EXECUTIVE SUMMARY

FIRST SCHEDULE ENVIRONMENTAL IMPACT ASSESSMENT

CADANGAN PROJEK PENYURAIAN TRAFIK DI ANTARA PLAZA TOL JURU DAN PLAZA TOL SUNGAI DUA, PULAU PINANG DI LEBUHRAYA UTARA-SELATAN (PLUS) DAN KAWASAN SEKITAR (PTJSD)

PROJECT PROPONENT

Address : Projek Lebuhraya Usahasama Berhad (PLUS)
Menara Korporat, Persada PLUS,
Persimpangan Bertingkat Subang, KM15
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Contact Person : Datuk Ir. Zakaria Ahmad Zabidi
(*Chief Operating Officer*)
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EIA CONSULTANT

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Contact Person : Datin Dr. Vijayalakshmi Samuel
(*Director, Principal Consultant*)
Email : vijayalakshmi@agvenvironment.com

OVERVIEW

Projek Lebuhraya Usahasama Berhad (PLUS) intends to upgrade and enhance the connectivity of the existing North - South Expressway for traffic movement between Juru Toll Plaza and Sg. Dua Toll Plaza with a total length of approximately 17.4 km. The Project aims to improve the traffic flow due to the increase in traffic volumes along this Project corridor. The current expressway is no longer capable of accommodating the growing traffic volume, particularly during peak hours, which often leading to severe congestion, long delays, and safety risks. As such, the Project will improve the overall traffic flow, reduce bottlenecks, and shorten travel times.

Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015

First Schedule

Activity 20: Road

a) Construction of expressways

c) Construction of road, tunnel or bridge traversing or adjacent or near to environmentally sensitive areas

PROJECT COMPONENTS

- Construction of additional two-lane capacity highway between Juru Toll Plaza and Sg. Dua Toll Plaza
- Upgrading of the Juru North (Auto City) Interchange and the East-West Interchange
- Construction of a new dedicated ramp from Perai to Juru
- Construction of a new elevated ramp at Jalan Tun Hussein Onn (Southbound)

STATEMENT OF NEED

CONFORMANCE TO POLICIES AND PLANS

The Project is in line with the following policies and plans at international, national, and state levels



UN SDGs Agenda 2030



Thirteenth Malaysia Plan 2026 – 2030



Fourth National Physical Plan 2040



National Transport Policy 2019 – 2030



Draft RTD Seberang Perai 2030

ECONOMIC BENEFITS OF THE PROJECT

✓ Support for Local Economic Activities

- Improved transport infrastructure will facilitate the movement of goods and services, thereby strengthening economic activity in Penang and the northern region corridor.





SOCIAL BENEFITS OF THE PROJECT

✓ Enhanced Accessibility and Connectivity

- This Project will improve access to essential services by easing traffic flow, particularly during peak hours and seasons

✓ Job Creation and Community Benefits

- Will create short-term employment opportunities during construction for local contractors, skilled workers and unskilled labour

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PROJECT LOCATION



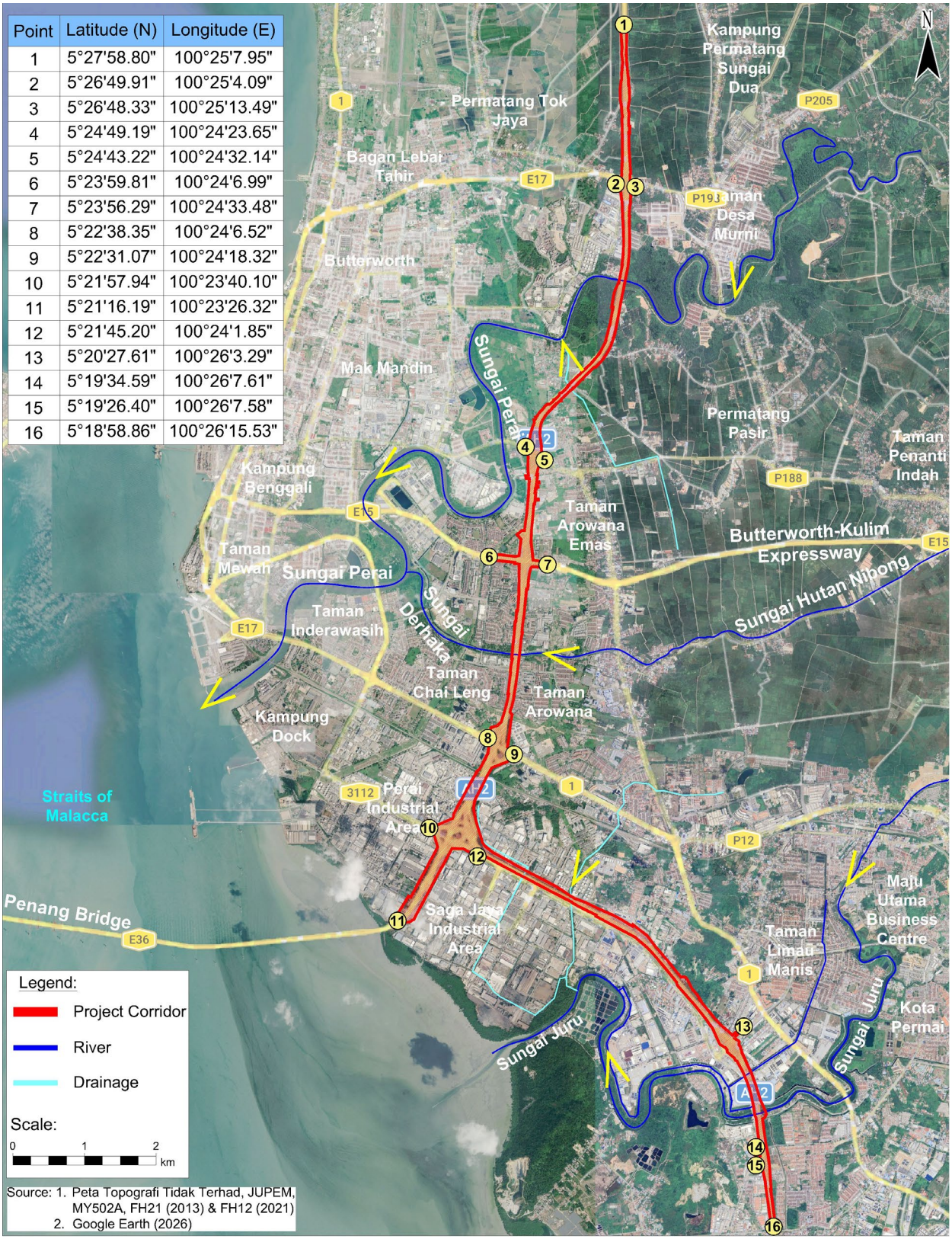
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PROJECT BOUNDARY

