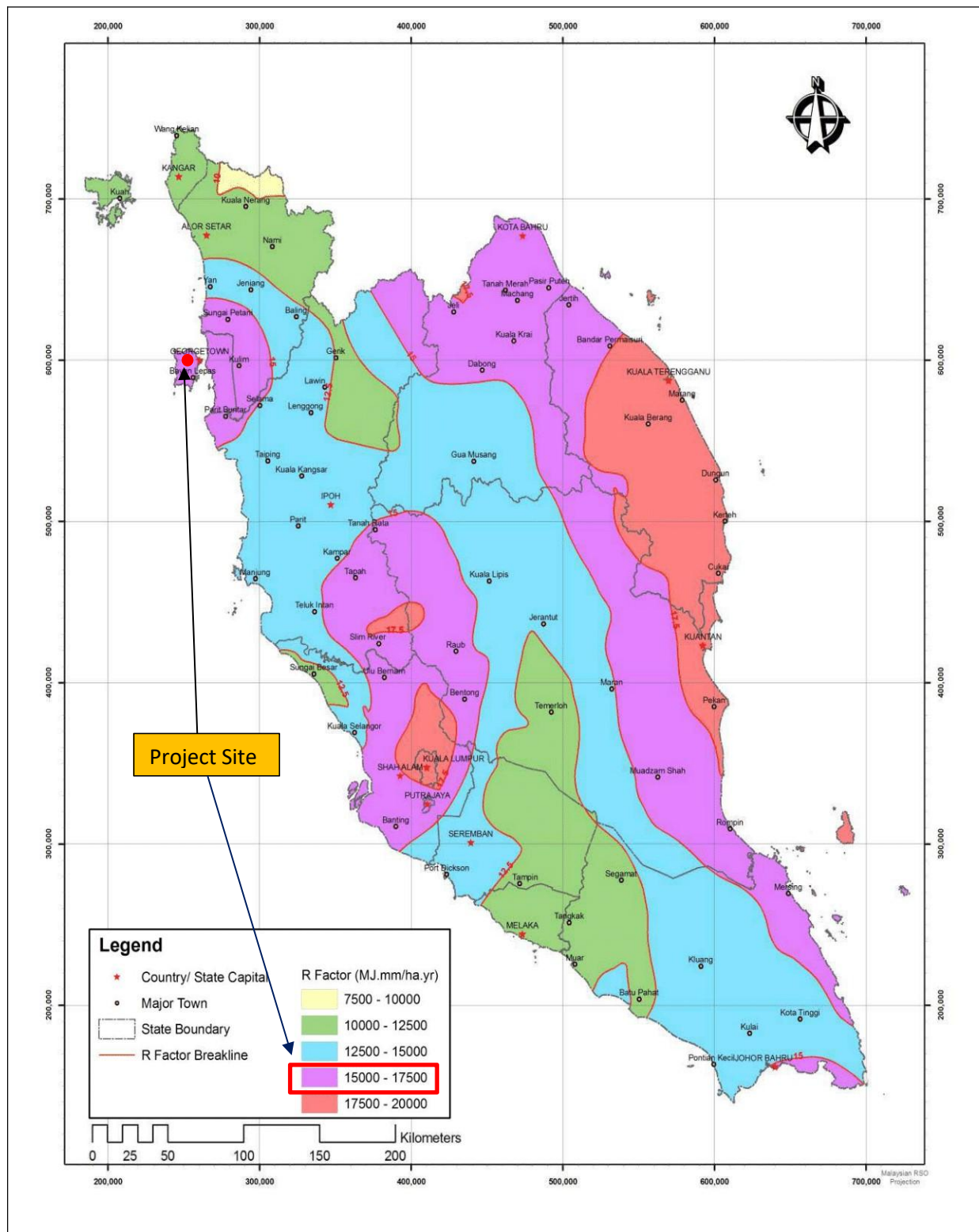


Figure 7.13 Determination of Rainfall Erosivity Factor (R Factor)

Table 7.24 Determination of K Factor

Development Phase	Borehole No.	Organic Matter	Sand	Silt	Clay	Soil Texture	M	S	P	K
		(%)	(%)	(%)	(%)					
EXISTING										
ONE-GO	BH1	0	39	19	22	Loam	4524	2	3	0.028
	BH2	0	54	15	18	Sandy Loam	5658	2	2	0.024
	BH3	0	52	26	13	Loam	6786	2	3	0.042
	BH4	0	49	14	32	Sandy Clay Loam	4284	4	4	0.049
	BH5	0	49	27	15	Loam	6460	2	3	0.039
	BH6	0	45	15	9	Loam	5460	2	3	0.033
	BH7	0	54	16	7	Sandy Loam	6510	2	2	0.029
	BH8	0	39	16	26	Loam	4070	2	3	0.025
	Average									
PRE-BULK GRADING STAGE/POST BULK GRADING STAGE/POST DEVELOPMENT										
ONE-GO	BH1	0	47	27	8	Sandy Loam	6808	2	2	0.031
	BH2	0	51	33	11	Loam	7476	2	3	0.046
	BH3	0	71	13	8	Sandy Loam	7728	2	2	0.037
	BH4	0	53	18	27	Sandy Clay Loam	5183	4	4	0.054
	BH5	0	43	25	11	Loam	6052	2	3	0.037
	BH6	0	50	30	14	Loam	6880	2	3	0.042
	BH7	0	54	16	7	Sandy Loam	6510	2	2	0.029
	BH8	0	39	16	26	Loam	4070	2	3	0.025
	Average									

Table 7.25 Determination of LS Factor

Development Phase	Upstream Level	Downstream Level	Slope Length, λ	Slope Steepness, S	m	LS Factor
	(m)	(m)	(m)	(%)		(unitless)
ONE-GO	670.95	670.58	36	1.0	0.3	0.136
PRE-BULK GRADING STAGE (WITHOUT BMPs)						
ONE-GO	670.95	670.58	36	1.0	0.3	0.136
PRE-BULK GRADING STAGE (WITH BMPs)						
ONE-GO	670.95	670.58	36	1.0	0.3	0.136
POST-BULK GRADING STAGE (WITH BMPs) / POST DEVELOPMENT						
ONE-GO	685.4	683.15	40	5.6	0.5	0.712

Table 7.26 The Summary of Adopted C Factor and P Factor

Erosion Control Treatment	C Factor	Sediment Control Treatment	P Factor
Existing Condition			
Forest/Tree - 100% cover	0.03	Grass buffer strips - Basin slope (0%-10%)	0.60
Commercial (low density, 50% green area)	0.25		
Pre-Bulk Grading Stage (without BMPs)			
Bare soil/Newly cleared land	1.00	Bare soil	1.00
Pre-Bulk Grading Stage (with BMPs) / Post-Bulk Grading Stage (with BMPs)			
Turfing 60%	0.05	Sediment containment systems	0.50
Plastic sheeting	0.02	Check Dam	0.80
Compacted gravel layer	0.05	Silt fence	0.55
Post Development			
Commercial (medium density, 25% green area)	0.15	Grass buffer strips - Basin slope (0%-10%)	0.60
Impervious (Parking lot, road, etc.)	0.01		
Turfing (60% cover)	0.05	Terracing - Slope (3%-8%)	0.10

Source: Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition) (DID, August 2012)

Based on soil tolerance rate class, the assessment value was further classified as shown in **Table 7.27**. The summary of the result is shown in **Table 7.27** and **Figure 7.14**. The description of soil loss result is described in **Table 7.28**.

Table 7.27 Soil Loss Tolerance Rates from Erosion Risk Map Malaysia

Soil Erosion Class	Potential Soil Loss (ton/ha/yr)
Very low	<10
Low	10 – 50
Moderate-High	50 – 100
High	100 – 150
Very high	>150

Table 7.28 Summary of Soil Loss Assessment for Development Site

Development Phase	R Factor	K Factor	LS Factor	C Factor	P Factor	A	Soil Loss Tolerance Rate Classification
	(MJ.mm/ha.hr.yr)	(ton/ha)(ha.hr/MJ.mm)	(unitless)	(unitless)	(unitless)	(ton/ha/yr)	
EXISTING CONDITION							
ONE-GO	17,500	0.034	0.136	0.140	0.600	6.758	Very Low
PRE-BULK GRADING STAGE (WITHOUT BMPs)							
ONE-GO	17,500	0.038	0.136	1.000	1.000	89.957	Moderate High
PRE-BULK GRADING STAGE (WITH BMPs)							
ONE-GO	17,500	0.038	0.136	0.040	0.617	2.219	Very Low
POST-BULK GRADING STAGE (WITH BMPs)							
ONE-GO	17,500	0.038	0.712	0.040	0.617	11.579	Low
POST DEVELOPMENT STAGE (FULL OPERATION)							
ONE-GO	17,500	0.038	0.712	0.070	0.350	11.500	Low

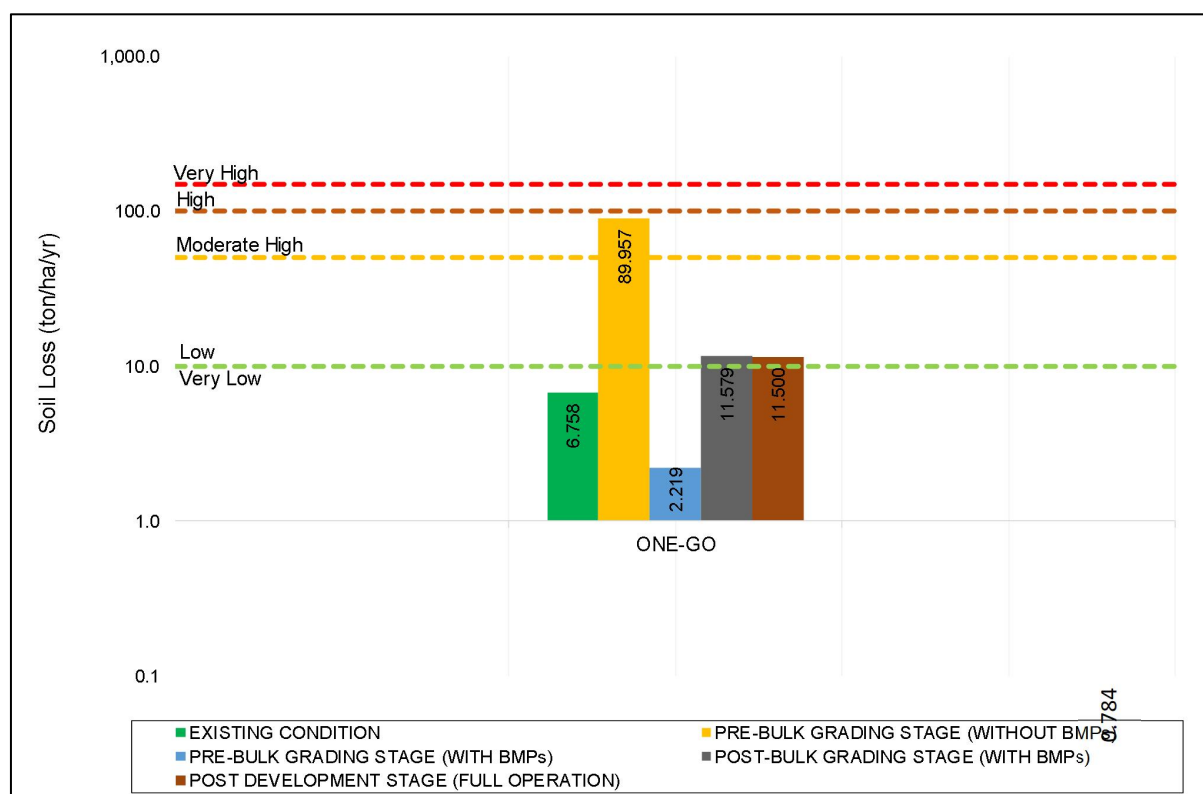


Figure 7.14: Anticipated Soil Loss on Site by RUSLE

Table 7.29 The Description of Soil Loss Assessment Result

Condition	Description
Existing Condition	During the existing condition, soil loss is very low (6.758 ton/ha/yr), indicating that the site is relatively stable under natural cover, with a low LS factor (gentle slope condition) contributing to minimal erosion risk.
Pre-Bulk Grading Stage (Without BMPs)	At the pre-bulk grading stage without BMPs, soil loss increases significantly to 89.957 ton/ha/yr (moderate high) due to complete soil exposure ($C = 1.0$) and absence of control measures ($P = 1.0$), even though the slope remains unchanged. This shows that vegetation removal is the main driver of erosion at this stage.
Pre-Bulk Grading Stage (With BMPs)	With the implementation of BMPs, soil loss is drastically reduced to 2.219 ton/ha/yr (very low), demonstrating the effectiveness of erosion and sediment control practices in mitigating the impact of exposed soil.
Post-Bulk Grading Stage (With BMPs)	The soil loss is minimal when the ground has reached the planned platform level (11.579 ton/ha/yr). Certain areas will be seeded with grass to mitigate the risk of soil erosion.
Post Development Stage (Full Operation)	Soil erosion is anticipated to be minimal during operation (11.500 ton/ha/yr), as the ground surface will have limited exposure. To mitigate the risk of soil erosion, the exposed areas will be seeded with grass.

7.10.3 Estimation of Sediment Yield

The summary of sediment yield result is shown in **Table 7.30** and **Figure 7.15**. The description of sediment yield result is given in **Table 7.31**.

