

1. SCOPE OF WORKS

- 1.1 The Works under this Section shall comprise the design, construction, testing at manufacturer's works, delivery, installation, pre-commissioning, testing, setting to work, performance testing and commissioning of all associated civil and building works, inclusive of all plant and equipment for the intake, pipelines to continuous supply 1,500MLD (nominal) raw water for the Rasau Water Treatment Plan (Rasau WTP) and all other ancillary works as necessary for the completion of the Works as specified, intended or implied, completed fit for purpose.
- 1.2 The scope of the Works shall be to provide of the following:
 - i) Topographical surveys and utilities mapping as specified and as necessary.
 - ii) All necessary site investigation works and producing all necessary geotechnical and geological reports and studies.
 - iii) All studies, including all river and drainage hydrological and hydraulic studies.
 - iv) The design, construction and completion of the Works as specified herein fit for purpose.
 - v) The design, manufacture, testing at manufacturer's works, delivery, installation, pre-commissioning, testing, setting to work, performance testing and commissioning of Plant as specified herein fit for purpose.
 - vi) The production of all architectural drawings for Building Works.
 - vii) Project management of the Works, including work programming and scheduling, site supervision, contract administration, progress reporting, quality assurance and management, resources management, risk management and all related work as specified.
 - viii) All site management including health, safety, security and environmental protection measures as specified, as necessary and as obligated by law.
 - ix) Facilities for the Government as specified and as necessary.
 - x) All necessary technical studies and reports, including drainage studies, hazard and operability (HAZOP) and hazard review (HAZREV) studies.

- xii) All workshops such as risk management and value management & engineering.
 - xiii) Clash analyses of external services and internal services.
 - xiv) All authority approvals as specified and as necessary, including all reports and required submissions.
 - xv) All As-Built Drawings, Instruction Manuals and computerised asset management system as specified.
 - xvi) Maintenance of the Works as required during the Defects Liability Period.
- 1.3 The detailed design of the Works shall comply to the SPAN Uniform Technical Guidelines for the Design of Water Treatment Plants and Related Water Supply System Components (UTG-WTP) and the SPAN Uniform Technical Guidelines on Water Reticulation and Plumbing as appropriate and relevant. Where there is a discrepancy between the Contract Specifications (the Technical Requirements, General Specifications and Drawings) and the UTG-WTP, the higher requirement shall apply.
- 1.4 The scope of the Works under **pumping, intake and building works** shall include, but not necessarily limited to, the following major components.
- 1.5 All civil works shall be carried out in single stage by taking into consideration the ultimate requirement which is to provide raw water yield with nominal capacity of 1,500MLD.
- 1.5.1 Sg. Klang Intake and Raw Water Pumping Station (IRWPS):
- i) Site formation and earthworks with freeboard of minimum 1m above and up to 200 Average Recurrence Interval (ARI);
 - ii) Drainage, slope stabilization, soil stabilization & treatment, earthworks and landscaping;
 - iii) Minimum 7m wide access road complete with road kerb within the compound, anti-climb fences as per Malaysia Office of the Chief Government Security Officer (CGSO) requirements, gates and infrastructures works;
 - iv) Low level collapsible weir with minimum height of 1.5m, the weir shall be constructed with minimum 4 panels and the control room. The collapsible weir must be constructed with maintenance facilities end to end across the Sg. Klang;

- v) Sg. Klang IRWPS to ensure continuous operation of Rasau WTP Intake Pond (Pond 7) at nominal capacity of 1,500MLD (with combination of storage within the ponds, Sg. Rasau and Sg. Air Hitam), the Sg. Klang IRWPS shall meet the following minimum requirements:
- a) Minimum six (6) inlet channel with the necessary floating booms, coarse screens (100mm opening), fine screens (25mm opening), automatic band screen, sand ejector hoppers, mixer and stoplogs;
 - b) Provide facility and equipment for maintenance and removal of debris from the intake including air compressor, landing platform in front of intake, and high pressure water hose;
 - c) Minimum twelve (12) pumping bays. The design capacity of pumpsets shall have minimum 100% standby during the nominal pumping flow of 1,500MLD and 50% standby during the design peak flow;
 - d) Grit removal system with series of hoppers that can be isolated for servicing or cleaning without reduction of plant capacity;
 - e) To provide common channel after band screen which enable debris free water to be directed towards any serviceable pump sump;
 - f) Facilities in the form of isolating valves or penstocks shall be provided so that each compartment of pumping system shall be able to be totally isolated (upstream and downstream) from the main water flow without any interruption in the other part of operation;
 - g) Sand retention facility; and
 - h) Any other works if necessary.