Point	Latitude (N)	Longitude (E)
1	5°27'58.80"	100°25'7.95"
2	5°26'49.91"	100°25'4.09"
3	5°26'48.33"	100°25'13.49"
4	5°24'49.19"	100°24'23.65"
5	5°24'43.22"	100°24'32.14"
6	5°23'59.81"	100°24'6.99"
7	5°23'56.29"	100°24'33.48"
8	5°22'38.35"	100°24'6.52"
9	5°22'31.07"	100°24'18.32"
10	5°21'57.94"	100°23'40.10"
11	5°21'16.19"	100°23'26.32"
12	5°21'45.20"	100°24'1.85"
13	5°20'27.61"	100°26'3.29"
14	5°19'34.59"	100°26'7.61"
15	5°19'26.40"	100°26'7.58"
16	5°18'58.86"	100°26'15.53"



Source: 1. Peta Topografi Tidak Terhad, JUPEM, MY502A, FH21 (2013) & FH12 (2021)
2. Google Earth (2026)

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PROJECT COMPONENT

Project Scope

The Project involves the construction of an additional two-lane capacity highway for through-traffic movement between Juru Toll Plaza and Sungai Dua Toll Plaza, together with the upgrading of existing interchanges and the construction of dedicated ramps.

- Construction of an additional two-lane capacity highway between Juru Toll Plaza and Sungai Dua Toll Plaza (total length 17.4 km), including dedicated ramps connecting Penang Bridge and the East–West Interchange
- Upgrading of the Juru North (Auto City) Interchange by converting it into a Diverging Diamond Interchange (DDI)
- Construction of a new dedicated ramp from Perai to Juru
- Road widening and installation of smart traffic lights at East–West Interchange
- Construction of a new elevated ramp at Jalan Tun Hussein Onn (Southbound)

Limit of Works

Section	Start	End	Length (km)
Juru Toll Plaza taper approach	Taper approach	Juru Toll Plaza	0.889
Juru – Sungai Dua	Juru Toll Plaza	Sungai Dua Toll Plaza	17.400
Sungai Dua Toll Plaza taper approach	Sungai Dua Toll Plaza	Taper approach	0.884
Total			**19.173**

Source: SSP, 2026. Overall limit of works: CH.-889.000 to CH.18284.209.

Project Scope by Chainage

Chainage	Reference	Scope	Status
CH.-889.000 to CH.4150.000	Package 2	Lane widening; MEL at grade; demolition of 2 Juru Toll Canopies; Juru Toll Plaza taper approach works; upgrading of Juru North Interchange; bridge over Sg. Juru 1 and Sg. Juru 2	Tender
CH.4150.000 to CH.8465.000	Package 3	Lane widening; elevated MEL; 4 new dedicated ramps to Penang Bridge and East-West Interchange; new toll plaza at Penang Bridge	Tender
CH.8465.000 to CH.13190.000	Package 4 (early works portion referred to as Package 1)	**Package 4:** Lane widening, elevated MEL; new elevated MEL ramps with new toll plaza connecting to Butterworth-Kulim Expressway (BKE) **Package 1:** Upgrading of East–West Interchange; 1 new elevated ramp at Jalan Tun Hussein Onn (Southbound)	Early works ongoing; balance at tender
CH.13190.000 to CH.18284.209	Package 5	Lane widening; MEL at grade; Demolition of 2 Sg. Dua Toll Canopies; bridge over Sg. Perai	Tender

Source: SSP, 2026 (Table 5.3.1).

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PROJECT COMPONENT

Road Design Criteria

Parameter	Mainline Express Lane	Interchange Ramp
Design speed (km/h)	80	70 (50)
Traffic lane width, multi-lane (m)	3.5	3.5 × 2
Traffic lane width, single lane (m)	–	5.00
Hard strip width (m)	1.0 (0.5)	1.0
Paved shoulder width (m)	3.0	2.0
Verge (m)	1.5	1.5
Minimum radius with maximum superelevation (m)	250	195 (90)
Maximum gradient (%)	5.0	6.0
Maximum superelevation (%)	6.0	6.0
Minimum vertical clearance for bridges (m)	5.4	5.4

Source: SSP, 2026 (Table 5.2.1). Values in parentheses denote double-lane interchange ramp criteria.

- Mainline design speed of 80 km/h; interchange ramps 70 km/h, reducing to 50 km/h for inner loop ramps
- The proposed MEL geometry is capable of fulfilling a 100 km/h design speed requirement and able to operate at the existing operating speed of 90 km/h
- Designed to the PLUS/NSE Concession Agreement and LLM and JKR guidelines, in particular the Guideline on the Geometric Design of Urban Highways (LLM/GP/T37-2017)

Pavement

- Flexible pavement designed by the mechanistic-empirical method in accordance with TRRL Laboratory Report 1132
- Staged construction – bound layers for a 10-year service life, unbound layers for 20 years
- Granular sub-base, crushed aggregate road base, DBM, ACBC and ACWC, with CBM for the mainline where required
- Equivalent thickness (TA) of 35 cm for the mainline and 32 cm for ramps; subgrade minimum soaked CBR of 5%

Earthworks Quantity

Item	Quantity	Unit
Stripping topsoil for reuse	613,862	m^2
Excavate suitable material	25,428	m^3
Excavate benching	64,398	m^3
Dispose hard mass	1,339	m^3
Fill using suitable material	89,825	m^3
Fill using imported material	428,914	m^3

Source: PLUS, 2026 (JSD Earthworks Quantity, Rev. R2).

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PROJECT COMPONENT

Interchanges

- Six interchanges along the corridor: Juru North (Auto City), Penang Bridge, Perai, East–West, Permatang Pauh and Sungai Dua
- Juru North (Auto City) Interchange upgraded and converted into a Diverging Diamond Interchange (DDI) to improve traffic flow and reduce weaving conflicts
- New dedicated ramp constructed from Perai to Juru to provide a direct connection for local traffic
- East–West Interchange upgraded, including upgrading of the East–West Interchange Roundabout, to reduce traffic signal waiting time
- New elevated slip ramp constructed at Jalan Tun Hussein Onn (Southbound)
- Dedicated ramps provided connecting the Penang Bridge and the East–West Interchange to the mainline

Typical Cross-Sections

- **Elevated MEL over CDL –** elevated Mainline Express Lane deck carries a dual two-lane carriageway with a total deck width of approximately 22.52 m (two 7.0 m carriageways, 1.62 m median, 3.0 m shoulders and 0.45 m edge margins); the CDL remains at grade with a 10.5 m three-lane carriageway on each side
- **At-grade widening –** MEL at the centre with a three-lane 3.5 m carriageway, 3.0 m shoulders and a 3.0 m median, flanked by the CDL on the existing NSE carriageway and separated by a New Jersey Barrier (NJB)
- **Dedicated ramps –** two-lane single carriageway deck of approximately 10.9 m (7.0 m carriageway, 2.0 m shoulder, 1.0 m marginal strip); one-lane deck approximately 8.9 m (5.0 m carriageway, 2.0 m shoulder, 1.0 m marginal strip)
- **Widening at bridges over rivers –** four separate decks, comprising two outer CDL decks of 12.4–12.9 m and two inner MEL decks of approximately 11.5 m
- **Elevated Toll Plaza (Perai) –** elevated MEL deck with a total width of approximately 21.62 m, providing two 4.0 m toll lanes per direction and a 2.0 m motorcycle lane at each outer edge; CDL at grade approximately 10.5 m each side with 1.5 m verge and 0.5 m marginal strip