Table 7.30 Sediment Yield Assessment Result

Development Phase	K Factor (ton/ha)(ha.hr/MJ.mm)	LS Factor (unitless)	C Factor (unitless)	P Factor (unitless)	Runoff Volume, V m ³	Peak Discharge, Q _p m ³ /s	Y (tonnes)
EXISTING CONDITION							
ONE-GO	0.034	0.136	0.140	0.600	707.61	0.48	0.90
PRE-BULK GRADING STAGE (WITHOUT BMPs)							
ONE-GO	0.038	0.136	1.000	1.000	702.34	0.90	16.98
PRE-BULK GRADING STAGE (WITH BMPs)							
ONE-GO	0.038	0.136	0.040	0.617	789.08	0.53	0.33
POST-BULK GRADING STAGE (WITH BMPs)							
ONE-GO	0.038	0.712	0.040	0.617	642.72	0.65	1.73
POST DEVELOPMENT STAGE (FULL OPERATION)							
ONE-GO	0.038	0.712	0.070	0.350	610.05	1.40	2.57

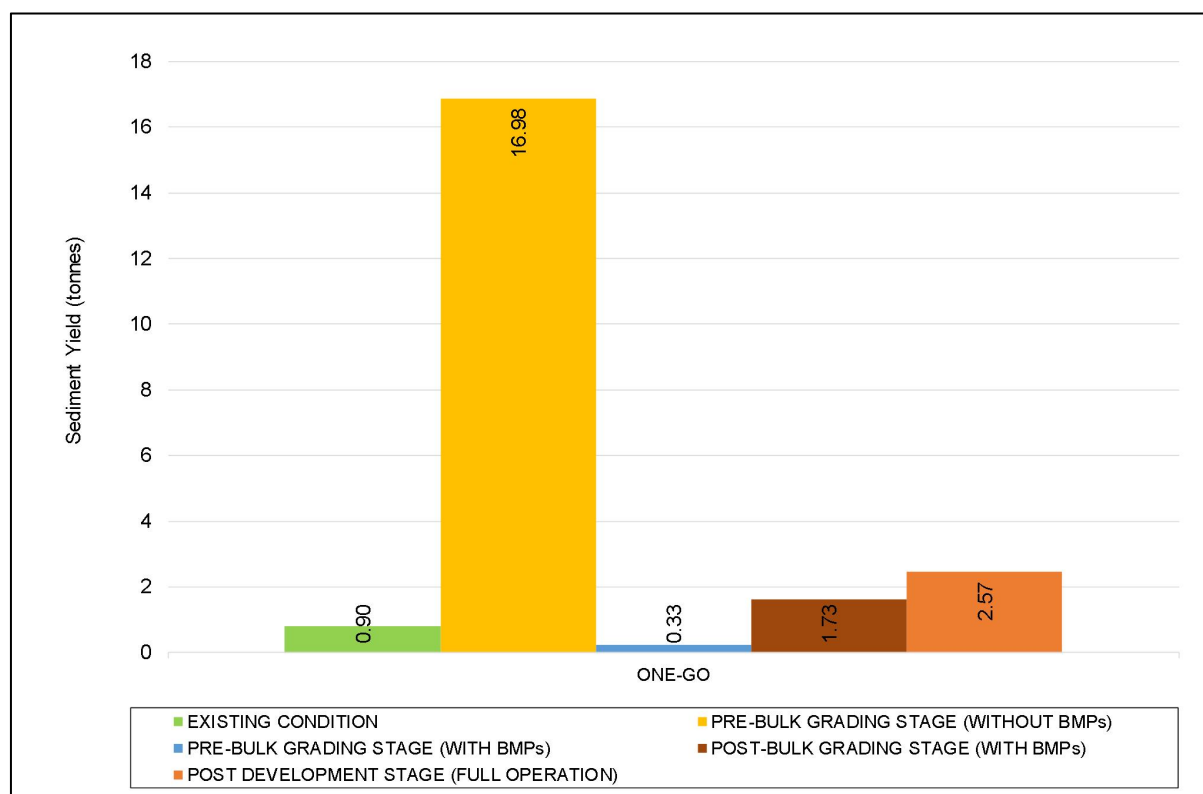


Figure 7.15: Anticipated Sediment Yield on site by MUSLE

Table 7.31 The Description of Sediment Yield Assessment

Condition	Description
Existing Condition	During the existing condition, sediment yield is very low (0.90 tonnes) with a low peak discharge (0.48 m ³ /s), reflecting stable ground cover and minimal erosion due to gentle slope conditions (low LS factor).
Pre-Bulk Grading Stage (Without BMPs)	At the pre-bulk grading stage without BMPs, sediment yield increases sharply to 16.98 tonnes, mainly due to complete soil exposure ($C = 1.0$) and lack of control measures. This is further amplified by a higher peak discharge (0.90 m ³ /s), which increases the ability of runoff to transport sediment.
Pre-Bulk Grading Stage (With BMPs)	With the implementation of BMPs, sediment yield is drastically reduced to 0.33 tonnes, even though runoff volume increases (789.08 m ³). This indicates that BMPs are highly effective in controlling erosion and trapping sediment despite higher runoff.
Post-Bulk Grading Stage (With BMPs)	During the post-bulk grading stage, sediment yield increases slightly to 1.73 tonnes due to the higher slope factor ($LS = 0.712$), but remains low overall because BMPs are still in place.
Post Development Stage (Full Operation)	In the post-development stage, sediment yield remains low at 2.57 tonnes, although peak discharge rises significantly to 1.40 m ³ /s, suggesting a more rapid runoff response. However, the site remains well stabilized, preventing excessive sediment loss.

Overall, it can be concluded that the erosion rate will reach its peaks during the active construction period if the site is not well protected. However, the soil loss/sediment yield is minimal since the site will be equipped with proposed BMPs (as per LD-P2M2). The summary of erosion risk map based on RUSLE estimation is given in **Figure 7.16**.

Legend (Soil Loss Tolerance Rate)	
	<10 ton/ha/year (Very Low)
	10-50 ton/ha/year (Low)
	50-100 ton/ha/year (Moderate High)
	100-150 ton/ha/year (High)
	>150 ton/ha/year (Very High)



(a) Existing Condition



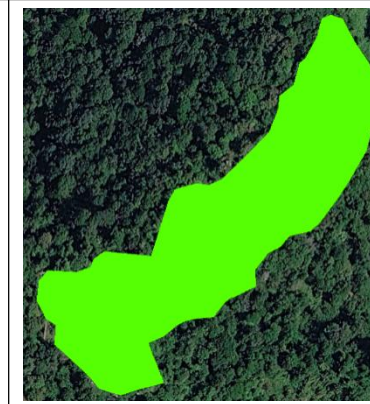
(b) Pre-Bulk Grading Stage (without BMPs)



(c) Pre-Bulk Grading Stage (with BMPs)



(d) Post-Bulk Grading Stage (with BMPs)



(e) Post Development

Figure 7.16 Erosion Risk Map

7.10.4 Sizing of Sediment Basin

During site clearing and earthwork, effective surface runoff management is essential. Temporary earth drains should be implemented to control surface runoff, which should then be filtered via sediment basin. **Table 7.31** presents a summary of the sediment basin specifications while **Appendix E** contains detailed basin sizing information. During the construction phase, one unit of sediment basin will be constructed to control the sediment and runoff from the entire site. After construction completed (operation phase), this sediment basin will be decommissioned and replaced with few units of onsite detention (OSD) tank to manage runoff from the completed development. **Appendix G** provides comprehensive design specifications for the OSD tank and detention pond. To prevent flooding issues in immediate and downstream zones, ensuring proper pond function is crucial, and regular maintenance is necessary to maintain optimal pond performance.

Table 7.32 Summary of Sediment Basin Specification

Design Parameter		Sediment Basin (During Construction)
Required Settling Zone Volume (m ³)		85.50
Required Total Basin Volume (m ³)		171.00
Overall, Pond Dimension	Top Width (m)	9.20
	Top Length (m)	21.20
	Bottom Width (m)	2.00
	Bottom Length (m)	14.00
	Settling Zone Depth (m)	0.60
	Sediment Storage Zone Depth (m)	1.20
	Total Pond Depth (m)	3.10
	Side Slope	2(H):1(V)
Outlet	Q ₁₀ (m ³ /s)	0.14
	Q _{riser} (m ³ /s)	0.11
	Q _{spillway} (m ³ /s)	0.96

7.10.5 Sizing of Temporary Earth Drain

Earth drainage systems are incorporated during earthworks and building construction to capture and divert any surface runoff to the sediment basin. Strategically placing these earth drains along the site perimeter as well as at intermediate locations facilitates the effective interception of surface water flows. For detailed specifications on earth drain sizing, refer to **Appendix E**. Once construction is completed, all earth drains will be upgraded to concrete drains with enhanced capacity.

CHAPTER 8

MITIGATION MEASURES

8.1 INTRODUCTION

This chapter will highlight the effectiveness of the proposed mitigation measures that will help to prevent or minimize the significant environmental impact associated from the various phases of project implementation. The proposed mitigation measures shall be functional and practicable for implementation at the proposed project.

At the stage of EIA Report preparation and all stages of project implementation, the requirements and specifications stipulated in the following guidelines issued by the DOE shall be adhered to:

NO.	REQUIREMENTS AND SPECIFICATIONS	DEPARTMENT
1.	Environmental Impact Assessment Guidelines in Malaysia (EGIM)	DOE, 2016
2.	Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in EIA Report as per Appendix 3 EGIM 2016	DOE, 2016
3.	Guidance Document for the Preparation of Land-Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) as per Appendix 4 EGIM 2016	DOE, 2016
5.	Urban Stormwater and Management (MSMA) 2 nd Edition	DID, 2012
6.	Guideline for Erosion & Sediment Control in Malaysia	DID, 2010

8.2 LAND DISTURBING POLLUTION PREVENTION AND MITIGATION MEASURES (LD-P2M2)

This conceptual LD-P2M2 has been prepared based on the Consultant's knowledge of the potential site works and construction methodologies that the project proponent might deploy for this site preparation.

The outline of this section complies with the requirements and specifications as stipulated in the "Guidance Document for the Preparation of the Document on Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2)", as well as Appendix 3 – "Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in the Environmental Impact Assessment (EIA) report" of the Environmental Impact Assessment Guidelines in Malaysia (EGIM) (DOE, 2016). The ESCP/LD-P2M2 plan and its detailed description is as attached in *Appendix E* that comprises of BMPs component briefly shown in **Table 8.1**.

Erosion control best management practices are required during all land-disturbing activity until permanent site ground covers are in place. A best management practice (BMP) is a physical, chemical, structural or managerial practice that prevents, reduces or treats contamination of water or which prevents or reduces soil erosion. Erosion prevention BMPs can be the simplest and most effective measures to retain sediments on the proposed site. The following BMPs protect and expose soil surfaces from rain generated splash erosion and can help slow flows across a site of ground disturbance.

Table 8.1: Proposed BMPs

NO.	BMPs	DESCRIPTIONS
a)	Sediment Basin	Sediment basins will be constructed during the earthwork phase to effectively manage erosion and sediment control. - For this proposed development, one (1) sediment basin is proposed as shown in ESCP/LD-P2M2 Plan. All sediment basins will discharge to the existing drain.
b)	Temporary Earth Drains	Temporary earth drains will be constructed to divert flow into the sediment pond. The temporary earth drains will be constructed internally to minimize the potential for soil erosion on-site, runoff and siltation off-site.
c)	Stabilized Construction Entrance	- The construction entrance will be stabilized using interlocking pavers. One (1) nos of washing bay is proposed at the entrance of the construction access to ensure vehicles exiting the site will be thoroughly washed before leaving the site to the public road.
d)	Check Dam	Check dams are proposed along the temporary earth drain. Before the water runoff flow into Sediment Basins, it will pass through a check dam.
e)	Retaining Walls	Retaining walls are proposed to stabilize the cut ground near the southern boundary of the site.
f)	Soil nailing	Soil nailing treatment is proposed for slope stabilization measures for slope areas along the sides of the project site.
g)	Silt fence	Silt fence are proposed along the area that will have earthworks and along the perimeter of the proposed site.
h)	Temporary facilities	<u>Waste Materials Storage Area:</u> This area is used to store construction waste before it is properly disposed of or recycled.

		• <u>Schedule Waste Storage/Diesel Storage Area:</u> The designated area for storing hazardous or scheduled waste, as defined under environmental regulations. • <u>Material/Equipment Storage Area:</u> This area is designated for storing construction materials and equipment. • <u>Biomass Stockpile Area:</u> This area is designated for storing biomass accumulated from site clearing. • <u>Site Office & Sanitary Facilities:</u> The site office is used for administrative purposes, meetings, and managing daily construction operations. Sanitary facilities (toilet facilities) are essential for the health and well-being of the workers.
i)	Hoarding	• Hoarding will be erected around the project site to shield them from view and prevent unauthorized access. It is an important component in ensuring health and safety, for site workers, visitors and the general public and can also be part of a site security system to prevent theft or vandalism.

Source: *Environmental Impact Assessment Guidelines in Malaysia (EGIM)*, 2016, *Malaysia Urban Stormwater Management Manual (MSMA)*, 2012, *Guideline for Erosion and Sediment Control in Malaysia* (2012)

8.3 MITIGATION MEASURES

The project's significant impacts have been analyzed in **Chapter 7**. It has been reviewed further and appropriate mitigation measures are proposed in this chapter which enables the impacts to be managed, reduced, or avoided where possible. **Table 8.2** shows the Pollution Prevention and Mitigation Measures (**P2M2s**) proposed to be implemented throughout the phase of the proposed project.

Besides, the proposed LD-P2M2 Plan and detailing is attached in *Appendix E* for further reference. LD-P2M2 plan plays an important role, especially for soil loss and erosion control. LD-P2M2 provides all the BMPs in need for every construction site, e.g., sediment basins, washing bay, temporary earth drain, hoarding, etc.

Table 8.2: Prevention Pollution and Mitigation Measures (P2M2s)

MAGNITUDE	POLLUTION PREVENTION AND MITIGATION MEASURES (P2M2s)	RESIDUAL IMPACT
1) AIR QUALITY		
DEMOLITION & CONSTRUCTION PHASE		
Moderate	The best practices are recommended to minimize fine dust dispersion and emissions during site preparation, earthworks, and construction work. The measures to include are as follows: (a) <u>Transportation Control</u> • Access road (paved/unpaved road) ○ Ensure access and internal roads are kept smooth, well-graded, and clean. ○ Paving/hard surface the unpaved road of temporary haul routes through the site i.e., using crushed stone, gravel or interlocking pavement etc. wherever practicable. • Transport of soil/materials ○ All excess soil will be reused on-site, eliminating the need for off-site transportation. Consequently, no dust emissions are expected from soil transport. ○ Vehicles for carrying building materials, debris and excavated materials should be clean, well maintained and in good running condition. If they carry loose materials, they should be covered and properly sealed to ensure that there will be no spillage of materials onto the public road. ○ All dusty materials should be sprayed with water immediately prior to any loading to the site so as to keep the dusty material wet. • Construction vehicle and machinery ○ Vehicles shall be regularly serviced and maintained to reduce undesirable emissions. ○ Machinery and dust causing activities should be located away from sensitive receptors. ○ Observed vehicle speed limit in the construction site to reduce the dust emitted to the atmosphere.	• Significant impacts. • Dry and windy days will increase the intensity of impacts.