1.5.2 Reinforced Concrete Building Works:

- i) Raw Water Pumping Station;
- ii) Compressor room/switch house;
- iii) TNB Sub-station;
- iv) Generator room;
- v) MV and LV Switch room;
- vi) Remote switch room;

- vii) Schedule waste room;
- viii) Control room complete with toilets and prayer room;
- ix) Laboratory with analyzer room;
- x) Store;
- xi) Guard house; and
- xii) Any other structure if necessary.

- 1.5.3 River protection works adjacent to the Sg. Klang IRWPS. The extent of the river protection works along the river bank (both sides) shall be minimum 150m upstream from the outer edge of the Intake structure and minimum 150m downstream from the low weir structure using concrete or steel sheet piles with capping beam or combination between sheet piles and other approved materials. Subjected to approval by authorities.
- 1.5.4 River bed protection works at the upstream and downstream of the river weir. The extent of the river bed protection works shall be minimum 150m upstream and downstream. Subjected to approval by authorities.
- 1.5.5 Two (2) nos. raw water pumping mains from the Sg. Klang IRWPS to the inlet sump of Sg. Air Hitam channel including the overhead bridge or underground crossing under the ELITE highway, pipejacking and river crossing.
- 1.5.6 Outfall structure to Sg Air Hitam channel.
- 1.5.7 Minimum 7m wide external access road from Jalan Kampung Lombong to the Sg. Klang IRWPS including the necessary upgrading at the junction between the existing and proposed road in compliance with authorities requirements.
- 1.5.8 The raw water pumping station shall be a reinforced concrete and brick wall structure and roof. The floor finishes for the main operation areas shall be finished with approved floor hardener and tile finishes at control room, office, store, switch room, remote switching room and toilets.
- 1.5.9 The operating floor of the pumping station (i.e., the motor hall, control rooms, etc.) and all electrical equipment shall in turn be 0.15-0.20 m above the ground platform level of the pumping station.
- 1.5.10 The design for any below ground pump station shall be provided with Hot Dipped Galvanized grating to allow the owner/operator to carry out maintenance.

- 1.5.11 Raw water pumping facilities that must be located in areas that may be subject to floods shall have electric service designed to provide continued operation of the pumping facilities during flooding.
- 1.5.12 The pumping station shall be readily accessible to operations and maintenance personnel at all times unless the overall system design allows the station to be out of service for the period of inaccessibility.
- 1.5.13 The area around the pumping station shall be graded to route surface water drainage away from the station.
- 1.5.14 Pumping stations shall be designed to prevent vandalism, and entrance by unauthorized personnel or animals.
- 1.5.15 Where handrail to be provided, access/working platform shall be installed within hand reach to the equipment where necessary without causing obstruction for maintenance access. Access/working platform shall be from reinforced concrete, Hot Dipped Galvanised (HDGI) chequered plate, or stainless steel grating.
- 1.5.16 Statutory safety signs shall be adequately provided at all facilities both indoors and outdoors. These safety signs shall cover mandatory, prohibition, warning, emergency, firefighting, speed limit, directional, and general notices. All signs shall be positioned at highly visible points.
- 1.5.17 Proper ventilations shall be provided as a means of providing sufficient fresh air and reducing corrosive, poisonous, or explosive gases from enclosed building and confined spaces where access to human is allowed.
- 1.5.18 The size of the selected site, the location of the pump building, and the electrical service and panels shall be designed to accommodate the use of portable or permanent power generators and their accessories.
- 1.5.19 Pumping stations shall be provided with all-weather driveways and parking areas to allow off- road parking and access for equipment during maintenance.
- 1.5.20 The pumping station structure should be designed to accommodate the addition of future equipment and piping.