Toll Plaza & MLFF

- Toll plaza works carried out at the affected toll facilities
- Multi-Lane Free Flow (MLFF) business rules are not yet finalised; the toll collection system is designed to accommodate MLFF requirements
- Gantry infrastructure provided ready to accommodate the future MLFF system

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PROJECT COMPONENT

Bridge Design Criteria

- All bridges designed in accordance with BS 5400 and the relevant departmental standards, with a design life of 120 years
- Pedestrian and motorcycle bridges designed for a live load of 5.0 kN/m² for cycle and pedestrian traffic

Structures Affected

No.	Structure	Quantity	Unit
1	River bridge	3	nos.
2	Land bridge	6	nos.
3	Overhead bridge	3	nos.
4	Pedestrian bridge	3	nos.

Source: SSP, 2026 (Table 5.3.2).

Bridges to be Demolished and Rebuilt

No.	Description	Existing Location	New Location	Works
1	Motorcycle bridge near Jalan Perusahaan	CH. 3041	CH. 3100	Demolish and rebuild
2	Pedestrian bridge near Jalan Tun Hussein Onn	CH. 9667	CH. 9635	
3	Motorcycle bridge before Caltex Sungai Dua	CH. 13035	CH. 13163	

Source: SSP, 2026 (Table 5.3.3).

River Bridges

- Three river bridges at Sungai Juru, Sungai Pertama and Sungai Perai
- Cross-section comprises four separate decks – two outer CDL decks and two inner MEL decks – each supported on a single reinforced concrete column pier with pile cap and bored pile foundation
- CDL deck 12.4–12.9 m wide, comprising a three-lane 10.5 m carriageway, 0.5 m marginal strips and edge parapets
- MEL deck approximately 11.5 m wide, comprising a 7.0 m two-lane carriageway and 3.0 m shoulder

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PROJECT COMPONENT

Drainage

- **Standards –** MSMA 2nd Edition (2012), Guidelines for Malaysia Toll Expressway System – Design Standards (LLM/GP/T5-08), JPS Hydrological Procedures and local authority requirements
- Surface drains designed for the peak discharge from the critical duration 10-year ARI storm; cross-culverts checked against the critical duration 50-year ARI with JPS approved climate change factors applied
- Peak discharge estimated using the Rational Method for catchments of less than 80 ha; drains and culverts hydraulically sized using Manning's equation, and culvert crossings sized using HY-8 software with the outlet assumed submerged during the 50-year ARI event
- **Design parameters –** rainfall from JPS station Komplek Prai (5303053); climate change factor of 1.28 (10-year ARI) and 1.30 (50-year ARI); runoff coefficients of 0.95 for roads and 0.40 for grassed open space; Manning's n of 0.018 (concrete drains), 0.011 (concrete culverts) and 0.035 (grassed drains); 0.05 m freeboard; flow velocity between 0.6 m/s and 4.0 m/s
- Additional drainage at the boundary between MEL and CDL along at-grade sections
- Runoff from elevated MEL sections collected via deck drains and downspouts, then conveyed by median drains and discharged to roadside drains via culverts at regular intervals
- Roadside drains are lined reinforced concrete U-shaped or V-shaped drains, with concrete covers beneath walkways and handrails to all open drains deeper than 1.2 m where exposed to pedestrian access

Geotechnical & Ground Improvement

- The alignment predominantly traverses the low-lying coastal and alluvial plain between Juru and Sungai Dua, generally underlain by thick, highly compressible soft soil (Quaternary marine and continental deposits)
- **Settlement criteria –** under the Supplementary Concession Agreement, estimated settlement within the first seven years after opening to traffic shall not exceed 10% of the total theoretical primary consolidation and secondary settlement, and shall nowhere exceed 400 mm
- **Techniques –** removal and replacement of unsuitable material; Prefabricated Vertical Drain (PVD) with surcharging, with or without counterweight berms or high-strength geotextile; mass mixing with or without deep mixing; piled embankments at bridge and structure approaches; and lightweight fill materials
- Settlement markers, piezometers and inclinometers installed at strategic locations to monitor settlement and groundwater conditions during construction; cut slopes, retaining walls and instrumentation designed to the factors of safety specified in the Design Brief

Road Furniture & Street Lighting

- Affected road furniture – traffic and directional signs, gantries, guardrails and ROW fences – will be demolished and replaced, with affected existing signs replaced on a one-to-one basis
- New traffic signs designed and placed in accordance with the relevant LLM and JKR guidelines
- Steel guardrails (TL-3) along embankment verges where required
- Reinforced concrete barriers (TL-4) to protect permanent structures, separate MEL from CDL and for median installations, preventing cross-bound collisions
- Reinforced concrete parapets on bridges, with TL-5 safety barriers where higher containment is required
- Road markings in all-weather thermoplastic (AWT) material
- Street lighting along the alignment per LLM, JKR and MBSP specifications – approximately 612 road lighting units and 60 high masts based on the affected NSE inventory
- Energy-efficient LED lighting adopted as part of the green technology approach

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PROJECT COMPONENT

Utilities & TCSS

- All existing utility services, above or below ground, affected by the widening works are identified, relocated or protected in accordance with the relevant utility agency's technical requirements
- Affected utilities include TNB electrical cables, an IWK 225 mm sewerage line, fibre optic and telecommunication cables, and gas pipelines
- The alignment crosses the KTMB railway at one location; detailed information to be provided during the utility verification stage
- Relocation coordinated with the respective utility agencies and carried out ahead of the main construction works, with existing services relocated on a like-for-like basis as close as practicable to the edge of the ROW
- Toll collection system and TCSS designed and constructed in accordance with LLM, PLUS and MCMC specifications