(b) Air pollution control/ Dust control

- **Wheel washing facility**
 - The wheel washing facility shall be provided at the site entrance/exit to avoid dirt being carried out of the project area and to prevent sediment from being tracked into public roads.
 - The water from the washing facility should be changed regularly to always ensure clean water (without sediment/silt).
- **Water spraying/sprinkling**
 - Provide water spraying/sprinkling along access roads and internal access roads in the project area.
 - Implement dust control measures using water jet spray.
- **Legal requirement**
 - Open burning activities are strictly prohibited at the construction site under **Section 29A-Prohibition on open burning (EQA, 1974)**.
 - Any potential emission sources such as fuel-burning equipment have to comply with the relevant agencies' requirements and limits.
- **Monitoring programme**
 - Ambient air quality monitoring shall be conducted on a periodical basis to assess and monitor the ambient air quality at the project area.
- **Barrier/Hoarding**
 - Construct hoarding along the project boundary to create a buffer between the project site to the surrounding area
 - Maintain the existing trees/ preserve trees along the boundaries of the proposed site until the works are completed to improve and maintain the quality of air and to remove pollutants from the air is well known.

	• Demolition Work - Phasing & Methods ○ Demolition work will be split into several phases to reduce the dust and pollutants produced. Demolition work will be done in 5 phases (refer Appendix F : Demolition Work Plan). ○ Furthermore, less disruptive methods, such as the manual demolition method will be utilized, in which buildings are dismantled piece by piece, often with the goal of salvaging materials for reuse or recycling. This method is expected to produce minimal dust and air pollutants.	
OPERATIONAL PHASE		
Minor	(a) <u>Vehicles Control</u> • Mobile vehicle ○ Impact from mobile vehicles are expected to be minimal as it is expected staff and visitors will mainly utilize the funicular train to reach the development once operational. Nevertheless, steps shall be taken to reduce vehicle emissions as much as possible. ○ Vehicles shall be regularly serviced and maintained to reduce undesirable emissions. ○ Avoid running engines for long periods of time when in a stationary position. ○ Open air burning will be strictly avoided.	Insignificant
2) NOISE LEVEL		
DEMOLITION & CONSTRUCTION PHASE		
Minor	Noise level can be addressed through measures to minimize noise disturbance to nearby receptors and protect workers in a high noise environment. The measures to include are as follows: a) <u>Demolition & Construction Work</u> • Operating hours ○ Construction activities should only take place between 8:00 am– 6:00 pm (Monday-Friday), 8:00 am- 1:00 pm (Saturday) and no work permitted/ noisy work prohibited (Sundays and public holidays). ○ Contractors or any other person should not operate or permit the operation of any tools or equipment used in construction, maintenance, etc. between the hours of 10:00 pm to 7:00 am the	• Significant impacts. • Impact mainly to the construction workers and

	following day on weekdays or at any time on the weekend and public holiday (Guideline for Environmental Noise Limits and Control, Third Edition, DOE 2019). ○ The contractor shall notify those who might be affected by the construction works (e.g., public living close by, visitors to Penang hilltop) prior to work. ● Construction vehicle and machinery ○ Streamline and schedule operation of vehicles, machinery, and noisy equipment so that the residents will be exposed to noise only on certain hours during the daytime and avoid nighttime work if possible. ○ Machinery that may be in intermittent use should be shut down between works periods or should be kept down to a minimum. <i>b) Noise & Vibration Control Measures</i> ● Barrier/Hoarding ○ Install perimeter hoarding along the project boundary will provide a barrier to the noise generating sources from the construction site. ○ The use of a movable noise barrier is recommended for a particular plant i.e., a mobile plant (excavator, mobile crane, etc.) to reduce noise level (if applicable). ○ Temporary barriers/enclosures can be constructed on the worksite from the common construction materials e.g., metal deck, plywood, etc. ● Personal Protective Equipment (PPE) ○ Protection of workers using PPE (e.g., earmuff) is important to a work environment. ● Vibration control ○ Schedule of pile driving operation whereby conducting the pile driving operation within a short time. ○ The method of pile driving applied on-site shall depend on the suitability of the site. Micro piles are proposed as the piling method for this proposed development as it is not expected to generate significant vibration impacts. Micro pile installation involves rotary drilling and grouting rather	visitors.
--	--	-----------

	than impact hammering, resulting in substantially lower vibration levels. Any vibrations produced will be localized, of low magnitude, and are expected to attenuate rapidly with distance. Therefore, the risk of vibration-related disturbance to nearby structures or receptors is considered minimal. • Monitoring programme ○ Ambient noise level and vibration limit monitoring shall be conducted on a periodical basis to assess and monitor the noise level and vibration limit at the project area and surroundings. • Demolition Work - Phasing & Methods ○ Work will be done in consecutive phases to reduce the dust and pollutants produced. Demolition work will be done in 5 phases (refer <i>Appendix F : Demolition Work Plan</i>). ○ Furthermore, less disruptive methods, such as the manual demolition method will be utilized, in which buildings are dismantled piece by piece, often with the goal of salvaging materials for reuse or recycling. This method will expected to produce minimal dust and air pollutants. c) <u>Transportation Control</u> • Transportation vehicles ○ Transportation vehicles should be maintained appropriate travelling speeds along the haul roads. ○ All vehicles and equipment used must have regular and efficient maintenance to ensure good working conditions. Thereby reducing the possible noise emission.	
OPERATIONAL PHASE		
Minor	(a) <u>Vehicles Control</u> • Mobile vehicle ○ Impact from mobile vehicles are expected to be minimal as it is expected staff and visitors will mainly utilize the funicular train to reach the development once operational. Nevertheless, steps shall be taken to reduce vehicle emissions as much as possible. ○ Vehicles shall be regularly serviced and maintained to reduce undesirable noise.	Insignificant

	○ Avoid running engines for long periods of time when in a stationary position. (b) <u>Landscaping</u> ○ Landscaping and natural buffers can help soften the noise from human activities	
3) WATER QUALITY		
DEMOLITION & CONSTRUCTION PHASE		
Moderate to High	Water quality of the receiving waterways can be affected due to soil erosion and the generation of sewage. These can be prevented and where possible to maintain water quality at baseline conditions within the DOE prescribed limits by the following P2M2s: a) <u>Implementation of LD-P2M2</u> ○ Implementation of LD-P2M2 tools at the project site at the early stage prior to commencement of earthwork such as sediment basins, temporary earth drains, washing bay, etc. (refer Appendix E). ○ For this proposed development, one (1) sediment basin is proposed to cater for the final discharge from the site during construction stage. The proposed sediment basin will discharge to an existing drain that eventually discharges to Sungai Ayer Terjun. ○ All the LD-P2M2 tools must be inspected and maintained regularly to maintain their effectiveness, including regular de-silting of the earth drains and wash trough. b) <u>Earthwork Control</u> • Earthwork scheduling ○ Earthworks shall be carried out as scheduled to reduce the exposure time of the land to erosion. ○ For this proposed development, the earthwork construction will be only in the southern section of the site and will be carried out in a single phase with all proper BMPs in place to reduce potential erosion and sedimentation issues (Refer to Appendix E). • Discharge control ○ Any surface water runoff discharge from the project site to the off-site area of the project site during the earthwork and construction work shall not contain TSS more than 50 mg/L.	• Significant impact • Construction during the rainy season can cause unnecessary delays • Mitigation measures will be required

	○ Unsuitable material from the project site shall not be disposed of directly into rivers, streams or onto low ground adjacent to waterways. ○ A temporary drainage system shall be installed prior to the commencement of the construction work to collect surface runoff by the site during construction c) <u>Sewage</u> ○ The construction of temporary toilet facilities shall be away from any water course. ○ Sanitary and toilet facilities should be kept in a clean and fully working condition. ○ Septic tank and toilet facility for site office to follow the National Water Services Commission (SPAN) requirements. ○ Any discharge of wastewater into the watercourses directly or indirectly must be avoided.	
OPERATIONAL PHASE		
Moderate	a) <u>Stormwater discharges</u> ○ Permanent drainage system will be provided to controls water runoff and prevents ponding or flooding on the development area. It has been designed and is to be constructed in accordance to MSMA 2nd Edition (DID, 2012) (<i>Refer to Appendix G: R&D Layout Plan</i>) b) <u>Sewage</u> ○ During the operational phase, the sewage of the proposed project will be discharged to the proposed Small Sewage Treatment System (SSTS) on site (refer <i>Appendix D - Sewerage Plan and Sewerage Report</i>), with a PE capacity of 199 PE. ○ To ensure that sewage is managed effectively and does not negatively impact the environment, the following mitigation measures shall be implemented: ➤ Treated effluent from the STP must comply with the Environmental Quality (Sewage) Regulations 2009 and meet the Standard A/B discharge limits as stipulated by the Department of Environment (DOE). ➤ Regular inspection and maintenance of sewer pipelines, pumping stations, and connections to avoid blockages, leakages, or overflow	Significant

4) SOIL EROSION & SEDIMENTATION

CONSTRUCTION PHASE

Moderate to High	The following are some of the proposed P2M2s (which include BMPs) that shall be considered at the project site for erosion and sedimentation control as recommended in the EIA Guideline in Malaysia, 2016. (a) <u>Best Management Practices (BMPs)</u> • Schedule of Phasing, Staging and Sequencing ○ Scheduling and sequencing of construction activities in accordance with the project implementation schedule to reduce the size of areas that need to be exposed to mitigate the erosion effects. • Scheduled Site Meeting ○ Conduct site meeting (kickoff meeting) prior to start of any construction activity or land-disturbing activity to be attended by the project proponent, project EO, project contractors and/or sub-contractors to discuss in detail all the relevant scopes of work that have relevance to pollution prevention and mitigating measures. ○ Proper minutes meeting need to be recorded in order to trace progressive works. • Construction markers ○ Physically mark on-site to show the limit of the land-disturbing from any drainage way/waterway/watercourse within the project site, areas not to be worked or disturbed and a buffer area of the existing vegetation meant for temporary or permanent preservation and protection. ○ The most physical construction marker for this proposed project is the construction of hoarding around the boundary of the project site as per proposed in EW/ESCP/LD-P2M2 Plan. The hoarding provided will protect from any encroachment from non-relevant construction personnel as well as for safety and security purposes.	Significant
------------------	---	-------------

- **Stabilized construction entrance**
 - A stabilized construction access by a point of entrance/exit to a construction site to reduce the tracking of mud and dirt onto public roads by construction vehicles where stabilized construction shall be constructed;
 - This proposed project will construct a temporary **wash through** and stabilized construction entrance with **interlocking pavement** as per proposed in EW/ESCP/LD-P2M2 Plan
- **Streams/drainage way/waterway/watercourse buffers**
 - Retain a 20 meters natural buffer between on-site land disturbance and any watercourse (intermittent or permanent) unless otherwise specified by the relevant authority; or
 - Provide a vegetated buffer that is less than 20 metres between on-site land disturbance and any watercourse (intermittent or permanent) in combination with additional erosion and sediment controls; or
 - If not feasible to provide a natural or vegetated buffer of any size between on-site land disturbance and any watercourse (intermittent or permanent), install suitable erosion and sediment controls in combination with all possible perimeter controls.
- **Perimeter control**
 - Perimeter control shall be first constructed and made operational before land-disturbing activities are executed.
 - This proposed project will provide **sediment basins, construction entrance, temporary earth drains, hoarding, earth bund, etc.** as per proposed in ESCP/LD-P2M2 Plan.
- **Sediment Basin**
 - Sediment basins shall be first constructed and made operational before land-disturbing activities are executed whereby the construction of sediment trap shall be in accordance with the design specification stipulated in MSMA 2012. The design criteria of the sediment basin are based on the suitable return period and the corresponding storm intensities, to ensure that the designs are not underestimated and unable to cope with additional runoff.
 - This proposed project will construct **one (1) sediment basin** in total as per proposed in ESCP/LD-P2M2 Plan to facilitate the runoff discharge from the construction site.

- **Runoff and stormwater management**
 - Temporary earth drain with a proper drainage system shall be provided to control stormwater runoff whereby it is recommended that drainage system shall be constructed first prior to the commencement of earthworks phase.
 - The **temporary earth drains** are provided during the earthwork phase is to drain surface runoff to propose sedimentation pond before discharging into existing earth drains.
 - The temporary earth drains within the project site shall be maintained regularly to ensure the drainage design network works efficiently and to prevent erosion.
 - The size and capacity of the drains must be sufficient to take in at least a storm of 10-years ARI event accordance with *Manual Saliran Mesra Alam Edisi-2 (MASMA-2)*.
- **Temporary or permanent watercourse diversion (if any)**
 - Temporary or permanent diversion channels of any watercourse or off-site run-on water shall be protected by using either plastic sheeting or by installing plastic sheeting canvas along the channel with extend across the side slope in combination with constructed check dams.
- **Temporary or permanent roadways (if any)**
 - Runoff conveyance systems such as temporary earth drain shall be constructed and conveyed runoff to the stabilized area or into sediment basin prior to discharge.
- **Stockpile soil management and spoil management area (disposal area)**
 - The location of stockpiles and disposal area shall be away at a minimum distance of 20 metres from any watercourse.
 - The stockpiled soil and disposal area shall be protected from control with the runoff water using a temporary perimeter control such as berms, silt fences and others.
- **Discharge**
 - All discharge runoff water to the offsite area shall only be allowed through a sediment basin before final discharging to any waterbodies.
 - Final discharge from the development site shall comply with the ambient standards for TSS (50mg/l).