- 1.5.21 Twin raw water pumping mains shall be provided as may be required.
- 1.5.22 The pumping station should house equipment which could potentially be damaged in a flood, including:
 - i) Electrical, instrumentation and control equipment, and
 - ii) Air compressor for backwashing the intake screens.
- 1.5.23 The pumping station shall be provided with vehicle access and adequate parking bays or subjected to Uniform Building By-Laws (whichever is higher) to allow for operation and maintenance and is accessible at all times.
- 1.5.24 The pumping station site shall be protected from vandalism, animals or unauthorized person using anti-climb fence.
- 1.5.25 Guard house complete with fan and toilet at the main entrance to the intake facilities shall also be provided.
- 1.5.26 The overall Sg. Klang IRWPS is intended to be fully operational in tandem with Rasau WTP commission which include all the mechanical, electrical and instrumentation to produce 750MLD. Therefore, the construction and completion of the pumping, intake and building works shall be coordinated and strictly comply with the deadlines of the other works.

2. STRUCTURAL WORKS

2.1 General

- 2.1.1 The design and construction of all Structural and related services shall follow good engineering practice and shall comply with the requirements of the relevant Authority in terms of design standards and parameters. The Contractor shall comply with the latest By-Laws and latest Rules and Regulations of all Approving Authorities. A copy of all correspondence with Approving Authorities shall be submitted to the P.D..
- 2.1.2 All design and build Works shall accommodate and satisfy the Architectural, Mechanical and Electrical (M&E) requirements and drawings.

2.2 Design Consideration

- 2.2.1 All buildings shall be designed and constructed to ensure structural strength, integrity, stability, serviceability, to satisfy the requirements of durability, cost effectiveness and aesthetics. All structural Works are to be designed and constructed in accordance with the relevant Malaysian/ European/ British Standards and Codes of Practice.
- 2.2.2 Design for all concrete structures shall take account of the conditions of exposure, the quality of cement, compatibility of admixtures, concrete compressive strength class, minimum cement content of concrete mix, maximum water/ cement ratio, concrete cover to reinforcement, the shape and bulk of the structure, ground water quality, curing, workmanship and other factors which influence the durability of reinforced concrete.
- 2.2.3 The nominal concrete cover shall be determined by the Consultant based on bond, durability and fire resistance requirements as specified in the Uniform Building By-Laws 1984 and in compliance with MS EN 1992.
- 2.2.4 All structural steel members shall be given protective treatment against corrosion and minimum 2 hours fire protection and shall comply with the latest JKR Standard Specifications for Building Works – Section J: Structural Steel and Metalworks and JKR Standard Specification for Structural Steel Works.
- 2.2.5 Proper attention shall be given to the stability of non-loadbearing brickwork or blockwork. Wall stiffeners shall be provided at every minimum of 3m vertically and horizontally to strengthen the brickwork and blockwork. Stiffeners, lintels, ties reinforcements, sleeper beam and connections shall be used judiciously.
- 2.2.6 Concrete slab for all wet areas shall be at least 150mm thickness. This type of floor shall be designed with sloping gradient or small upstand.
- 2.2.7 The design of concrete flat roof and fully cantilevered concrete gutter is not recommended. However, if there is a requirement, the design shall have a minimum cambering of 1:60 or as specified by the Architect towards the water outlet and shall be waterproofed. The same design shall be applied for concrete trenches and other concrete wet areas.

- 2.2.8 The aesthetics of bunds near the housing area must be carefully considered and integrated into the design process to create a beautiful and functional structure.
- 2.2.9 All precast elements shall be designed to include safety during transportation, erection and launching. The design of these elements shall take into account the requirements for fail safe mechanisms to prevent accidental collapse during launching and erection. A minimum Factor of Safety of 1.5 shall be used for the design of these elements.
- 2.2.10 Coordination for all mechanical and electrical components such as sanitary fittings, internal plumbing and water reticulation pipes shall be designed and installed properly. No hacking/ break-up is allowed on hardened concrete components.
- 2.2.11 Detailing of all structural concrete components shall be in accordance with relevant Codes of Practice. The minimum size of main reinforcement for columns and beams is 12mm while for other structures is 10mm. For stirrup or link, the reinforcement shall not be less than 8mm.
- 2.2.12 Design for maintenance shall take into consideration the following;
- i) All structural elements shall be designed for enhanced durability. Materials shall be durable and adequate protection shall be provided against environmental deterioration.
 - ii) All structural elements shall be designed for ease of inspection, maintenance and replacement of the various parts such as expansion joints.
 - iii) Suitable access facilities shall be provided and incorporated in the building structure where access is not possible by normal means.
 - iv) Movement joints, expansion joints, construction joints or other permanent structure joints shall comply with the latest JKR Standard Specifications for Building Works – Section D: Concreting.