Best Management Practices

BMP	Standard specification	Indicative quantity
Wash trough	Overall length approximately 17.0 m (5.0 m + 9.0 m + 3.0 m bays), width 6.437 m, brickwall opening 900 mm × 900 mm, with water storage and pressurised spray facilities	60 units along the alignment
Silt trap (Type 1)	Total disturbed area of the development: 0.50 ha L1: 16,000 mm; L2: 15,000 mm; W1: 8,000 mm; W2: 7,000 mm; H: 1,200 mm; 300 mm freeboard; 1:2 side slopes; filter cloth embedded minimum 100 mm at the upstream end	17 units along the alignment
Silt trap (Type 2)	Total disturbed area of the development: 1.00 ha L1: 22,000 mm; L2: 20,900 mm; W1: 11,000 mm; W2: 9,900 mm; H: 1,250 mm; 300 mm freeboard; 1:2 side slopes; filter cloth embedded minimum 100 mm at the upstream end	
Silt trap (Type 3)	Total disturbed area of the development: 1.50 ha L1: 25,500 mm; L2: 24,300 mm; W1: 12,500 mm; W2: 11,300 mm; H: 1,300 mm; 300 mm freeboard; 1:2 side slopes; filter cloth embedded minimum 100 mm at the upstream end	
Silt trap (Type 4)	Total disturbed area of the development: 2.00 ha L1: 28,000 mm; L2: 26,700 mm; W1: 14,000 mm; W2: 12,700 mm; H: 1,400 mm; 300 mm freeboard; 1:2 side slopes; filter cloth embedded minimum 100 mm at the upstream end	
Rock filter check dam	300 mm diameter riprap (D50), installed at 10 m intervals along temporary earth drains	Continuous along temporary earth drains
Silt fence	1.5 m star pickets at maximum 3.0 m centres, with self-supporting geotextile	Along the ROW boundary of each chainage section where works affect the area

Source: PLUS, 2026 (Table 5.4.5).

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PROJECT ACTIVITIES

Indicative Construction Programme

Activity	Duration (month)	Start	Finish
Site clearing and earthworks	12	Oct 2026	Sep 2027
Relocation of services	12	Jan 2027	Dec 2027
Geotechnical works	18	Jan 2027	Jun 2028
Bridge works, motorcycle and pedestrian bridge	36	Apr 2027	Mar 2030
Drainage works	30	May 2027	Oct 2029
Pavements	36	Jul 2027	Jun 2030
Road furniture	20	Dec 2028	Jul 2030
Traffic management control	48	Oct 2026	Sep 2030
Environmental protection works	43	Dec 2026	Jun 2030
Street lighting works	36	Jul 2027	Jun 2030
Landscaping works	24	Jul 2028	Jun 2030
Toll plaza	12	Jan 2029	Dec 2029
Toll collection system and TCSS	14	Jul 2029	Aug 2030
Testing, commissioning and handover	6	May 2030	Oct 2030

Source: PLUS, 2026 (Table 5.5.2). Programme applies to the remaining chainage sections. Construction commencement is subject to obtaining the relevant permits and approvals from the local authorities and technical agencies.

Completion & Handover

- Testing, commissioning and handover of the completed works and the toll collection system programmed from May 2030 to October 2030
- Landscaping and permanent erosion protection completed ahead of handover, with exposed areas turfed or vegetated in accordance with local authority requirements
- Settlement monitoring instrumentation readings continue through to handover to confirm compliance with the settlement criteria under the Supplementary Concession Agreement

Green Technology (MyGHI)

Sustainability principles and green technologies are incorporated throughout, in line with the Malaysian Green Highway Index (MyGHI):

- Adoption of energy-efficient LED lighting
- Use of precast components to accelerate construction and minimise material wastage
- Use of lightweight fill materials to reduce the carbon footprint of geotechnical works
- Retention and repurposing of existing paved shoulders to reduce demand for new road base and sub-base materials

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EXISTING ENVIRONMENT

Topography



- Topography of the Project site and its surrounding are flat

Slope Gradient

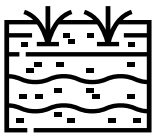
- Class I : 97.80%
- Class II : 2.00%
- Class III : 0.20%
- Class IV : 0.02%

Geology



Underlain by Quaternary marine and continental deposits of clay, silt, sand and peat with minor gravel

Soil



Dominant soil groups include gley soils and alluvial soils, which are located on recent marine and riverine alluvium.

Climate & Meteorology



Meteorological Station:

- Perai, Seberang Perai
- Butterworth, Seberang Perai

Data from 2016 to 2025

Temperature
Average between 27.6 °C to 29.3 °C

Relative Humidity
Average between 76.6% to 85.1%

Rainfall and Rain Days
Months with highest rainfall and rain days:
September, October and November
Highest rainfall: October 2019 (650.6 mm)
Lowest rainfall and days: January 2022

Wind
Strongest winds: February
Wind speed ranging between 1.13 and 2.10 m/s
Predominantly from east (27.1%)

Hydrology & Drainage



- 3 Major watercourses: Sg. Perai, Sg. Derhaka, Sg. Juru
- These 3 rivers flow in a westward direction
- The river discharges into Strait of Malacca.
- 4 JPS sluice gates present around the Project corridor
- No water intake point located downstream

Fisheries & Aquaculture



Inland Fisheries

- 127 inland fishermen along Sg. Perai
- Inland fisheries concentrated at:
  - Tamang Jetty
  - Machang Jetty

Aquaculture

- 2 freshwater pond culture farms within ZOS
- Main culture species are:
  - Udang Putih
  - Senangin
  - Siakap

Terrestrial Ecology



- Vegetation along riverbanks include wild and cultivated species such as Ficus, Acacia, papaya, mango, oil palm, coconut and grasses.
- Fauna is limited to adaptable species like Long-tailed Macaques, Plantain Squirrels, and urban tolerant birds.

Survey Result:

- Avifauna : 10 species
- Mammals : 2 species

Socio-Economic



- The Project site is located within the Seberang Perai Utara and Seberang Perai Tengah district.
- SEA methodologies:
  - Total of 6141 units identified within a 200-meter radius of study area
  - Core Zone: 3046 units
  - Buffer Zone: 3095 units

Traffic



- The Project corridor is located along North-South Expressway
- 6 main interchanges within the Project corridor
- Critical peak hour :
  - 7.15 am to 8.15 am
  - 5.30 pm to 6.30 pm

Public Health



- Hypertension is the most prevalent chronic disease (11.34%)
- Acute ailments: More common among children than adults, Fever (27.90%)