	• Corrective actions ○ Corrective actions must be taken if P2M2 was installed incorrectly or does not work properly to produce discharge that complies with the discharge standards provided by DOE. The timeframe for the action is 7 days from the time of discovery. • Site inspection, maintenance, and monitoring ○ Regular site inspection of the BMPs shall be conducted by the environmental officer (EO) with CESSWI, CISEC or CePEOEIA certification and maintenance of the structures to ensure their performance efficiency especially after heavy storm events; ○ If the rainfall at one time is 12.55mm or more, reporting via <i>Sistem Pemantauan EIA</i> (SPEIA) is to be conducted within 24 hours. ○ A maintenance programme shall be prepared to include plans for removal and disposal of unwanted sediments, repair of structural damages and improvement or modification of BMPs provided at the site to ensure the effectiveness of BMPs, inspection prior to a rain event ensure that BMPs are cleaned out and operate properly. Maintenance should be conducted when problems are identified. • Standards and Specifications for P2M2s ○ All the P2M2 shall be provided, designed, constructed and maintained in accordance with good practices. The details of the LD-P2M2 tools provided for this project site shall be referred to <i>Appendix E – EW/ESCP/LDP2M2 Plan</i>.	
OPERATIONAL PHASE		
Minor	• During the operational stage, the rate of sediment runoff will be minimal due to the protection afforded by landscape vegetation, buildings, pavements, and turfing. Hence, besides maintaining the vegetation and turfing within the project site, no additional mitigation measures are necessary, with the exception of rehabilitation works that take place. • Permanent drainage network and on-site detention (OSD) tank are to be installed at-site to capture runoff from the site (refer <i>Appendix G – R&D Layout Plan</i>).	Minor

5) WASTE MANAGEMENT

DEMOLITION & CONSTRUCTION PHASE

Moderate	Waste in demolition phase comprises solid waste/demolition waste and scheduled waste, while waste in construction phase comprises biomass waste and unsuitable material, overburdened materials, solid waste/construction waste, domestic waste, and scheduled waste. All of these wastes require specific management strategies to minimize the amount of waste generated from the site and ensure proper collection, storage, and disposal of the different types of waste generated. a) <u>Biomass Waste and Unsuitable Material</u> <i>Biomass Waste Management</i> <i>Biomass Management Plan</i> ○ Biomass from vegetation clearance is obtained from the clearance of trees, shrubs, and undergrowth. ○ Clearing of secondary bushes and undergrowth shall be carried out in stages to reduce the volume of biomass waste generated in a short time. ○ All the biomass wastes can be temporarily stockpiled at the designated areas on site as per proposed in ESCP/LD-P2M2 Plan before mobilizing any further action. ○ A biomass stockpile area should be earmarked within the Project area prior to disposal at an approved dumpsite. ○ The exposed stockpile should be covered properly and shall be away from the watercourse. ○ Open burning of biomass is strictly prohibited because it will cause air pollution (zero open burnings). ○ Shrub and undergrowth vegetation can be mulched on site especially on the bare areas within the site from any receiving waterways as temporary mulching material to reduce soil erosion. ○ For smaller trees, on-site shredding is planned, while larger trees will be carefully trimmed using a crane to lift a worker and cut the tree in sections. ○ Adopt the 3R concept imposed on the 3R (Reduce, Reuse, Recycle). Adopt a re-use scheme for biomass e.g., transform it into biomass energy or sell it to Landscape Contractors (re-use of	Significant
----------	---	-------------

	biomass). <i>Unsuitable Material Management</i> • Re-use (if any) ○ Reuse unsuitable material from the project site for filling depressions and other low areas. • Disposal of Material ○ The unsuitable materials from the project site shall not be disposed of directly into rivers, streams or onto low ground adjacent to waterways, but collected and disposed of on land at approved disposal facilities. ○ Identify a suitable area for the dumping of the unsuitable material either within or outside the project site. ○ Dispose of unwanted material from land clearing, grubbing, and stripping of topsoil to local council approved dumping facility or on-site dumpsite.	
Minor (If any)	<i>b) Overburden Materials Management</i> • Overburden management ○ Overburden can be sold to sites nearby as well as its suitability for disposal. ○ The overburdened materials can also be utilized to construct earth bunds for internal roads subjected to approval from the local authority. ○ Prohibit dumping excess overburdened material within 10.0 m from the edge of the river/stream or sensitive area to ensure that no runoff enters directly into any stream. ○ Stabilize the soil materials by conducting earth compaction to appropriate density.	Insignificant
Minor	<i>c) Solid Wastes/ Construction waste</i> • Disposal handling of solid waste ○ Provide adequate bins covers within the project site at site office. ○ Waste to be collected regularly by the municipality and proper disposal of solid waste by dispose	Significant

	of at the nearby local solids wastes disposal sites ○ Solid waste shall only be disposed of at an approved dumpsite landfill ○ Non-degradable wastes such as plastics, food containers, drink cans, glass and bottles must be disposed of at an approved landfill site; ○ Regular housekeeping. ○ Provide reuse, reduce and recycle (3R) skip and bins • Disposal handling of construction waste ○ Reuse on-site some of the materials such as wooden pallets for material storage and transport, cut reinforcement for use as site marking etc. ○ Reduce the amount of steel reinforcement cutting onsite by ordering correct dimensions from the supplier, where applicable. ○ Recycling recyclable waste at the site such as cardboard, plastic, concrete, masonry blocks, steel, recyclable timber, and wood etc. • Handling of excess earth ○ 405m³ of excess earth is expected to be produced from earthwork activities. The soil will be reused on site as topsoil for landscaping activities.	
Minor	d) <u>Sewage</u> • Sewage handling and disposal ○ The handling and disposal of sewage should be in accordance with Environmental Quality (Sewage) Regulations, 2009. • Sewage discharge ○ During this phase, a toilet shall be provided for the construction site. The construction of proper toilets for workers shall be away from any watercourse. ○ Sewage discharges from site offices should be discharged into an on-site temporary basic treatment facility such as septic tank before to final discharge.	Minor

Minor

e) Scheduled Waste

Significant

- Scheduled waste handling and disposal**

- The general scheduled waste projected/expected from this project for demolition and construction is listed in **Table 8.3(a)** and **Table 8.3(b)** respectively.
- The handling and disposal of scheduled waste should be in accordance with Environmental Quality (Scheduled Wastes) Regulations 2005.

Table 8.3(a): List of Scheduled Wastes expected from Demolition Activities

Expected Waste	Waste Code	Waste Description
Asbestos	SW201	Asbestos waste in sludge, dust or fibre forms
Heavy metal contamination	SW104	Dust containing heavy metals
Oils & Lubricants from Machinery	SW305	Spent lubricating oil
	SW306	Spent hydraulic oil
Chemical Residue	SW 303	Adhesive or glue waste containing organic solvents excluding solid polymeric materials
Contaminated soil, debris, containers & rags	SW 408	Contaminated soil, debris or matter resulting from cleaning up of a spill of chemical, mineral oil or scheduled wastes
	SW 409	Rags, plastics, papers or filters contaminated with chemicals, pesticides, mineral oil or scheduled wastes
	SW410	Rags, plastics, papers or filtes contaminated with scheduled wastes
Paints, Varnish,	SW 417	Waste of inks, paints, pigments, lacquer, dye or varnish

Solvents	SW 418	Discarded or off-specification inks, paints, pigments, lacquer, dye or varnish products containing organic solvent
Electrical & Electronic Waste	SW110	Waste from electrical and electronic assemblies containing components such as accumulators, mercury-switches, glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors or contaminated with cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, manganese or polychlorinated biphenyl
Mixed Waste	SW421	A mixture of scheduled wastes
	SW422	A mixture of scheduled and non-scheduled wastes

Table 8.3(b): List of Scheduled Wastes at the Construction Site

Waste Code	Waste Description
SW 305	Spent lubricating oil
SW 306	Spent hydraulic oil
SW 408	Contaminated soil, debris or matter resulting from cleaning up of a spill of chemical, mineral oil or scheduled wastes.
SW 409	Disposed containers, bags or equipment contaminated with chemicals, pesticides, mineral oil or scheduled wastes.
SW 410	Rags, plastic, paper or filters contaminated with scheduled wastes.
SW 421	A mixture of scheduled wastes.
SW 422	A mixture of scheduled and non-scheduled wastes

- **Scheduled waste storage area**

- The storage area of scheduled wastes should be designed, constructed, and maintained adequately to prevent spillage or leakage of scheduled wastes into the environment.
- The floor of the site shall be covered with concrete.
- The entire storage area must be fenced-in and regarded as a restricted area. Adequate signage should be put up clearly and visible with the word “**DANGER**” and “**SCHEDULED WASTES STORAGE**” at the entrance to the storage area (**Figure 8.1**);



Figure 8.1: Example of scheduled waste storage area

- **Storage container**

- An appropriate container should be selected according to the characteristics of the scheduled wastes. The characteristic of scheduled wastes shall be compatible with the type of material used for the container to prevent any reaction which will deteriorate the container.
- It is recommended that metal drum container is used to store the scheduled wastes (**Figure 8.2**). However, for a different group of incompatible wastes, different containers should be used.



Figure 8.2: Example of scheduled metal drum container

- **Schedule waste labelling**

- Containers of scheduled waste shall be clearly labelled in accordance with the types of applicable to them as specified in the Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations 2005 and marked with the scheduled waste code as specified in the First Schedule of the Environmental Quality (Scheduled Wastes) Regulations 2005 for identification and warning purposes.
- The characteristics are labels as in the Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations 2005 as shown in **Figure 8.3**.
- Scheduled wastes generated may be stored for 180 days or less and the quantity must not exceed 20 metric tonnes.

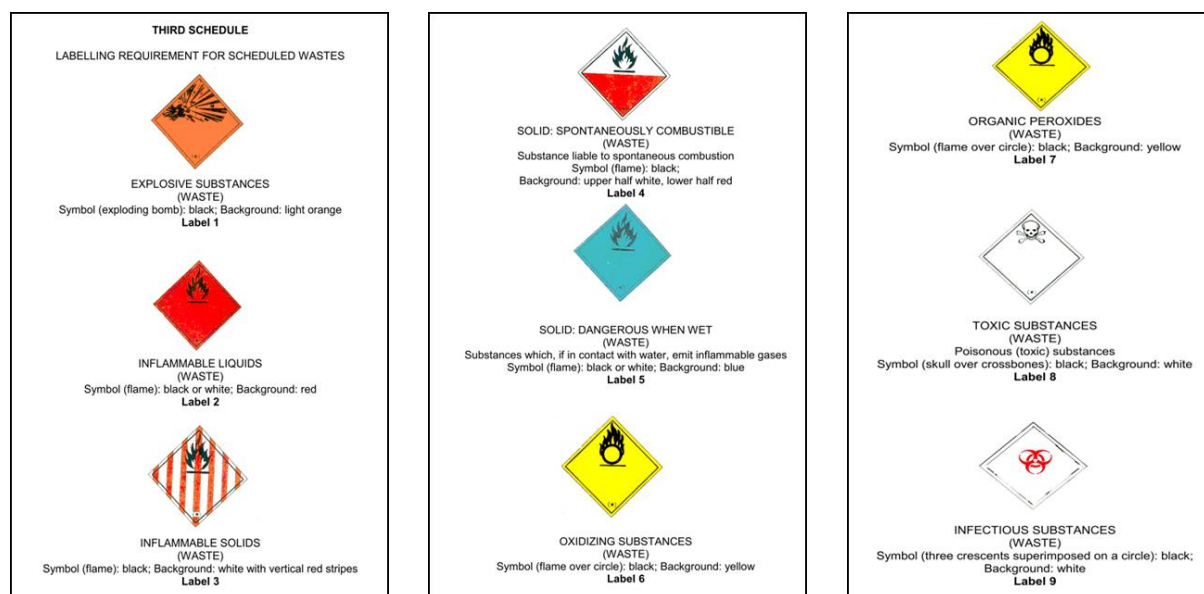


Figure 8.3: Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 2005

Moderate	f) <u>Demolition Waste Management</u> • Demolition debris management ○ Onsite sorting must be done to separate hazardous and non-hazardous waste. ○ Hazardous materials and pollutants must be disposed of separately according to the proper regulations (as mentioned above in Scheduled Waste). ○ The project proponent has highlighted their initiative to reuse and recycle demolition waste as much as possible in the Demolition Method Statement (<i>refer Appendix F</i>). Materials such as timber, asphalt, concrete, bricks, rebar, etc. can be recycled and reused for construction. ○ Bricks and concrete will be crushed and then processed into aggregates, typically used for the construction of internal driveways and foundations. Timber and boards will be reused on site for formwork, propping, temporary storage, temporary working platforms, etc. Scrap metal and glass sheets will either be reused for temporary structures or be reused in new structures. ○ Other components, such as doors, fixtures, and hardware, etc., will either be salvaged to be reused or repurposed. ○ If any materials are deemed to have heritage value, then they will be salvaged to be reused in the new structures or sold to local heritage contractors (as listed by Georgetown World Heritage Inc) or to private collectors. ○ Demolition debris that are deemed unsalvageable shall be disposed of only at approved waste landfill sites that accept construction/demolition waste. The demolition waste from the proposed site will be disposed of at Pulau Burung Landfill.	Significant
OPERATIONAL WASTE		
Moderate	a) <u>Solid waste</u> All wastes will be managed in accordance with a solid waste management plan for the site to create and maintain good housekeeping. The amount of solid waste generated by the overall development is estimated about 199 kg/day at a production rate assuming of 1 kg/person/day. The measures to include are as follows: ○ Provide large moveable and stationary containers at the point of generation meeting the standards requirement by the local authority. Adequate waste bins should also be provided with suitable design to discourage the wildlife from disturbing the trash.	Significant

	○ The waste generated shall be collected and disposed of at the approved disposal site. ○ Sustainable solid waste management should be practiced through reduce, reuse and recycle. Recycling of waste material should be encouraged by providing recycling bins to reduce waste. Other green measures such as composting of food waste, should be implemented as well. b) <u>Sewage</u> ○ The sewage of the proposed project is connected and will be discharged to the proposed private Small Sewage Treatment System (SSTS) on site (refer <i>Appendix D - Sewerage Plan and Sewerage Report</i>), with a PE capacity of 199 PE built over an area of 396 m².	
6) TRAFFIC		
DEMOLITION & CONSTRUCTION PHASE		
Moderate	The mitigation measures to control traffic and improve safety that can be considered are as follows: - a) <u>Transportation road</u> • Access road ○ Design and construct a temporary main access road to the project site with proper signage to ensure good road safety on-site. ○ Design and construct the internal roads within the project site. ○ The temporary access road shall be regularly and properly maintained for its performance. ○ Ensure the temporary access road are always clean. • Transportation control ○ Scheduling the heavy transport for construction material during off-peak periods e.g., from 9.00 am - 12.00 pm and from 2.00 - 4.00 pm can reduce issues relating to traffic hazards in the area. ○ No movement of transportation occurs after 7 pm and before 7 am to reduce risk to the public and vehicle speeds should be limited within the project site. ○ Speed control on-site. The ideal speed limit within the construction site and near populated areas should be less than 50km/hr.	Significant

- **Planning of transportation activities**

- Vehicles for carrying debris and excavated materials should be clean, well maintained and in good running condition. If they carry loose materials, they should be covered and properly sealed to ensure that there will be no spillage of materials onto the public road.
- The project-related transportation activities shall be carried out during off-peak hours to avoid early morning and afternoon traffic volume increases.
- Control the number of construction vehicles and equipment used at the site at any one time to avoid obstruction to traffic flow;
- Through advance planning of the routes to be travelled for transported soils can help to mitigate traffic issues whereby the transported trucks/lorry can only use the access route that was approved by the local authority.
- Proper scheduling of trucks/lorry trips can be planned to avoid potential impacts on traffic congestion during peak or normal hours;

b) Traffic control

- **Traffic Management Plan**

- A traffic management plan is necessary along logistics roads to accommodate heavy vehicular traffic to and from the project site throughout the operation period. This traffic management shall be carried out in a comprehensive manner to ensure that there are no unnecessary delays and nuisances caused to road users due to the additional traffic generated by the project development.
- Traffic disturbance needs to be minimized by avoiding high-density areas, using proper traffic signs, etc. Adequate temporary signage and markings need to be installed as recommended by JKR Guidelines i.e., Arahan Teknik (Jalan) 2A – 85 and 2C – 85, Standard Traffic Sign and Temporary Signs and Work Zone.
- The temporary signages/ warning signs proposed shall be maintained to ensure the maximum effectiveness of traffic management during daytime and nighttime not only for vehicular traffic but also for the movement of locality.