2.3 Structural Action (Loading)

- 2.3.1 All structures shall be designed for the worst combination of action (loading) and additional loads and comply with MS EN 1991: Action of Structure. All loads mentioned shall be combined in the most unfavorable way for design of structural member and for stability of the whole structure. Actual action (loading) shall also be obtained from catalogues/ mechanical and electrical engineer/architect and special requirements by the client.
- 2.3.2 Design of building for earthquake resistance shall be in accordance with MS EN 1998. Check for design ground acceleration for determination of seismic zone and ground types based on soil parameters shall be carried out in early state of design for all projects. For projects under low to moderate seismicity and high intensity seismicity, mitigation approach with level of performance requirement and appropriate structural system shall be adopted. Structural simplicity, uniformity, regularity, symmetry and redundancy shall be as basic principle in conceptual design.
- 2.3.3 The minimum design variable action (loading) to be used for the roof truss design shall be $0.25\text{kN}/\text{m}^2$. In the design of roof trusses, provision for inspection for the purpose of maintenance such as platform with railings shall be included to consider M&E services.
- 2.3.4 The minimum density of materials for non-loadbearing brickwork or blockwork considered in the structural design shall be $19\text{kN}/\text{m}^3$. All slab designs shall be able to transfer action (loading) of non-loadbearing brickwork or blockwork of unknown location.
- 2.3.5 For load bearing blockwork designs, the mean compressive strength of block units shall not be less than $7\text{N}/\text{mm}^2$ and the minimum net dry density shall not be less than $1500\text{kg}/\text{m}^3$. The minimum strength of normal mortar shall be $6\text{N}/\text{mm}^2$ and for thin layer mortar shall be $12\text{N}/\text{mm}^2$. The concrete infill for reinforced block shall be of minimum C25/30 with 10mm nominal size aggregates. All designs and construction shall comply with the JKR Standard Specification for Load Bearing Blockwork System.
- 2.3.6 Wind actions mean all actions (loading) due to the effect of wind pressure or suction. Wind actions (loading) shall be calculated in accordance with MS 1553 or MS EN 1991 with modification on the wind speed to suit the actual local condition.

2.3.7 Execution action (loading) affects partially completed structures during the execution stage and is characteristically temporary. The magnitude and direction of such forces acting on any part of the structure depends on the type of execution plant or equipment employed and its placement with respect to the affected structural member concerned and shall be taken into consideration in the design of the structural elements. The minimum execution action (loadings) is 1.5kN/m².

2.4 Structural Material

- 2.4.1 All structural concrete shall be minimum of strength class C32/40 (cylinder strength/ cube strength) with maximum aggregate size 20mm, minimum cement content 300kg/m³ and free water content between 160 kg/m³ to 180kg/m³.
- 2.4.2 Steel reinforcement yield strength shall be 500N/mm² and shall be noted as 'H' in the structural drawings. Steel reinforcement yield strength for wire mesh fabric shall not be less than 500N/mm². Reinforcing bar for stirrups and links of yield strength 250N/mm² are allowed if required and shall be noted as 'R' in the structural drawings.
- 2.4.3 All structural steel otherwise specified shall be in Hot Rolled Sections, Structural Hollow Sections, Plates and Bars and shall comply with the appropriate standards mentioned in the JKR Standard Specification for Structural Steel Work, MS EN 1993-1 and relevant code of practice. The structural steel material shall be at least Grade S275 (yield strength = 275 N/mm²).
- 2.4.4 For hot rolled roof trusses, the Contractor shall indicate on the drawing, that M&E services shall be installed using strap fixed on bottom chord member. Installation on purlins is not allowed. Rod to support ducting shall be designed to be installed on web plane member or stronger axis to decrease twisting on truss member. Drilling is strictly prohibited on all truss members.
- 2.4.5 Proprietary prefabricated cold formed roof trusses shall be manufactured only by reputable licensed truss suppliers and approved by the P.D. The full requirements are outlined in JKR Standard Specification for Prefabricated Cold Formed Steel Roof Trusses.