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EXISTING ENVIRONMENT

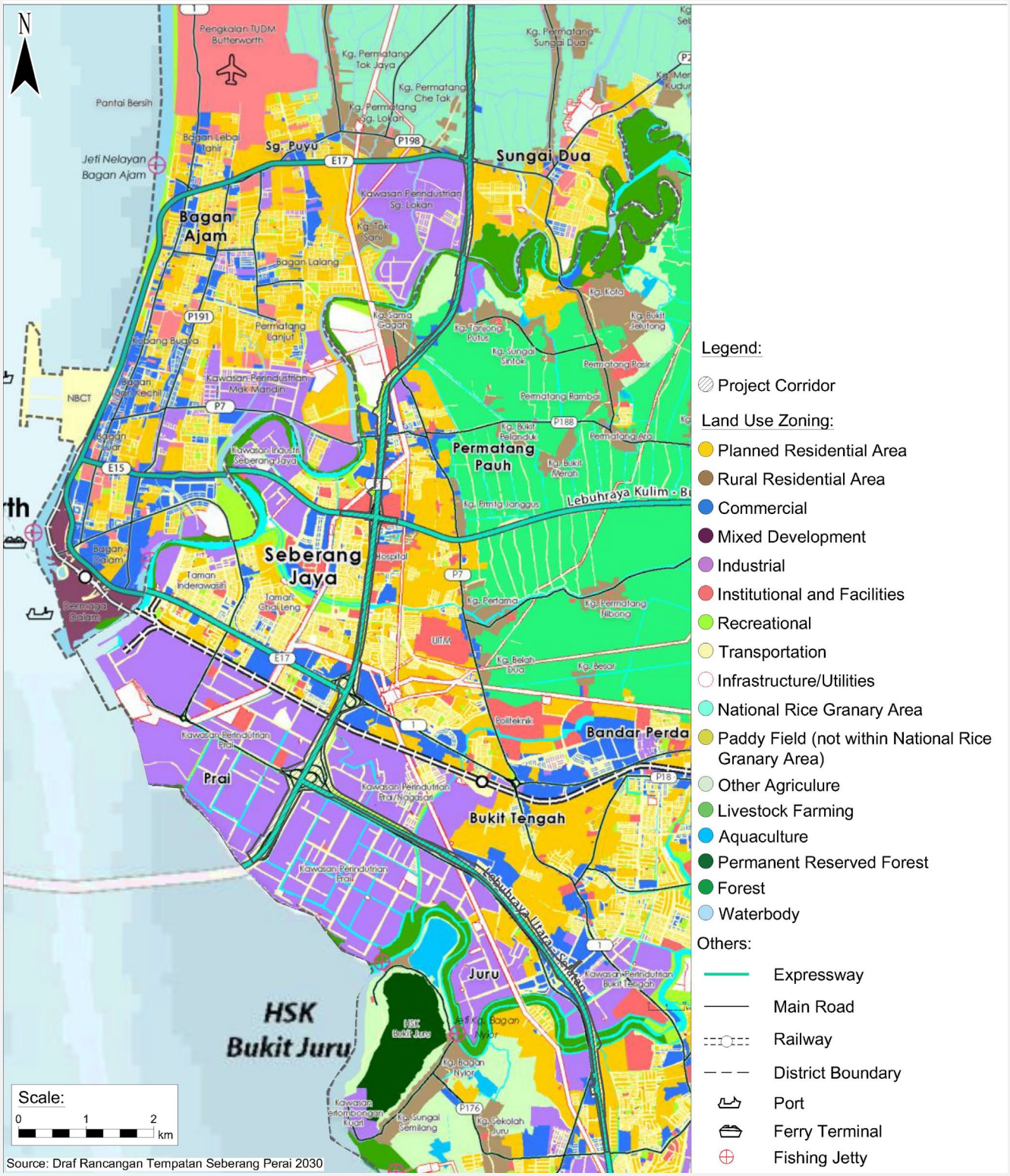


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LAND USE ZONING



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EXISTING ENVIRONMENT



Environmental Baseline Sampling

Water Quality

- 10 river water quality monitoring stations, compared with Class IIA NWQS
  - **DO** at all stations were recorded **below** the limits .
  - **BOD** and **COD** levels at all stations exceeded the limits.
  - **AN** and **NO_3** concentrations at most of the stations exceeded the limits,
  - Parameters including **pH, TSS**, and **turbidity** were within the limits.
  - Overall water quality for all monitoring locations categorized as **Polluted (Clean III and Class IV)**.

Ambient Air Quality

- 10 air quality monitoring stations for 6 parameters
- All measured parameters complied with **MAAQS (2020)**
- **CO, SO_2, NO_2,** and **O_3** were found at very low concentrations

Parameter	MAAQS 2020 (averaging time)
PM_{10} (µg/m³)	100 µg/m³ (24hr)
$PM_{2.5}$ (µg/m³)	35 µg/m³ (24hr)
SO_2 (µg/m³)	80 µg/m³ (24hr)
NO_2 (µg/m³)	70 µg/m³ (24hr)
CO (mg/m³)	10 µg/m³ (8hr)
O_3 (µg/m³)	100 µg/m³ (8hr)

Noise Level

- 10 noise level monitoring stations, compared with Second Schedule: Recommended Permissible Sound Level (LAeq) By Receiving Land Use for Existing Built-Up Areas in Guidelines for Environmental Noise Limits and Control, Third Edition 2019 (Reprint 2021)
- **Station N1-N4** and **Station N7-N10**: Suburban and Urban Residential, Mixed Development
- **Stations N5, N6**: Low Residential, Noise Sensitive Receptors, Institutional (School, Hospital, Worship)
- The noise levels measured at most monitoring stations complied with the respective limits, except for Stations N6, N7, N9 and N10 (night time), N3 (day time) and N5 (day and night time)

Vibration Level

- 10 vibration level monitoring stations, compared with Third Schedule: Recommended Vibration Limits for Human Response and Annoyance from Intermittent Vibration in Guidelines for Environmental Vibration Limits and Control, Third Edition 2021
- **Station N1-N4** and **Station N7-N10**: Residential
- **Stations N5, N6**: Vibration Sensitive Receptors
- The PPV readings of the vertical axis recorded for 24 hours monitoring at most stations were compliant with the respective limits, except for V1, V3, V4, V7, V8, and V10 (night time), V5 and V6 (day and night time).

EXECUTIVE SUMMARY

FIRST SCHEDULE ENVIRONMENTAL IMPACT ASSESSMENT

CADANGAN PROJEK PENYURAIAN TRAFIK DI ANTARA PLAZA TOL JURU DAN PLAZA TOL SUNGAI DUA, PULAU PINANG DI LEBUHRAYA UTARA-SELATAN (PLUS) DAN KAWASAN SEKITAR (PTJSD)

IMPACT ASSESSMENT

Soil Erosion & Sedimentation

Soil Erosion Modelling

- Assessment was conducted for 3 scenarios
  - Scenario 1: Existing
  - Scenario 2: Worst-case
  - Scenario 3: With Mitigation Measures

	Scenario 1: Existing Condition	Scenario 2: Worst Case	Scenario 3: With Mitigation Measures
Rate of Soil Loss (t/ha/yr)	4.98	109.72	7.58
Sediment Yield (tonne)	172.84	839.50	395.06

Water Quality

CONSTRUCTION PHASE

- Surface runoff containing suspended solids
- Surface runoff contaminated with traces of oil and grease and construction related chemicals.
- Water quality modelling for TSS was conducted using QUAL2K at Sg. Juru and Sg. Perai
  - Scenario 1: Existing baseline; Scenario 2: With mitigation (TSS input: 50 mg/L); Scenario 3: Without mitigation (TSS input: 500 mg/L)
  - Significant deterioration is predicted under worst case scenario; whereas TSS is expected to maintain at NWQS Class II under normal construction activities with mitigation in place

OPERATIONAL PHASE

- Expected to be insignificant due to the nature of the Project.
- Potential source of impact is from the surface runoff and the improper solid waste management