OPERATIONAL PHASE

Minor	• Local authority compliance ○ Shall abide by local authorities and JKR requirements for traffic management and transportation requirements. ○ However, there is not much traffic impact expected from this development, as it is located on top of Penang Hill, where the main mode of access for visitors is through the funicular train, and access by road is via a private road that requires permission from the Penang Hill Corporation or through registered private jeep services.	Insignificant
-------	--	---------------

7) SAFETY AND HEALTH

DEMOLITION & CONSTRUCTION PHASE

Minor	The mitigation measures to improve safety and health at construction site and public areas that can be considered are as follows: - <i>a) Construction site</i> • Work-related injuries and accidents <i>a) Communicable diseases</i> ○ Workers must wear a mask and normal personal protective equipment (PPE) on-site; ○ Avoid physical contact with others and direct employees/ contractors/ visitors while practicing social distancing; ○ Always maintain good personal hygiene through regular cleaning and disinfection of the venue <i>b) Risk to workers within the construction site</i> ○ Preparation of Emergency Response Plan (ERP). Emergencies can create a variety of hazards for workers in the impacted area. Preparing before an emergency incident plays a vital role in ensuring that employers and workers have the necessary equipment, know where to go, and know how to keep them safe when an emergency occurs. These ERP include as shown in Table 8.4;	• Insignificant impacts. • Construction safety measures should be implemented on-site.
-------	--	---

Table 8.4: Emergency Response Plan (ERP)

No.	ERP	Descriptions
1.	Design and construction requirements for exit routes	Establishes requirements for the proper design and construction of exit routes.
2.	Maintenance, safeguards and operational features for exit routes	Requirements for employee alarm systems and procedures for working during construction, repair, or alteration. Maintaining exit route standards will prepare the workplace for a successful emergency evacuation
3.	Medical services and first aid	The employer must ensure that medical personnel and adequate first aid supplies are available to workers to handling potential workplace injuries
4.	Portable fire extinguishers	If portable fire extinguishers are provided for employee use, provide an educational program at initial employment and at least annually thereafter.

Source: Occupational Safety and Health (OSHA), 2004

- **Safety Officer (SO) Employed**

- Safety officers evaluate and monitor health and safety hazards and develop strategies to control risks in the workplace;
- Inspect workplaces to ensure that equipment, materials and production processes do not present a safety or health hazard to employees or the general public;
- Develop, implement and evaluate health and safety programs and strategies;
- Provide consultation and deliver training programs to construction industry employers and employees on workplace safety issues and (depending on the project) environmental protection

- **Personal Protective Equipment (PPE) Requirement**

- Employers must provide the proper PPE to all workers include of safety jackets, gloves, safety shoes, helmets, etc.;

	○ Employers must ensure PPE is appropriately used and whenever necessary by their workers. ● Workers to have CIDB green card ○ All personnel working in construction sites must involve in the registration and accreditation of Construction Personnel of CIDB green cards to enhance safety levels at Construction work sites. ● CIDB Training Program ○ To ensure that construction workers are aware of the importance of a safe and healthy working place; ○ To provide basic knowledge on safety and health at the construction worksite; ○ To inform construction workers of the legal requirements in relation to safety and health. ○ Automatically covered by a special insurance scheme that insures the construction personnel against death and accidents. ● Health checks on workers ○ Health checks on workers to prevent spread of communicable disease to each other. ○ Qualitative/ quantitative health risk assessment (HRA) encompassing hazard identification, exposure assessment and risk characterization.	
8) LAND-USE, LANDSCAPE, AND VISUAL		
CONSTRUCTION & OPERATIONAL PHASE		
Minor	The mitigation measures to improve aesthetics of the area that can be considered are as follows: - ● Vegetation and Re-Vegetation ○ The removal of vegetation shall be minimized whereby it can be removed in stages. ○ Any bare ground resulting from the removal of vegetation should be immediately turfed to minimized erosion problems. ○ Rehabilitation of the site through landscaping and replanting the area.	Significant

9) ECOLOGY MANAGEMENT

CONSTRUCTION PHASE

Minor	The mitigation measures that can be considered for ecological protection are as follows: - • Biomass clearing ○ Vegetation clearing will be kept to a minimum through brush cutting if deem necessary; ○ All no-go areas will be demarcated; ○ Erosion control measures will be implemented in disturbed areas. ○ Re-vegetation of cleared areas and landscaping the area shall be undertaken to ensure that recovery is taking place;	Significant
Significant	• Flora and fauna protection ○ The Fauna Survey found 2 endangered, 1 critically endangered, along with 1 near-threatened and 4 protected species of avifauna. No threatened or endangered flora species were recorded. ○ Therefore, mitigation will focus on protecting the important fauna species and facilitating their return following the completion of the project. ○ All the P2M2 measures shall be properly implemented and maintained in accordance with good practices. ○ Flora salvage can be done to remove selected native plants from the development area and replanting them elsewhere deemed suitable. ○ Only native flora should be used for landscaping. Construction materials and soil shall be inspected for invasive seeds or pests. ○ Use sturdy, high-visibility fencing to protect the “drip line” of trees. Materials or machinery should not be stored inside these zones to prevent root compaction. ○ Strict “No Feeding” policy among the workers, and food waste storage should be secured to prevent attracting wildlife.	Significant

OPERATIONAL PHASE

Significant	• Disturbance from light pollution to fauna ○ Shielded, downward-facing fixtures should be used to prevent skyglow ○ Warm spectrum lighting should be used as it is less disruptive to bats and insects ○ Motion sensors should be used for security lighting in the peripheral forest areas. • Measures to minimize potential environmental damage ○ A sustainable and holistic approach must be adopted in design. ○ Resource efficiency measures, such as energy-saving systems and water conservation steps, shall be implemented. ○ Waste generated from the operational phase should be managed effectively with green measures such as recycling, composting and reducing single-use plastics. ○ Comprehensive education shall be provided to staff and guests, in order to foster responsible tourism practices. This will ensure long term protection of the local ecosystem. ○ Future research and monitoring can be established to further understand and conserve the ecological dynamics of the area.	Significant
-------------	---	-------------

10) SOCIO-ECONOMIC

CONSTRUCTION PHASE & OPERATIONAL PHASE

Beneficial	The mitigation measures that can be considered for socio-economic are as follows: - • Employment ○ The project proponent should advertise to the surrounding community to encourage locals to participate in jobs such as security officers, workers during felling, earthworks activities, maintenance activities, etc. ○ During operational phase, project proponent should prioritise hiring locals with related work experience in industries such as hospitality, finance, food and beverage etc. ○ Implementation of skills development programs to support the local population in obtaining employment opportunities; ○ The contractor shall make sure that foreign workers recruited have a work permit to enter the	Beneficial
------------	---	------------

	construction site. ○ All matter related to workers should comply with the Employment Act 1955 (Act 265); ○ Orientation briefing are to be given to new foreign workers to familiarize themselves with the Malaysian laws, customs and social etiquettes; and ○ Continual engagement and corporate social responsibility (CSR) should be implemented with surrounding communities.	
11) GEOTECHNICAL CONSIDERATIONS		
CONSTRUCTION PHASE & OPERATIONAL PHASE		
Significant	The proposed development of the proposed site required attentive and stringent measures. Therefore, the key findings from the geotechnical analysis by geotechnical consultants and ICE must be properly adhered to. a) <u>Potential Geohazards - Landslide Risk</u> • At a gentle slope (gradient <35°) the process of transportation and deposition may happen, where the material of the top surface contains lots of clay and silt, which might cause siltation and sedimentation problems. • Therefore, a proper drainage system with proper engineering input on the slope design is important to ensure stability of slopes, suitability of the site and safety of the development. • Furthermore, the Geohazard Map (refer <i>Softcopy Attachments - GTM Report</i>) shows that the landslide risk score of the project is less than 25, which indicates Low to Moderate Risk. 56.17% of the project site lies on Low Risk zone and the remaining 43.83% lies on Moderate Risk zone. b) <u>Slope Stabilization Measures</u> • The assessment of slope stability should be conducted in accordance with the design criteria outlined in the “MS JKR 21500-0011-10 Guidelines for Slope Design” published by the Jabatan Kerja Raya (JKR). These guidelines provide comprehensive recommendations to ensure that slope designs meet minimum safety requirements. • According to JKR, unreinforced slopes — including both cut and fill slopes — must be evaluated	Significant

for both local and global stability. To ensure an acceptable level of safety and performance, a minimum Factor of Safety (FoS) of 1.3 is recommended for all such slopes. This value reflects the ratio of resisting forces to driving forces acting on the slope, and achieving this minimum threshold is essential to reduce the risk of slope failure. The stabilized slopes have been designed to a minimum FOS of 1.5.

- Soil nailing will also be implemented as a slope stabilization measure. The soil nail will mainly consist of T32 rebar with a nail length of 15m which shall provide a working load of 120kN/nail. This is expected to achieve the required safety of factor in stability.

c) **Instrumentation and Monitoring**

- **Instrumentation and Monitoring**

- Four (4) inclinometers are proposed at strategic locations. Frequency of readings shall be on a fortnightly basis or at least 10 trips during the construction stage. After construction, the frequency of readings can be adjusted.

- **Post Construction Slope Monitoring & Site Maintenance**

- All exposed area shall be turfed. This is to minimise the rain water seeping into the ground and weakening the surface soils strength. The growth of turf will be checked monthly.
- Cleaning of slope drainage system to be done once a month

8.4 ABANDONMENT PHASE

Even if the possibility of abandonment of the project is unlikely, there must be a contingency plan if this happens in abnormal circumstances. The abandonment could take place at any stage of the project. In a particular case where the project proponent intends to abandon a project whether it is in the pre-construction phase, construction phase or after it has started operation (post-construction phase), an abandonment and closure plan shall be prepared accordingly. As such, it is important to establish a proper abandonment plan which lists out works to be conducted prior to actual abandonment. These may include assessment of site suitability for other future developments, site cleaning works as well as rehabilitation works.

Project proponent shall be responsible to rehabilitate the site within a reasonable time to avoid the adverse impact due to project abandonment. The following shall be taken by project proponent: -

- ❖ The detailed abandonment plan shall be submitted to DOE for review and acceptance at least six (6) months prior to its implementation.
- ❖ The DOE shall be informed the actual date of closure or abandonment of the project.
- ❖ Project proponent shall be given the commitment to rehabilitate the project site by considered all the safety and environmental impact.
- ❖ Provide stakeholders with accurate, timely and comprehensive information about the closure process and closure related issues.
- ❖ Ensure that the necessary regulatory requirements are fulfilled.
- ❖ Site offices/PV structures shall be demolished
- ❖ Construction wastes, domestics wastes from demolition work must be disposed off from the project site at an approved landfill
- ❖ Scheduled wastes must be transported out from the project site and managed adequately by licensed contractors.

The detail of the abandonment plan shall be adopted during EMP implementation whereby the environmental monitoring committee shall ensure that the implementation of the environmental management programs outlined oversee the effectiveness of the mitigation measures implemented throughout the project development

However, for this development, project abandonment is very unlikely in view of the project proponent management, financial background, and excellent track record with a reputation as the biggest and most prominent Buddhist temple in Penang. This is further supported with the need for such project to support the need of alternative burial methods for the local non-Muslim community.

8.5 INSPECTION AND MAINTENANCE

8.5.1. General BMPs Inspection and Maintenance

The following describe the routine maintenance and monitoring of the proposed BMPS that will be performed for the project based on ESCP/LD-P2M2 Report. In addition, if sediment and erosion control measures are to remain effective, they must be installed properly, inspected in a timely manner and properly maintained. The inspection and maintenance criteria in a project area are depend on the several factors such as its location, weather, size and type of project. Periodic inspection and maintenance are required to remove trapped sediments and repair of any damage (if any) especially during heavy rainfall event. The construction contractor will be responsible for the preparation, installation and removal of temporary erosion control measures include of: -

- ❖ Site inspections shall be conducted to check and to ascertain that all P2M2s have been properly installed and maintained as well as to determine whether any controls that are clearly not operating as intended or any P2M2s requires replacement, or additional P2M2s are required. The site inspections shall also assess if pollution is effectively being controlled and off-site discharge is being prevented in compliance with the EIA conditions of approval (COAs).
- ❖ All inspection activities shall be recorded in the logbook
- ❖ Inspections shall be conducted at the site prior to commencement of land clearing activities and after every storm event during construction and as specified in the established inspection schedule.
- ❖ Initial inspection of erosion control measures as they are completed to ensure they will function as desired.
- ❖ Inspections following each rainstorm to ensure replacement of damaged or missing structures and materials.
- ❖ Notifying project construction crew when to implement adequate precautions in anticipation of rainy weather condition.
- ❖ Defining a schedule for watering the access roads and other disturbed areas for dust suppression.
- ❖ Developing additional remedial erosion and sediment controls for problems areas if any.
- ❖ Complying with other BMPs requirement as required by DOE.