2.5 Standard and Code of Practice

The Standards and Codes of Practice shall be applicable for all structural engineering Works but not limited to the following:

Malaysian Uniform Building By-Laws (UBBL)

MS 1553	: Code of Practice on Wind Loading for Building Structure
MS EN 1990	: Basic of Structural Design
MS EN 1991	: Action of Structure
MS EN 1992	: Design of Concrete Structure
MS EN 1993	: Design of Steel Structure
BS EN 1994	: Design of Composite Steel and Concrete Structure
BS EN 1996	: Design of Masonry Structures
MS EN 1997	: Geotechnical Design
MS EN 1998	: Design of Structures for Earthquake Resistance
MS 1195	: Code of Practice for Structural Use of Concrete
MS EN 197	: Composition, Specifications and Conformity Criteria for Common Cements
MS EN 12620	: Aggregates for Concrete
MS 30	: Method of testing Aggregates
MS EN 206	: Concrete – Specification, Performance, Production and Conformity
MS 523-1	: Concrete – Part 1: Specification, Performance, Production and Conformity
MS 523-2	: Concrete – Part 2: Method of Specifying and Guidance for the Specifier
MS 144	: Steel Wire for the Reinforcement of Concrete Products – Specification
MS 145	: Steel Fabric for the Reinforcement of Concrete – Specification
MS 146	: Steel for the Reinforcement of Concrete – Weldable Reinforcing Steel – Bar, Coil and Decoiled Product – Specification
BS EN 10025	: Hot Rolled Products of Structural Steels
BS EN 10210	: Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Steels
BS EN 10219	: Cold Formed Welded Structural Hollow Sections of Non-Alloy and Fine Grain Steels
BS 499	: Welding Terms and Symbols
MS 1064	: Guide to Modular Coordination in Buildings
BS 8000	: Workmanship on Building Sites. Code of Practice for Waterproofing
MS 2282	: Masonry Units
BS 6073-2	: Precast Concrete Masonry. Guide for Specifying

	Precast Concrete Masonry Units
BS EN 771-3	: Specification for Masonry Units. Aggregate Concrete Masonry Units (Dense and Lightweight Aggregates)
BS EN 772-2	: Methods of Test for Masonry Units. Determination of Percentage Area Voids in Masonry Units (by paper indentation)
BS 5606	: Guide to Accuracy in Building

3. CIVIL WORKS

3.1 Earthworks

- i) Earthworks shall be carried out according to good engineering practice, conforming to MS EN 1997 and MSMA or other relevant standards.
- ii) Earthworks shall be designed in conjunction with the Technical Requirements for Geotechnical Works.
- iii) Earthworks shall consist of Site clearing, excavation, filling, rock blasting, grading, levelling, compaction and other earthworks within the limits of Works. It shall include the removal, proper utilization, hauling or disposal of all excavated materials, constructing, shaping and finishing of all excavation over the entire Works in conformity with the drawings and specifications.
- iv) The excavation shall be executed in such manner and order as approved by the P.D.. The Contractor shall be responsible for the compliance with the Rules and Regulations and By-Laws of Local Authorities.
- v) The entire site formation levels shall be designed and filled higher than the known flood levels provided by Jabatan Pengairan dan Saliran (JPS). In absence of such information the flood level shall be determined by other reasonable means.
- vi) Unsuitable material shall be excavated to such depth and over such area. They shall be transported and disposed of in an approved manner. The Contractor shall be responsible for providing his own dumpsite for such unsuitable materials as approved by Local Authorities. Voids created due to removal of such materials shall be backfilled with suitable material compacted to a dry density not less than that of the surrounding or that specified for the respective part of the earthworks or as directed by the P.D..