Hydrology and Hydraulic

CONSTRUCTION PHASE

- Increase in turbidity and TSS level from the Project activities
- Degradation of river capacity due to unattended overburden, stockpiles and biomass materials

OPERATIONAL PHASE

- Expected to be insignificant as proper roadside drain will be built to cater surface runoff.
- Proposed river crossings are not expected to significantly affect existing flow capacity of Sg. Juru, Sg. Derhaka and Sg. Perai

Geotechnical Consideration

CONSTRUCTION PHASE

- Soil compaction and disturbance due to the Project alignment is predominantly underlain by marine deposits comprising clay and soft clay with low shear strength and high compressibility
- Risk of slope failure if the minimum FOS is not achieved
- Excessive loading from embankment filling may induce immediate settlement, particularly within soft clay zone

OPERATIONAL PHASES

- Residual settlement is expected to be limited primarily to secondary compression
- Gradual settlement or deformation of road surface due to long term bearing capacity
- Adversely affect performance of adjacent structures due to differential settlement in structural zone

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IMPACT ASSESSMENT



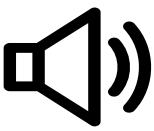
Air Quality

CONSTRUCTION PHASE

- Generated by site preparation and earthworks; wind-blown dust from exposed construction areas; and construction related activities.
- Air dispersion modelling: AERMOD air quality model for 10 identified ASRs.
- **Predicted 24-hr GLCs**
  - PM_{10} - Scenario 1: exceeded limits at all ASRs except for ASR3; Scenario 2: exceeded limits at all ASRs except at ASR2, ASR3 & ASR4; Scenario 3: within limits at all ASRs
  - $PM_{2.5}$ – Scenario 1: exceeded limits at all ASRs except for ASR2, ASR3 & ASR4; Scenario 2: within limits at all ASRs except ASR7 & ASR10; Scenario 3: within limits at all ASRs.
- **Predicted Annual MAICs**
  - PM_{10} - Scenario 1: exceeded limits at all ASRs except for ASR2, ASR3 & ASR4; Scenario 2: exceeded limits at all ASRs except at ASR2, ASR3, ASR4 & ASR6; Scenario 3: within limits at all ASRs
  - $PM_{2.5}$ – Scenario 1: exceeded limits at all ASRs except for ASR7, ASR8 & ASR9; Scenario 2: within limits at all ASRs except ASR8; Scenario 3: within limits at all ASRs.

OPERATIONAL PHASE

- Air quality assessment for traffic emission was predicted using CALINE4.
- Air pollutants of major concern do not exceed the MAAQS (2020).



Noise

CONSTRUCTION PHASE

- The primary noise generating activities are piling works during foundation construction and compaction works during site preparation and road formation.
- Movement of heavy machinery and haulage vehicles will also contribute to the noise level.
- Noise modelling using procedures from the ISO 9613-2: Acoustic and dBmap.net software.
- Findings:
  - Scenario 1 (unmitigated): cumulative noise levels for compaction exceed limit at NSR9 & NSR10, with "Strong" anticipated community response at NSR6 & NSR9; piling works comply with limit at all NSRs.
  - Scenario 2 (mitigated with 1.8 m hoarding): cumulative noise levels for both compaction and piling works comply with limit at all NSRs.

OPERATIONAL PHASE

- Main source to noise pollution will be from human activities and traffic movements.
- **Predicted Noise Level (Daytime):**
  - The predicted cumulative L_{Aeq} levels at all NSRs were generally below the recommended limits except for NSR1, NSR2, NSR3, NSR4 & NSR6.
  - The anticipated community response to noise was “None” due to higher existing noise.
- **Predicted Noise Level (Night-time):**
  - The predicted cumulative L_{Aeq} levels exceeded limits at NSR1, NSR2, NSR3 & NSR4.
  - The anticipated community response to noise was “Medium”; can be reduced or maintained with implementation of noise barriers.



Vibration

CONSTRUCTION PHASE

- Vibration impact assessed using FTA 2018 and DOE Guidelines 2021.
- Sensitive receptors are not within the ZOI of 15 mm/s and 10 mm/s.
- Those at the immediate proximity may experience perceived vibration level (<10 m/s) that can be tolerated if prior warning and explanation has been given to residents.

OPERATIONAL PHASE

- Traffic induced ground-borne vibrations only occur in very extreme circumstances.
- No ground-borne vibration impacts anticipated.

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IMPACT ASSESSMENT



Waste Management

CONSTRUCTION PHASE

- Types of waste generated include construction and demolition wastes, biomass, municipal solid waste, and scheduled wastes.
- Improper waste management could cause blockage to surrounding drainage and elevate flood risk, soil contamination from accidental spillage/leakage, proliferation of pests, and odour nuisance.

OPERATIONAL PHASE

- Solid waste and scheduled waste is expected to be generated during the operational phase; the amount of waste generated are expected to be lesser.



Terrestrial Ecology

CONSTRUCTION PHASE

- Project corridor is not ecologically sensitive; short-term localised impacts are likely.
- Site clearing near Sg. Juru and Sg. Perai may result in the loss of some urban-tolerant flora.
- Piling activities will generate noise and vibrations, potentially causing stress or temporary displacement of small fauna.
- The area is already highly disturbed and dominated by human activity, the impacts from habitat disturbance and fragmentation are expected to be very low or negligible.

OPERATIONAL PHASE

- The Project corridor is already highly modified and dominated by human activity; wildlife that is frequently seen in the area are tolerant of human presence.
- Any ecological impact during the operational phase is expected to be very low or negligible.



Aquatic Ecology

CONSTRUCTION PHASE

- Turbidity and TSS is expected to increase from the Project activities that may accidentally flow into the river, namely Sg. Juru, Sg. Derhaka, and Sg. Perai.
- Large equipment will cause considerable vibration in the river and produce excessive noise.
- The impacts only for the duration of the construction period and considered as short-term.

OPERATIONAL PHASE

- No significant impacts are anticipated.



Socio-Economy

CONSTRUCTION PHASE

- Will create temporary employment and business opportunities for local communities.
- Increased movement traffic by heavy vehicles lead to temporary traffic congestion, slower travel speeds, potential road safety risks, and deterioration of existing road surfaces.
- Temporary disturbance to nearby communities due to increased traffic, noise, dust, and changes in road conditions.
- Impacts are expected to be temporary and localised.

OPERATIONAL PHASE

- The Project is expected to generate long-term socio-economic benefits, particularly in terms of improving accessibility, traffic efficiency, and connectivity for road users and surrounding communities.

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IMPACT ASSESSMENT



Public Health

CONSTRUCTION PHASE

- **Exposure to Air Pollutants**
  - The exposure to PM_{10} and $PM_{2.5}$ was assessed for acute (24-hr) and long-term (annual) exposures.
  - Scenario 1 (unmitigated) & Scenario 2 (mitigated with 35% reduction): exposure could pose some non-carcinogenic risks (HQ>1) at some receptors.
  - Scenario 3 (mitigated with 84% reduction): exposure significantly reduced and would not pose any non-carcinogenic risks (HQ<1) to all receptors.