Routine maintenance measures to be implemented include: -

- ❖ Maintenance shall begin as soon as the first P2M2 is installed or applied and shall continue through all the succeeding activities until the permanent erosion control measures are established and functioning. Maintenance method shall be in accordance with design specification.
- ❖ General site maintenance and erosion sediment control measures such as hoarding, tyre washing bay/facilities, sediment basin, temporary earth drains shall be constructed prior to earthwork.

- ❖ The on-site sediment basin will be monitored following each major rainstorm for accumulation of sediment. Sediment will be removed in order to maintain adequate capacity of minimum setting depth.
- ❖ Silt fences will be inspected and replaced as needed. Accumulated sediment will be removed when it reaches a depth of 300mm
- ❖ Protected storage areas for stockpiled soils or other materials will be inspected.
- ❖ Soil stabilization and vegetation success will be monitored by periodic inspection of the disturbed areas of degree of turfing/ plant coverage.
- ❖ Stabilized construction entrance or wash trough or tires washing facility shall be maintained so as not to track-out sediment or mud onto any adjacent public roads. In any occasion where sediment has been tracked-out from the project site onto the off-site streets, the deposited sediment shall be removed the end of the same work day by sweeping, shoveling, or vacuuming the surfaces, or by using other similarly effective means of sediment removal. Hosing or sweeping tracked-out sediments into any drainage is prohibited unless it is connected to a sediment trap, or similarly effective control.

8.5.2. Slope Protection and Maintenance

8.5.2.1. Instrumentation and Monitoring

Instrumentation such as inclinometer is proposed to permanently monitor the slope movement. Four (4) inclinometers are proposed at the strategic locations with the frequency of the reading taking shall be on fortnightly basis or at least 10 trips during the construction stage. After construction, the frequency of taking the readings can be adjusted.

8.5.2.2. Post Construction Monitoring and Maintenance

Slope maintenance works after the completion of development is required. This is particularly crucial on the maintenance works of the drainage system. All exposed area shall be turfed. This is to minimise the rain water seeping into the ground and weakening the surface soils strength. **Table 8.5** shows the proposed frequency of the regular maintenance works for post construction works.

Table 8.5 Frequency of regular maintenance works

Item	Description	Frequency
1	Cleaning of the slope drainage system including berm drain, cascade drain etc.	Once per month
2	Check on growth of turf	Once per month

CHAPTER 9

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1 INTRODUCTION

The formulation of the Environmental Management Plan (EMP) is a crucial step to ensure that any significant impacts on the existing environment can be controlled. The EMP provides a framework for dealing with the pollution risk associated with the site preparation and operation to ensure that appropriate measures are taken to handle issues that have been identified as significant and most likely to arise throughout the whole development. It functions as an effective tool to minimize environmental impacts that are imposed by the development. The EMP shall be prepared based on the findings of the EIA and the requirements stipulated in the EIA approval conditions (COA) in accordance with the **Guidance document for Preparation and Submission of Environmental Management Plan** by DOE.

The EMP comprises a structured plan for mitigation of predicted environmental impacts for Environmental Monitoring and Environmental Auditing. It will apply to all contractors and their employees working in the Project site.

9.2 OBJECTIVE OF THE EMP

The main objectives of the EMP are:

- To effectively manage and mitigate the environmental impacts arising from project activities throughout all phases of the development.
- To ensure that all works are conducted in compliance with the Conditions of Approval (COA) and adhere to the Environmental Quality Act 1974 and its associated regulations.
- To provide a comprehensive action plan for implementing mitigation measures, ensuring that environmental risks are managed and minimized.
- To ensure that the Pollution Prevention and Mitigation Measures outlined in the Environmental Impact Assessment (EIA) report are properly implemented and maintained throughout the project

9.3 SCOPE OF THE EMP

The scopes of works to achieve these objectives are as follows:

- Assess the environmental monitoring baseline data and the recommended mitigation measures which involves determining compliance with requirements by DOE for environmental quality and the effectiveness of proposed mitigation measures.
- Identify sources of environmental impact and compare them with environmental quality standards and legislative requirements. This step is crucial for reviewing the effectiveness of the EMP and the implemented mitigation measures.

- Propose additional mitigation and remedial measures as necessary. This includes recommending any changes in environmental monitoring parameters, locations, or frequencies based on the observed effectiveness of the current measures.
- Evaluate the effectiveness of environmental management practices and procedures during the construction phase. This assessment helps ensure that environmental impacts are managed effectively throughout the project's development.

9.4 KEY INFORMATION IN THE EMP

The EMP contains the following key information as shown in **Table 9.1**:

Table 9.1: Key Information in the EMP

Content	Description
Introduction	• Objectives of the EMP. • Scope of the EMP. • Description of the existing environment and development schedule.
Policy and budget	• Policy statements from the project proponent on safety, health, and environmental management and protection. • Budgeting for EMP implementation, including measures for regulatory compliance and environmental mitigation.
Organizational Structure	• Organizational structure and details of the Environmental Performance Monitoring Committee (EPMC). • Responsibilities for environmental management and site protection.
Training Requirement	• Training programs for the EPMC members and workers to develop competencies necessary for effective environmental protection and compliance.
Environmental Requirements	• Identification of issues and recommended mitigation measures from the EIA report • Additional Best Management Practices (BMPs) as appropriate • Environmental Management Action Plans (EMAPs), Environmental Monitoring Programmes, Closure Plans, and Environmental Auditing Programmes.
Environmental Contingency Plan	• Procedures to be followed in case of emergencies during the construction and operational phases.
Conclusion	• Summary of the EMP, including key points and overall effectiveness.

9.5 REGULATORY REQUIREMENTS

The proposed P2M2s as described in **Chapter 8** of this EIA report are generally developed in accordance to the relevant environmental requirements and regulatory requirement includes in the EMP to comply with to the following: -

Environmental aspects	Acts and Regulations
Air Quality	• New Malaysia Ambient Air Quality Standards (MAAQS), 2020 • Environmental Quality (Clean Air) Regulations, 2014
Noise Level and Vibration Limit	• The Guidelines for Environmental Noise Limits and Control Third Edition 2019 (Reprint 2021) • Guidelines for Environmental Vibration Limits and Control Third Edition (DOE, 2021)
Water Quality	• National Water Quality Standards (NWQS) • Environmental Quality (Sewage) Regulations, 2009
Erosion and Sedimentation	• Guidance Document for Addressing Soil Erosion and Sediment Control Aspects (DOE, 2016) • Guidance Document for the Preparation of the Document on LD-P2M2 (DOE, 2016) • Guidelines for Erosion and Sediment Control in Malaysia (DID, 2010) • <i>Manual Saliran Mesra Alam Edisi-2 (MSMA-2) (DID, 2012)</i>
Landuse	• Structure Plan, Local Plans, Special Area Plans etc. • National Physical Plan-4 (NPP-4) • Local authority requirements
Safety and Health	• Occupational Safety and Health Act 1994 • Department of Occupational Safety and Health (DOSH)
Wastes	• Environmental Quality (Prescribed Activities) (Open Burning) Order, 2000 • Environmental Quality (Sewage) Regulations 2009 • Environmental Quality (Scheduled Wastes) Regulations 2009 • Guidelines For Packaging, Labelling and Storage of Scheduled Waste in Malaysia (DOE, 2014)

9.6 GUIDED SELF REGULATION (GSR) THROUGH ENVIRONMENTAL MAINSTREAMING TOOLS

The project proponent is committed to mainstreaming environmental protection into the Project and implementing GSR to ensure the quality of environment is protected during the construction and operation of proposed project. The implementation of the environmental mainstreaming is to promote and instill self-regulation that will be translated into regulatory requirements on performance and compliance monitoring of pollution controls measures, scheduled reporting, record keeping, competent persons and environmental professional with the roles and responsibilities.

Details on GSR for the project shall be incorporated into the EMP framework as required in the Environmental Mainstreaming Directive issued by DOE. This shall cover the Seven (7) environmental mainstreaming tools.

9.6.1 Environmental Policy (EP)

The project proponent is fully committed to the prevention of pollution, protecting and minimizing the effects of our operations on the environment. This company will take all the reasonable steps to ensure that all persons working for the company are aware of the rules in accordance with the legislation. Their policy states that they aim to:

- a) Adhere to all necessary legal and regulatory requirements related to environmental management
- b) Identify the requirements for effective environmental management and assign clear responsibilities to site personnel
- c) Implement systematic monitoring of environmental management aspects on site and maintain thorough records of environmental issues.
- d) Continuously enhance awareness and provide necessary training to employees and customers to integrate environmentally responsible practices into standard operations.
- e) Minimize the use of environmentally sensitive materials;
- f) Clearly communicate environmental policies to all personnel involved in the company's operations

9.6.2 Environmental Budgeting (EB)

Sufficient budgeting will be allocated to implement measures to comply with environmental regulations and mitigation measures. The budget will include all the mini-laboratory, auditing, pollution control facilities, monitoring, training, and remedial and rehabilitation works.

9.6.3 Environmental Monitoring Committee (EMC)

EMC was hired by project proponent to ensure the proposed P2M2 implemented and to promote collective responsibility. Environmental mainstreaming has been integrated into all the recent regulations of the DOE. Hence, this section discussed the roles and responsibilities of the various persons involved in proposed project.

9.6.3.1 Project Proponent (PP)

- a) Allocating adequate resources for all steps in the EIA process and every stage of project planning, including temporary pollution prevention and mitigation measures (P2M2s);
- b) Establish the organization chart and clearly shows the placement of Environmental Officer (EO);
- c) Appointing an EO, at the EMP stage to execute environmental quality control and performance monitoring functions during construction and operation phases of the project implementation;
- d) Establish a project EPMC to monitor the environmental performance effectiveness of P2M2;
- e) Setting up a 'mini laboratory' to facilitate the implementation of environmental performance monitoring program. This mini laboratory shall adequately equip with relevant resources including portable testing equipment and staff (if in need);
- f) Ensuring the EMP including temporary and permanent P2M2 are implemented and maintained according to Best Management Practices (BMPs).

9.6.3.2 Environmental Consultant (EC)

The Environmental Consultant (EC), who is a Registered EIA Consultant, plays a pivotal role in ensuring that the EIA process and subsequent environmental management are conducted in accordance with regulatory requirements and best practices. The roles and responsibilities of the EC include:

- a) Developing comprehensive Environmental Impact Assessment (EIA) report, outlining the potential environmental impacts of the project and recommended mitigation measures.
- b) Assisting clients in understanding and adhering to relevant environmental regulations and standards, ensuring that all legal and regulatory requirements are met.
- c) Preparing a detailed Environmental Management Plan (EMP) that outlines the strategies and actions required to manage and mitigate environmental impacts throughout the project lifecycle

9.6.3.3 Environmental Officer (EO)

The Environmental Officer (EO) is a key role responsible for overseeing environmental management practices on-site and ensuring that all control measures are implemented effectively. The EO must be competent and their details, including name, position, and contact information, should be submitted to the Department of Environment (DOE) before commencing land-disturbing activities. The specific tasks of the EO include:

- a) Supervise the control of erosion and sediment at the site as outlined in the LD-P2M2 and Environmental Management Plan (EMP)
- b) Update the daily logbook of the Project Site;
- c) Conduct daily inspection on the preventive and pollution control measures (P2M2s) includes of Best Management Practices (BMPs) control of erosion and sediment (including drainage perimeter, check dam, silt trap, wash trough, and others)
- d) Conduct site meetings every two (2) weeks with project manager/ project proponent and contractors;
- e) Conduct in-situ measurements of turbidity at the point of discharge from the sediment control structure such as sediment pond within 30 minutes after heavy rainfall. If the rainfall continues for 24 hours measurement are to be conducted every day (Failure to comply to this condition is to be recorded and the reason shall be reasonable)
- f) All good housekeeping practices based on the 5S Concept (*Sisih, Sapu, Susun, Seragam & Sentiasa Amal*) shall be implemented form the land disturbing activities until the completion of the project.
- g) Implement all the tasks detailed out in the EIA Guideline in Malaysia (EGIM) published by DOE.

9.6.4 Environmental Facility (EF)

EF ensures that the Project is equipped with the necessary equipment to monitor important components of the environment to enhance the effectiveness of environmental monitoring and able to take any action with the variation event occurred. EO shall provide and maintain the necessary mini-laboratory equipment on site to facilitate in-situ measurement (e.g., turbidity or TSS). The exact requirements for in situ measurements shall be detailed out in the EMP report.

9.6.5 Environmental Competency (EC)

Environmental professionals (Environmental Consultant, Environmental Auditor, and Environmental Officer) who have been certified as Competent Persons (CP) by DOE are responsible individuals to supervise the environmental management of the Project. Below are the certification processes for CP as follows:

- a) Registered Environmental Consultant by DOE;
- b) Registered Environmental Auditor by DOE;
- c) Certified Professional Environmental Officer in EIA Projects (CePEOEIA)
- d) Certified Inspector of Sediment and Erosion Control (CISEC)
- e) Certified Erosion, Sediment and Storm Water Inspection (CESSWI)

The monitoring program will be supervised by CP who is able to understand, interpret and analyze the results in relation to the on-going construction works.

9.6.6 Environmental Reporting and Communications (ERC)

Environmental reporting will be going throughout the various stages of the project. The main objective is to document environmental status or progress and ensure that the issues arising during construction are handling properly.

This report is prepared to monitor and regulate the actions being taken to manage the project's impacts on the environment. Reports will be prepared by EC for submission to DOE to fulfill the environmental legal requirements. This report will assist the effectiveness of the EMP, LD-P2M2 and others mitigating measures being implemented as well as in terms of monitoring compliance.

9.6.6.1 External Reporting

Environmental report for regulatory compliance will be prepared at various levels of the project. Within the environmental management structure of the project, the environmental reporting consists of Two (2) stages:

- a) Preparation of reports by EO for submission to the PP to fulfill contractual requirements.
- b) Preparation of reports by PP for submission to DOE to fulfill the environmental legal requirements and EIA COA.

The types of reports prepared as tabulated in **Table 9.2**.