OPERATIONAL PHASE

- **Exposure to Air Pollutants**
  - HRA for NO_2 and CO are calculated based on the predicted 1-hr MAICs.
  - Exposure to these pollutants is negligible (HQ<1) and will not pose any non-carcinogenic risks to all sensitive receptors.
  - Cancer risks from exposure to long-term (annual) PM_{10} were within acceptable limits.
- **Exposure to Water Contaminants**
  - Predicted TSS concentrations are not expected to result in significant adverse health effects or significantly alter the current beneficial uses of the river.
  - The residual impact is expected to be localised, temporary, reversible, and manageable.
- **Exposure to Noise**
  - The elevated HQ values reflect the existing ambient noise environment is a significant contributing factor.
  - Under unmitigated scenario, most locations recorded HQ values below 1 except for N4, N5, N6 and N9.
  - With the implementation of 1.8 m hoarding, the HQ values at most locations remain above 1 except for N1 and N3 (HQ<1).
  - With the implementation of 2.0 m piling shroud, the HQ values at most locations were reduced, except for N5 and N6 which remains above 1.



Traffic

CONSTRUCTION PHASE

- Significant impacts from movement of heavy-load vehicles carrying construction materials.
- Increase wear and tear of the road, leading to potholes and uneven road surface.
- Dirty road conditions due to spillage/leakage of loads, and carryover of mud and silt.
- Partial road closures or lane narrowing could result in traffic congestion, particularly during peak hours.

OPERATIONAL PHASE

- Screenline analysis was undertaken for the projected Year 2030 and 2040 traffic conditions.
- **Traffic Impacts Analysis for Interchange:**
  - Interchange 1 (Juru Interchange): LOS F (AM) and LOS E (PM); with Project implementation the LOS will further reduce the signal delays and improves to LOS A to C.
  - Interchange 2 (Penang Bridge Interchange): LOS F (AM) LOS D (PM); with Project implementation LOS improving to LOS D (AM) and LOS C (PM).
  - Interchange 3 (Perai Interchange): LOS F (AM and PM); with Project implementation LOS improving to C (AM and PM).
  - Interchange 4 (East West Interchange): LOS F (AM and PM); with Project implementation LOS improving to D (AM and PM).
  - Interchange 5 (Permatang Pauh Interchange): LOS D (AM and PM); projected to deteriorate to LOS F by 2040; with Project implementation LOS improving to D (AM) and LOS E (PM).

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MITIGATION MEASURES

Soil Erosion & Sedimentation



CONSTRUCTION PHASE

- Risk expected to be minimal with the implementation of LD-P2M2 measures.
- BMPs like construction markers, perimeter control, earth bund, silt trap, construction entrance, diversion drains; surface runoff management, stockpile soil management, temporary or permanent watercourse diversion, temporary stabilization, and management of spoil and solid waste.
- ESCP has been developed to ensure the erosion control mechanisms and retention structures have been designed and sized adequately.

OPERATIONAL PHASE

- Most of the site will be concreted and paved with asphalt, which will greatly reduce erosion.
- Water run-off will be collected through the roadside drains and then discharged rivers.

Water Quality



CONSTRUCTION PHASE

- Implement soil erosion control measures as indicated in ESCP and LD-P2M2.
- Proper stockpile, fuel and chemical, and waste management.
- Implement monthly water quality monitoring program at the discharge outlet of the silt traps.

OPERATIONAL PHASE

- Ensure good housekeeping of the Project corridor through proper waste management.
- Scheduled wastes generated shall be managed in accordance with the Environmental Quality (Scheduled Wastes) Regulations 2005.
- Ensure that the road is free from flooding and ponding, and maintained in good condition.

Hydrology and Hydraulic



CONSTRUCTION PHASE

- Implement water quality monitoring before, during, and after construction.
- Ensure the Project does not disturb natural water flow, including rainwater, underground drainage, and nearby rivers.
- Install appropriate surface runoff control measures, e.g. oil traps, silt traps, detention ponds.

OPERATIONAL PHASE

- Impacts on hydrology during operational phase are expected to be insignificant.
- Periodic maintenance of drainage system along road alignment will be carried out to ensure nearby waterways are not affected.

Geotechnical Consideration



CONSTRUCTION PHASE

- Three (3) types of ground treatment will be adopted, namely Prefabricated Vertical Drain with Surcharge (PVD), Piled Embankment and Light Weight Fill (LWF) embankment.
- 400 mm RC pile will be adopted for the pile embankment foundation at RS wall.
- Settlement, lateral ground movements, and excess pore water pressure must be regularly monitored to ensure the effectiveness of the treatment.
- Bore piles selected as the foundation system for the bridge; with a uniform 1.2 m diameter will be adopted for both abutment and pier.

OPERATIONAL PHASE

- Long-term monitoring of the slope by installing standpipe piezometer and inclinometer to study the fluctuation of water table and horizontal movement.
- Conduct periodic ground surveys to track any unexpected ground movement.
- Perform routine visual inspections and geotechnical reviews of the embankments and foundation elements.
- Monitor and maintain surface drainage to prevent water infiltration into the subgrade.
- Post-handover settlement monitoring to confirm long-term performance.

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MITIGATION MEASURES

Air Quality

CONSTRUCTION PHASE

- Implement appropriate BMPs such as proper management of construction and waste materials, maintenance of vehicles and machinery, dust dispersion control measures, and monitoring of ambient air quality.
- Maintain good housekeeping and implement periodic internal environmental auditing.

OPERATIONAL PHASE

- Planting and maintaining trees as vegetative buffer (where possible).
- Impose speed limit especially near the rural settlement areas.

Noise

CONSTRUCTION PHASE

- Construction activities involving high noise will be carried out during the daytime only (between 7 am to 7 pm); only very minimal work during night-time and public holidays.
- Construction activities to be carried out in phases to minimise the cumulative impact.
- Piling and compaction works shall not be carried out concurrently; only one piling rig shall operate at any given time.
- All equipment and machineries are to be well-maintained to avoid emitting excessive noise.
- Imposing speed limits for the incoming and outgoing construction vehicles.
- Work in high noise environment to be done in shifts.
- Regular ambient noise monitoring.
- Erection of hoarding or temporary jersey barrier with plastic hoarding around the Project site and/or active work areas.

OPERATIONAL PHASE

- Adopt the BMPs in the "Guidelines for Environmental Noise Limits and Control – Annex D: Best Practice to Minimise Noise Disturbance" issued by DOE Malaysia.
- Design of the noise barrier by the appointed Specialist Engineering Consultant.
- Planting and maintaining trees as vegetative buffer (where possible).
- Impose speed limit especially near the rural settlement areas.