Table 9.2: Types of Environmental Report and Submission Responsibility

No.	Types of Report	Person in Charge (PIC)	Responsibility
1	EMP report	Environmental Consultant	Prepare, review, and Submit to DOE

2	Implementation of LD-P2M2 at project site	Environmental Officer	Observe, review, compile and submit to DOE
3	Quarterly Monitoring Report for submission to DOE	Environmental Consultant	Prepare, review, and submit to DOE
4	EIA 1-18 and EIA 2-18 (submit quarterly)	Environmental Consultant	Prepare, review, and submit to DOE

9.6.6.2 Internal Reporting

In accordance with the DOE's guided self-regulation requirements, internal environmental reports will be prepared during the Project's construction stage include:

1) Environmental Performance Monitoring Document (EPMD);

Before the commencement of site works for each construction, the EC will prepare the EPMD. The EPMC will describe in detail how the contractor will comply with the EIA COA as well as ensuring that all the P2M2 are functioning and effective in mitigating impacts. The details will include performance monitoring equipment, sampling analysis, monitoring parameters, frequency, discharge compliance, record keeping and others. Besides, this report also has Compliance Monitoring (CM) and Impact Monitoring (IM).

2) Performance Monitoring Report (PMR)

Environmental monitoring will be conducted as specified in the EPMD and the finding will discuss in the Performance Monitoring report. The findings will be analyzed and evaluated the effectiveness P2M2 and compared the result with recommended standards or guidelines. The result analysis will in the graphical presentation and some suitable statistical technique. The PMR will submit to project proponent and the document shall be kept and maintained for inspection by DOE officers.

9.6.6.3 Communication Channels

The communication between project proponent and EC must be good either face to face or by email. These communication channels shall be maintained well so that any feedback or problems regarding adverse impact on the surrounding environment can be solved immediately and efficiently.

9.6.7 Environmental Transparency (ET)

The best option to implement the environmental transparency (Environmental Sustainability Report/Website/Billboard, etc.) will be taken into consideration and implemented later during construction and operation phases. Environmental sustainability reporting is proposed to be incorporated into the company's corporate reporting.

9.7 ENVIRONMENTAL MONITORING PROGRAMME

Project proponent will be able to monitor the effectiveness of the P2M2 during the monitoring programme when the construction and operation were implemented at the project site. The main aims of the environmental monitoring program are to provide the baseline data against any short or long-term environmental impacts of the environmental control measures or practical fail to achieve the standards provide by the DOE. The environmental monitoring, it comprises three types namely: Performance Monitoring (PM), Compliance Monitoring (CM), and Impact Monitoring (IM) has described in **Table 9.3**.

Table 9.3: Environmental Monitoring Programme Description

No	Environmental Monitoring Programme	Description
1.	Performance Monitoring (PM)	Performance Monitoring (PM) involves assessing the effectiveness of environmental management and pollution control systems, including any mitigation measures implemented as part of the project. The focus is on ensuring that these systems are operating as designed and are effective in mitigating environmental impacts. Key aspects include: • Parameters Monitoring: Specific environmental parameters are monitored to ensure that all mitigation measures, such as those in the LD-P2M2 Plan, are functioning correctly. • System Effectiveness: Evaluating whether the implemented systems are achieving their intended environmental protection goals.
2.	Compliance Monitoring (CM)	Compliance Monitoring aims to ensure that all mitigation measures and Conditions of Approval (COA) from the Environmental Impact Assessment (EIA) are being properly implemented on-site. This includes: • Discharge Monitoring: Checking the quality of discharges to ensure they meet regulatory requirements. • Air Quality, Noise & Vibration Monitoring: Assessing air quality, noise levels and vibration to ensure they remain within acceptable limits

3.	Impact Monitoring (IM)	Impact Monitoring (IM) is conducted to verify the accuracy of the potential impacts identified during the EIA scoping process and to ensure that the mitigation measures (P2M2) are effectively implemented.
----	-------------------------------	--

These monitoring activities are crucial for ensuring that the project adheres to environmental standards, mitigates impacts effectively, and remains compliant with legal requirements throughout its lifecycle. As such, the environmental monitoring programme proposed of the proposed project are summarized in **Table 9.4** and the proposed sampling locations are shown in **Figure 9.1 - 9.2 and Table 9.5**.

Table 9.4: Environmental Monitoring Programme

Monitoring Programme/ Indicator	Monitoring Location	Standard Requirement		Frequency		Personnel Required	Monitoring Programme		
		Parameters	Compliance Limits	Monitoring	Reporting		Performance Monitoring (PM)	Compliance Monitoring (IM)	Impact Monitoring (M)
Duration: From the land disturbing activities/ operational/ until project completion (depending on the suitability of the project)									
Sediment Basin [ESCP/LD-P2M2]	Discharge from Sediment Basin	Total Suspended Solid (TSS)	50mg/l	Monthly Biweekly Per rainfall event	Monthly	Environmental Officer (EO)	√	√	Not Applicable
		Turbidity	250 NTU						
BMPS [ESCP/LD-P2M2]	Temporary earth drains Wash through Hoarding Silt fence Berm drain Etc.	Not Applicable	Not Applicable	Biweekly Per rainfall event	Monthly	Environmental Officer (EO)	√	√	Not Applicable
Air Quality (A) [Figure 9.1]	A1 5°25'45.38"N 100°16'12.47"E A2 5°25'33.45"N 100°16'10.82"E A3 5°25'43.39"N 100°16'19.62"E	PM _{2.5} PM ₁₀	35 µg/m³ 100 µg/m³	Monthly	Quarterly	SAMM Accredited Laboratory	Not Applicable	√	√
Noise Level (N) [Figure 9.1]	N1 5°25'45.38"N 100°16'12.47"E N2 5°25'33.45"N 100°16'10.82"E N3 5°25'43.39"N 100°16'19.62"E	LA _{eq} L _{min} L _{max} L ₁₀ L ₅₀ L ₉₀	[N1] Residential: Daytime: 55 dBA Nighttime:50 dBA [N2] Commercial: Daytime: 65 dBA Nighttime:60 dBA [N3] Industrial: Daytime: 70 dBA Nighttime:65 dBA	Quarterly	Quarterly	SAMM Accredited Laboratory	Not Applicable	√	√
Vibration (V) [Figure 9.1]	V1 5°25'45.38"N 100°16'12.47"E V2 5°25'33.45"N 100°16'10.82"E	Peak particle velocity	[V1] Residential: Day: 0.8-1.6 mm/s Night: 0.4 mm/s [V2] Commercial: Day: 0.8-1.6 mm/s Night: 0.4 mm/s	Quarterly	Quarterly	SAMM Accredited Laboratory	Not Applicable	√	√

Water Quality (W) [Figure 9.2]	W1 5°25'45.21"N 100°16'15.27"E W2 5°26'25.77"N 100°16'57.22"E W3 5°26'24.94"N 100°17'12.08"E	pH, Temperature Turbidity Dissolved oxygen (DO) Conductivity Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD) Total Suspended Solids (TSS) Ammoniacal Nitrogen, Oil & Grease E. Coli Faecal Coliform Total Coliform	National Water Quality Standards for Malaysia (NWQSM)	Monthly	Quarterly	SAMM Accredited Laboratory	Not Applicable	√	√
Standards:	<i>Air Quality - New Ambient Malaysia Air Quality Standard (2020)</i> <i>Noise Level - Guidelines for Environmental Noise Limits and Control, Third Edition (DOE, 2019); Recommended Permissible Level (Laeq) by Receiving Land use for New Development (Urban Residential)</i> <i>Water Quality - National Water Quality Standards (NWQS)</i> <i>Vibration - Guideline for Environmental Vibration Limits and Control (DOE, 2021); Recommended Vibration Limits for Human Response and Annoyance from Intermittent Vibrations (Third Schedule); Human Perception of Vibration and Likely Environmental Impact</i>								

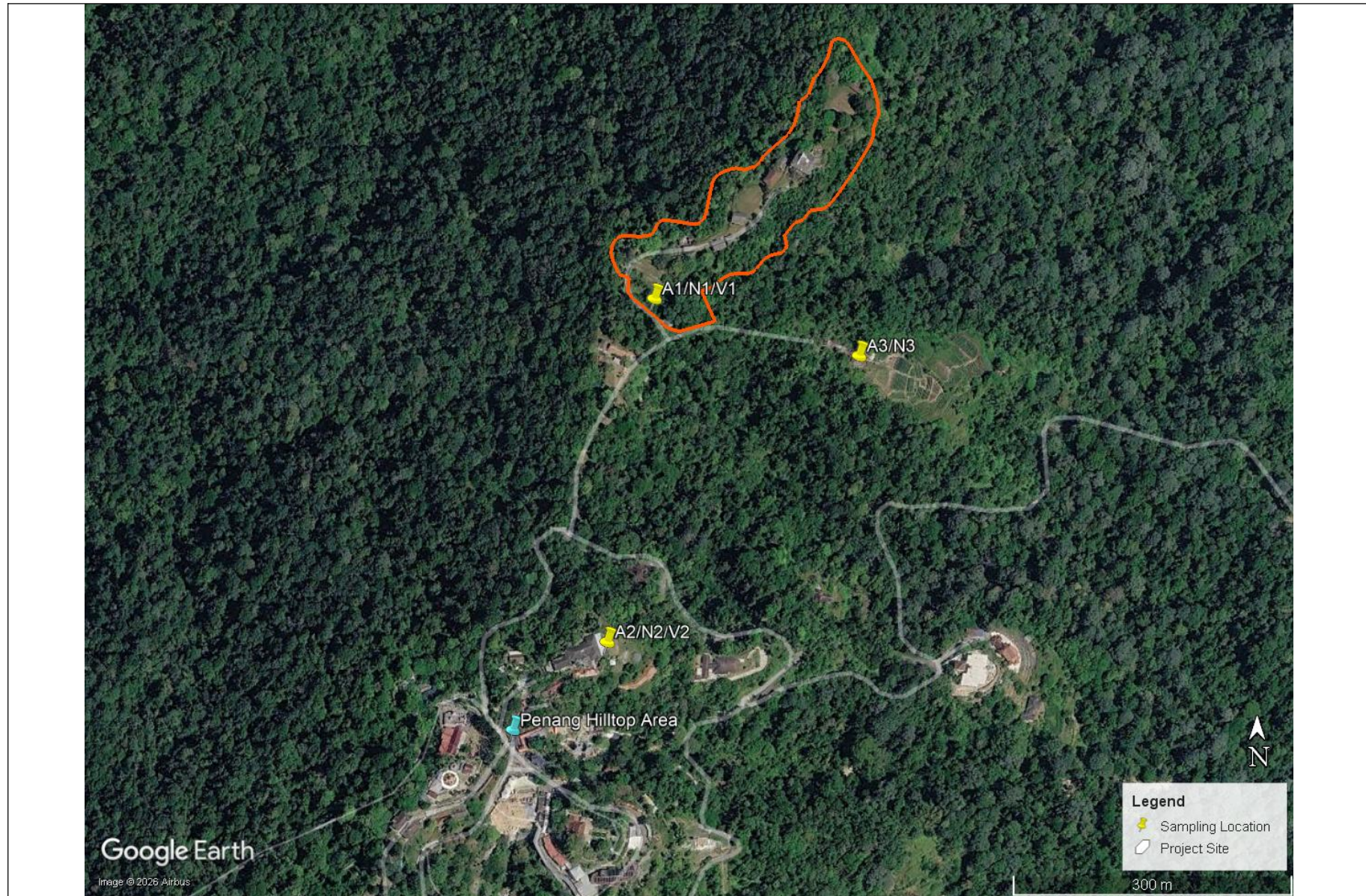


Figure 9.1: Monitoring Sampling Point Locations (Air, Noise and Vibration)

Source: Google Earth and Updated by Runding Alam Resources, 2025

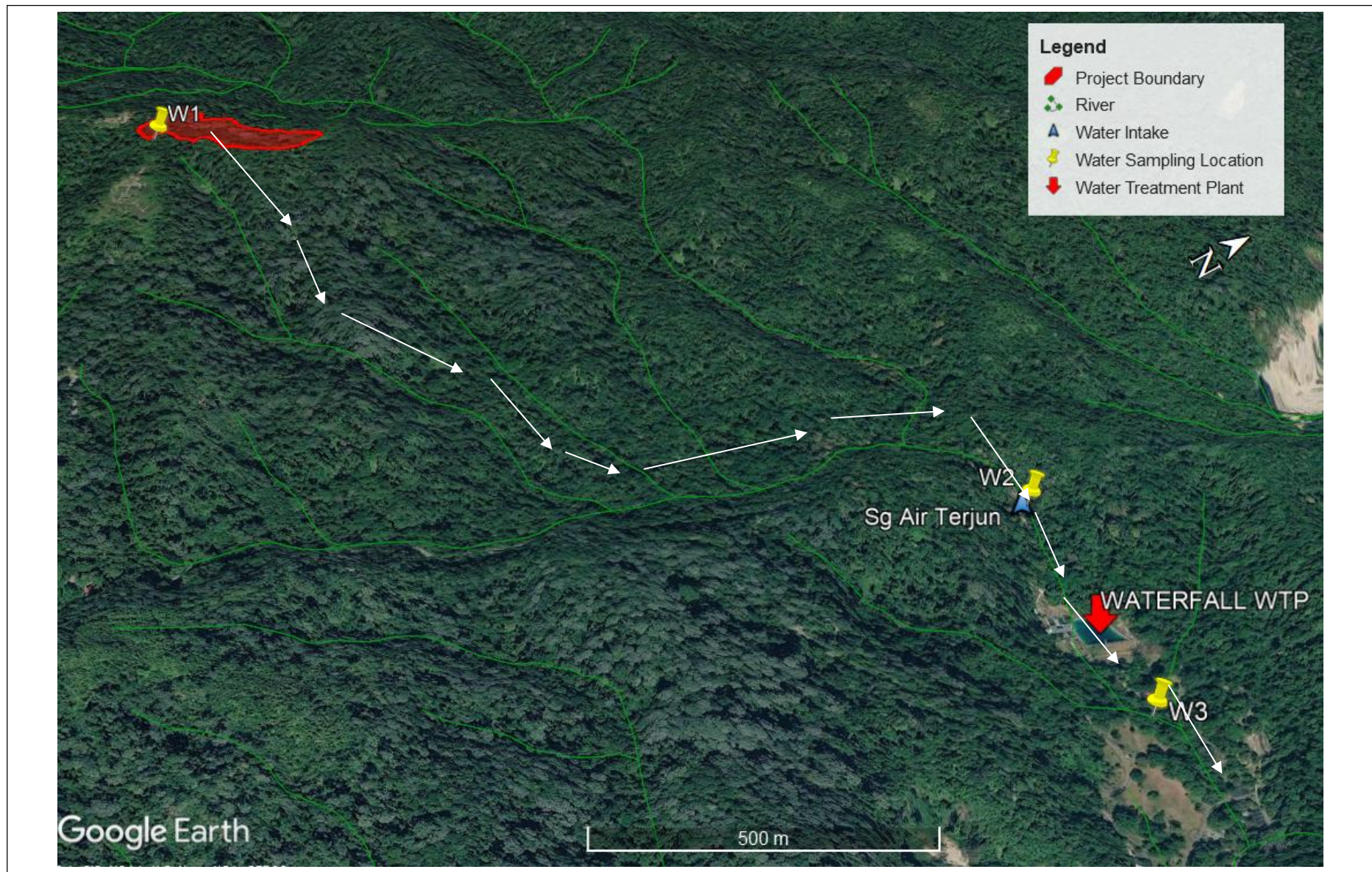


Figure 9.2: Monitoring Sampling Point Locations (Water Quality)