Vibration

CONSTRUCTION PHASE

- Control vibration at source or engineering control: e.g. choosing alternative lower impact equipment, vibration isolation, use of vibration dampers, use well-maintained equipment, etc.
- Administrative control: limiting the operating time of vibration source(s).
- Control the transmission of vibration: distance between source and receptors.
- Control vibration at the receptors: land use planning; gazette of buffer space.
- Short term exceedance to be investigated and corrective measures be undertaken.

OPERATIONAL PHASE

- Vibration levels will not be a cause of concern during the operational phase.

Waste Management

CONSTRUCTION PHASE

- Demolition and construction waste should be segregated and stored in designated areas.
- Clear vegetation in phases and temporarily stockpile away from waterways; daily disposal.
- Adopt the Pyramid Waste Management Hierarchy approach for domestic waste.
- Management of scheduled wastes carried out in accordance to the "Guidelines for Packaging, Labelling and Storage of Scheduled Wastes in Malaysia" and Environmental Quality (Scheduled Wastes) Regulations 2005.

OPERATIONAL PHASE

- The amount of waste generated are expected to be minimal; proper waste management to be carried out and maintained by the management.

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MITIGATION MEASURES

Terrestrial Ecology

CONSTRUCTION PHASE

- Conduct vegetation clearance ethically, ensure that all the BIPs and pollution control measures are consistently operated and well-maintained throughout the project duration.
- Train workers on safety protocols and appropriate actions in the event of wildlife encounters, including first aid procedures for incidents such as snake bites.
- Conduct site clearing in stages to allow wildlife to move to nearby vegetated areas.
- Establish a formal HWC management protocol in consultation with the PERHILITAN.

OPERATIONAL PHASE

- Maintain green buffer zones along the riverbanks and prevent encroachment.
- Enforcing proper waste and pollution management.

Aquatic Ecology

CONSTRUCTION PHASE

- Implementation of LD-P2M2 and Environmental Protection Works.
- Control pile driving noise levels.
- Consider CSR activities, such as releasing freshwater fish fingerlings with DOF approval.

OPERATIONAL PHASE

- No mitigation measures required as no impacts foreseen during operational phase.

Socio-Economy

CONSTRUCTION PHASE

- Prioritise local employment opportunities, where feasible.
- Public awareness and notification provided prior to major construction activities.
- Regular monitoring of traffic conditions and provide adequate safety measures.
- Lane closures or major traffic diversions should be properly scheduled and avoid peak periods.
- Construction machinery and vehicles operated by trained and competent personnel, and maintained in safe operating conditions.
- Employment of migrant workers legally in compliance with Immigration Act 1959/63.
- A complaint management mechanism should be established.

OPERATIONAL PHASE

- Continuous engagement between the Project Proponent, highway operator, local communities, and relevant authorities.
- A public complaint management system should remain available during the operational phase.

Public Health

CONSTRUCTION AND OPERATIONAL PHASES

- Provision of adequate and safe water supply and sanitary provisions for the workers.
- Practice good housekeeping and free from any stagnant water.
- Regulate all entry access points which will serve to limit similar risks of aberration whilst also meeting safety and health requirements.
- Proper pre-employment health assessment through FOMEMA.
- Ensure good environmental sanitation and hygiene practices at workers' base camps.
- Health screening and routine health monitoring to identify early symptoms of diseases.

Traffic

CONSTRUCTION PHASE

- Implement traffic control: transporting materials during off-peak hours, speed limits, securing loads, cover dusty materials, road signage, install barriers and reflective markers, flagman, etc.
- Vehicles used will be well maintained, and the drivers are licensed and competent.
- Conduct regular road maintenance to prevent deterioration.

OPERATIONAL PHASE

- Enforce traffic control measures and adhere to comprehensive road safety procedures.
- Implement routine road maintenance and regular inspections.
- Continuous traffic performance monitoring.

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Proposed Environmental Monitoring Program

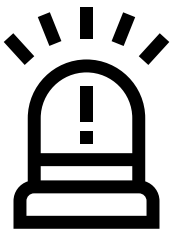


COMPLIANCE MONITORING (CM)

- Ensures EIA conditions of approval are complied with by the Project Proponent
- Carried out by Accredited Laboratory

ENVIRONMENTAL COMPLIANCE AUDIT

- Environmental Audit by a registered environmental auditor
- Possess Certified Erosion, Sediment and Storm Water Inspector (CESSWI) or Malaysian Certified Inspector of Sediment and Erosion Control (MY-CISEC) Qualifications
- Best Management Practices (BMPs) will be adopted



PERFORMANCE MONITORING (PM)

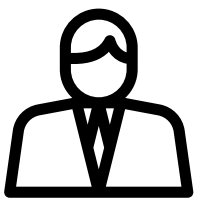
- Ensures effectiveness of pollution control systems and mitigation measures
- EO to carry out PM on site

BASELINE MONITORING

General indication of the baseline environmental conditions at the time of reporting

ENVIRONMENTAL MONITORING PROGRAM

- Provides database of environmental impacts
- Early indicator of environmental impacts



IMPACT MONITORING (IM)

- Ensures effectiveness of pollution control systems and mitigation measures
- EO to carry out PM on site

SELF-REGULATORY MONITORING

- Ensures effectiveness of mitigating measures and compliance towards environmental regulations
- Carried out by EO

ENVIRONMENTAL MONITORING PROGRAMME DURING CONSTRUTION PHASE

MONITORING	FREQUENCY
Performance Monitoring	
As per LD-P2M2 plan	• Monthly • After heavy rainfall (>12.55mm as measured by rain gauge)
Compliance Monitoring	
Discharge points of silt traps	Monthly
Impact Monitoring	
• River water quality (8 stations) • Air, noise, & vibration (10 stations each)	Monthly
• Vibration near gas pipeline (4 stations)	During piling activities

ENVIRONMENTAL MONITORING PROGRAMME DURING OPERATIONAL PHASE

MONITORING	FREQUENCY
• Air quality (4 stations)	Quarterly
• Noise (5 stations)	Quarterly

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Emergency Response Plan

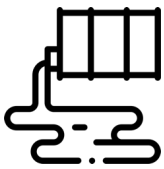
EMERGENCY RESPONSE TEAM

- A team of qualified individuals with specific roles and responsibilities to carry out during an emergency.
- Responsible for executing the following procedures:



FIRE EMERGENCY RESPONSE

Coordinating workers movement and communication with fire department



CHEMICAL SPILLAGE PROCEDURES

Mitigation methods and reporting process



ESCP FAILURE RESPONSE

Control and maintenance methods

CONCLUSION

EIA GUIDELINES

EIA Guidelines in Malaysia (EGIM), 2016

CONSTRUCTION PHASE IMPACTS

Soil Erosion and sedimentation, geohazard consideration, water quality, air quality, Noise and Vibration.

OPERATIONAL PHASE IMPACTS

Impacts are minor and can be controlled

All potential impacts can be reduced significantly with implementation of **ALL** recommended mitigation measures