Source: Google Earth and Updated by Runding Alam Resources, 2025

Table 9.5: Environmental Monitoring Sampling Stations

Station	Coordinate		Location
	Latitude	Longitude	
A1/N1/V1	5°25'45.38"N	100°16'12.47"E	Near Richmond Bungalow (within project boundary)
A2/N2/V2	5°25'33.45"N	100°16'10.82"E	Near Bellevue Hotel (south of project site)
A3/N3	5°25'43.39"N	100°16'19.62"E	Near agricultural land (southeast of project site)
W1	5°25'45.21"N	100°16'15.27"E	At concrete drain near final discharge point from project site
W2	5°26'25.77"N	100°16'57.22"E	Upstream of Sungai Air Terjun (upstream of water intake)
W3	5°26'24.94"N	100°17'12.08"E	Downstream of Sungai Air Terjun (downstream of water intake)

Note: *A – Air Quality*
 N – Noise Level
 V – Vibration
 W – Water Quality
 M – Marine Water Quality

9.8 ENVIRONMENTAL AUDITING

The Amendments (1996) to the EQA 1974 required environmental audit is made mandatory under Section 33A of the EQA 1974 for projects with EIA approvals. Environmental Auditing is a post-EIA evaluation process to determine the effectiveness and performance of the mitigation measures put in by the project proponent to comply with the COAs. Audit requirements are guided by the Environmental Audit Guidance Manual by DOE. An independent third party must undertake the audit as a DOE registered auditor.

The EMP should include a checklist for the environmental auditor to fill in while conducting an audit on site. The audit should include the review of documents/records, environmental monitoring reports, complaints, and correspondence by other authorities or nearby residents or receptors and a thorough inspection of site activities. The audit findings should be used to identify any weaknesses in the EMP to update the EMP and to allow for environmental management improvement practice within the Project site.

During the construction phase, activities within the proposed project should be audited internally on every quarterly basis to check the effectiveness of the EMP and the compliance with the EIA COAs. Any non-compliance detected during the audit will be documented and acknowledged by the contractor and their sub-contractors. Following this, corrective as well as preventive actions recommended should be initiated by the contractor within the agreed period. The Third-Party Environmental Compliance Audit should be done on yearly basis by an auditor registered with the DOE throughout the construction period. During the operation of the project, the Third-Party Environmental Compliance Audit will follow the requirement by DOE.

9.9 ABANDONMENT PLAN

Abandonment and Closure Plan is required to be prepared if the project to be abandoned during any time in the project phases due to various reasons. Unforeseen circumstances that could lead to the abandonment of the project include but not limited to the economic and/or legal matters. Hence, abandonment plan is needed to be taken to restore, rehabilitate, and/or make safe the components of the project that will be abandoned. This is to safeguard the environmental, safety, and the other concerns that might be arisen in the future.

Normally, DOE requires the project proponent to prepare and submit a closure or an Abandonment and Closure Plan for their approval. The document must be submitted three months prior to the actual event of abandonment take place. An outline of the main activities to be addressed in an Abandonment Plan is given as below for reference:

- i. Provide adequate notification to relevant authorities, suppliers, contractors, and workers regarding the intention to cease operations. This ensures all parties are informed and can prepare for the transition.
- ii. Systematically dismantle all structures, machinery, and equipment associated with the project. This includes the safe disassembly and removal of physical components
- iii. Properly remove and dispose of machinery, equipment, and materials. Ensure that disposal methods are in line with environmental regulations and best practices to prevent contamination.
- iv. Conduct thorough clean-up of the project area, particularly focusing on areas contaminated with chemicals or oils, such as workshops and fuel storage areas. This step is crucial to prevent environmental hazards.
- v. Installation of security system such as fencing, warning signs, or barricading to safeguard the abandoned area from an intrusion of a public, and protect the site against unauthorized entries or illegal use; and
- vi. Carry out post-abandonment inspections and monitoring, especially for critical components like drainage systems and surrounding areas. Continue monitoring until the site condition is stabilized and deemed safe.

The Abandonment and Closure Plan ensures that the project site is managed responsibly if the project must be halted, protecting both the environment and public safety

CHAPTER 10

STUDY FINDINGS

The proposed project intends to demolish 22 units of existing abandoned wooden buildings and redevelop the existing historic Crag Hotel building into a hotel and spa, with related facilities, on Lot 10000, Bandar Bukit Bendera, Daerah Timur Laut, Pulau Pinang. This development proposal has considered MBPP's development policies and strategies and is in line with local plans such as Penang Structure Plan 2030 (RSNPP 2030) and Penang Hill Special Area Plan 2016 (PHSAP 2016) as outlined in **Chapter 1**. The details of the project description and components are further described in **Chapter 5**.

Overall, the proposed project is expected to provide direct or indirect benefits to the state, local authorities, the general public community, and other parties. The preliminary existing environmental studies were conducted which included a site survey, soil investigations, site geology as well as an environmental baseline assessment, etc. Environmental baseline assessment and analysis was conducted by an accredited SAMM laboratory (MYCO2 Sdn Bhd) to assess the existing ambient air quality, ambient noise level, vibration and water quality. Overall findings for ambient air quality, noise level and vibration levels are compliant, following DOE's standard latest guidelines. The result of the water quality status at W2 located upstream of the water intake facility was classed as 'Clean', while W3 located downstream was classed as 'Slightly Polluted' due to low dissolved oxygen (DO) levels. Field observations indicate that multiple discharge points from surrounding area likely contribute to these observed compliance failures. No water discharge was recorded at W1. The detailed baseline analysis is illustrated in **Chapter 6** and the certificate of analysis is attached in *Appendix I*.

The findings of the significant environmental impacts are discussed in detail in **Chapter 7** of this EIA Report. The proposed project mainly aims to redevelop a historical building back to its roots as a luxury hotel with a health spa. Positive economic impacts are expected during the different phases, which include creation of employment, stimulating development through revenue, taxes and income, creating a market for goods and services, and creating business opportunities for various companies and individuals. However during the demolition and construction phase, impacts such as minor increases in fugitive dust emissions, noise disturbances and traffic generation are expected on the surroundings. The large area of land exposed after land-clearing activities could cause erosion and sedimentation problems that will affect existing waterways. Nevertheless, with the proper implementation of LD-P2M2 on-site, significant erosion and sedimentation are anticipated to be minimal.

As such, the specific mitigation measures are proposed as discussed in **Chapter 8** to overcome and minimize potential impacts from the project site to the surrounding environment. It is important that before any land-disturbing activities are executed or prior to the commencement of earthworks, the proposed BMPs in LD-P2M2 shall be made available and operational on site. Besides, the recommendations proposed in the approved geotechnical report shall be carefully considered and implemented on-site to address the geotechnical aspects of the proposed project.

Thus, it can be concluded that, with the adoption of best management practices during construction and operation, optimized processes, more efficient equipment, and the proper implementation of mitigation measures outlined in the report, there is no doubt that the environmental impact associated with the project will be kept to a minimum. With proper planning and implementation of the recommended mitigation measures, the identified potentially significant impacts on the environment can be mitigated to an acceptable level to comply with stipulated environmental requirements and standards.

It is recommended that for the development option, it is of utmost importance that strict enforcement of all the mitigation measures recommended in this EIA is carried out in a timely manner to safeguard the environment, in particular the occupied residential premises adjacent to the site. It is also recommended that all BMP's should be implemented, monitored, and maintained effectively. It is imperative that environmental monitoring and auditing be carried out by competent personnel throughout the construction phase to ensure that all the mitigation measures are effectively implemented to consistently achieve compliance with standards stipulated by the DOE at all times. Therefore, to manage the impacts of implementing the proposed project, an environmental management plan and various environmental monitoring programs, as well as auditing, are recommended as outlined in **Chapter 9**.

Once fully developed, the property will return to its original use — a luxurious hotel and spa — centred around the historic Crag Hotel building, which will be restored as part of the development. Twenty-eight luxury guest rooms, each approximately 75 square metres, will be constructed along the eastern and western flanks of the site, in single-storey buildings overlooking Georgetown and the Straits of Malacca. The project once operational will also provide an opportunity for visitors to explore the historic and heritage values of Crag Hotel.

REFERENCES

- Bracken, P. (2024, November 28). **Demolition debris calculator**. Brackenbox.
<https://brackenbox.com/blog/house-demo-calculator>
- Cheen, K. S., Yieh, L. C., Adullateef Ashola, O., Nik Yahya, N. N., Han, W. S., & Yusof, M. N. (2018). **A study of construction waste practice in Selangor**. *PLANNING MALAYSIA JOURNAL*, 16(2). <https://doi.org/10.21837/pmjournal.v16.i6.476>
- Chong Kum Kwan Architect (2018). **Laporan Cadangan Pemajuan (LCP)**.
- Clement Acoustics. (2024, August 1). *Noise propagation*. Clement Acoustics.
<https://clementacoustics.co.uk/noise-propagation/>
- Department of Environment (DOE) (2009). **Environmental Quality (Sewage) Regulations**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia.
- Department of Environment (DOE) (2016). **Environmental Impact Assessment Guidelines in Malaysia (EGIM)**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia
- Department of Environment (DOE) (2016). **Guidance Document for the Preparation of Land Disturbing Pollution Prevention and Mitigation Measures**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia.
- Department of Environment (DOE) (2016). **Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in The Environmental Impact Assessment**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia.
- Department of Environment (DOE) (2016). **Guidance Document for The Preparation of The Document on Land Disturbing Pollution Prevention and Mitigation Measures**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia.
- Department of Environment (DOE) (2019). **Guidelines for Environmental Noise Limits and Control Third Edition**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia.
- Department of Environment, (DOE) (2020). **Malaysia Ambient Air Quality Standards (MAAQS)**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia
- Department of Environment (DOE) (2021). **Guidelines for Environmental Vibration Limits and Control, Third Edition**. Department of Environment, Ministry of Natural Resources and Environment, Malaysia
- Department of Irrigation and Drainage (DID) (2010). **Guidelines for Erosion and Sediment Control in Malaysia**. Department of Irrigation and Drainage Malaysia, Ministry of Natural Resources and Environment, Malaysia.
- Department of Irrigation and Drainage Malaysia (DID) (2012). **Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition)**. Department of Irrigation and Drainage Malaysia, Ministry of Natural Resources and Environment, Malaysia.
- EDP Consulting Group Sdn Bhd (2020). **Geotechnical Report**.
- Environmental Quality Act (1974), Act 126, **Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015**.

- Environmental Protection Agency. (2025, January). *Sustainable Management of Construction and Demolition Materials*. EPA. <https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials>
- Jia-Ju. (2022, April 14). *The Crag Hotel: An abandoned colonial building on penang hill*. TheSmartLocal Malaysia - Travel, Lifestyle, Culture & Language Guide. <https://thesmartlocal.my/the-crag-hotel-penang/>
- Jiawei, C., Man, H., Cai, W., Lin, L., Chen, X., Shao, X., Xu, L., Zhu, B., & Bao, Y. (2023). Evaluating City Road Dust Emission Characteristics with a Dynamic Method: A Case Study in Luoyang, China. *Science of the Total Environment*.
- Green Acres Arboriscape Plt. (2025). **Flora and Fauna Assessment Report**.
- Strategi Geo Engineering (2025). **Geological Assessment and Site Investigation Report**.
- Strategi Geo Engineering (2019). **Geological Terrain Mapping Report**.
- PLANMalaysia. **National Physical Plan 4 (NPP-4)**
- PLANMalaysia@Penang. **Penang Structure Plan 2030 (RSNPP 2030)**
- PLANMalaysia@Penang and Penang Hill Corporation (2016). **Penang Hill Special Area Plan 2016 (PHSAP 2016 / RKKBB 2016)**
- Pacific Geoscience (M) Sdn Bhd (2014). **Soil Investigation (SI) Report**.
- U.S. Department of Transportation(2005) . Micropile Design and Construction Reference Manual . NHI Course No. 132078 , Publication No. FHWA NHI-05-039.
- Saeed et al., 2009. **Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia**. 29(7):2209-2213. doi:10.1016/j.wasman.2009.02.017
- Sim, E. (2022, November). *The Crag Hotel: The beginning of Penang's medical tourism*. Penang Monthly. <https://www.penangmonthly.com/the-crag-hotel-the-beginning-of-penangs-medical-tourism/>
- United States Environmental Protection Agency (USEPA). (1995). **Section 13.2.3: Heavy Construction Operations**. In *Compilation of Air Pollutant Emission Factors* (5th ed., Vol. 1: Stationary Point and Area Sources, p. 13.2.3-1-13.2.3-7). Retrieved from <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-13-miscellaneous-0>
- United States Environmental Protection Agency (USEPA). (1995). **Section 13.2.1: Paved Roads**. In *Compilation of Air Pollutant Emission Factors* (5th ed., Vol. 1: Stationary Point and Area Sources, p. 13.2.1-1-13.2.1-9). Retrieved from <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-13-miscellaneous-0>
- Washington State Dept of Transportation (WSDOT). (2012). **Chapter 7: Noise Impact Assessment**. In *WSDOT Biological Assessment Guidance*.