- vii) If the removal of unsuitable material is to be done under standing water, voids created due to removal of such materials shall be backfilled with hard clean crushed rock, natural gravel or sand having grading within the respective limits.
- viii) Prior to forming embankment over soft ground, the soil below fill material shall be given strength improvement treatment by means of replacement of unsuitable material as specified in Clauses 3.1 (vi) and 3.1 (vii) of this section or other approved methods. The first layer or layers of fill materials shall be deposited over the full width of the embankment in thickness and compacted using suitable compaction plant for working over soft ground.
- ix) The embankment shall be built to different heights in stages with or without surcharge and with allowance for consolidation time in between stages. Where surcharge is specified, the Contractor shall be responsible for the provision of surcharge materials, removal and disposal of excess material on completion of consolidation or when directed by the P.D..
- x) The Contractor shall also be responsible to provide ground monitoring instrumentations such as settlement markers and plates, inclinometer and piezometer within embankment and soil replacement areas to facilitate the monitoring and reporting phase of any ground improvement slope stabilization method where necessary or as directed by the P.D..

3.2 Site Clearing

- i) The Site shall be cleared and debris shall be removed from the Site. The topsoil shall be stripped and stocked at suitable places to be used for turfing and landscaping as approved by the P.D.. Existing utilities and services that are affected by the construction shall be determined and relocated as approved by the P.D..
- ii) The characteristic of the soil has to be studied to determine its engineering properties and suitability as filling materials.

3.3 Environmental Management Plan (EMP)

Environmental Management Plan (EMP) shall be carried out by the Contractor in accordance with Technical Requirements for Environmental Protection and Enhancement Work (EPW).

3.4 Erosion and Sediment Control Plan (ESCP)

- i) The Contractor shall propose a comprehensive Erosion and Sediment Control Plan (ESCP) conforming to MSMA requirements. This shall include provision of Best Management Practices (BMPs) such as turfing, earth drains, check dams, sediment basin and other temporary control measures. Washing bays shall be provided to remove excessive sediment from outbound vehicles at all Site access points.
- ii) The Contractor shall construct and maintain the ESCP measures above throughout the construction period. The Contractor shall be solely responsible to pay any fine imposed by the Local Authorities as a result of his own negligence or that of his employees or agents in this connection. On completion of the Works or whenever directed, the Contractor shall remove all ESCP BMPs including making good all damages done and payment of all charges.
- iii) Earthworks shall be planned and constructed without causing silting up of canals, streams, drains, culverts or any other drainage structures. Precautions shall also be taken to prevent earth moving plants and vehicles from affecting cleanliness of public roads or causing pollution to the atmosphere.
- iv) Temporary drainage shall be constructed within the Site to prevent any flash flooding and ponding or water logging. Good surface drainage shall be maintained to prevent erosion and to stabilize cut and fill slopes.

3.5 Turfing

- i) All turfing works shall conform to the JKR Standard Specifications for Building Works.
- ii) All slopes and open areas shall be turfed. Slopes shall be closed turf or equivalent methods to be carried out immediately within two (2) weeks after the formation of the slope.

3.6 Earth Retaining Structures

All Earth Retaining Structures shall be designed in accordance with the following:

- i) Technical Requirements for Geological and Geotechnical Works;
- ii) JKR Standard Specifications for Building Works.

3.7 Slope

- i) All cut and fill slopes shall be designed in conjunction with the Technical Requirements for Geological and Geotechnical Works.
- ii) All slopes shall be designed for stability and provided with adequate protection against soil erosion.
- iii) Drains shall be provided for each berm/ bench of all slopes.
- iv) All unstable rock slopes shall be adequately protected and stabilized with acceptable techniques.

3.8 Drainage

3.8.1 General

- i) The drainage Works shall consist of all required design and construction of the drainage system to conform with the requirements of JKR, JPS and other Local Authorities.
- ii) Proper sustainable drainage system shall be designed in compliance with MSMA and constructed to give the best hydraulic features. There shall be no flooding, ponding, and silting-up either during construction or after completion of the Works.
- iii) Drainage system shall include but not limited to the construction of drains, sumps, culverts, scupper drains, cascading drains, subsoil drains, interceptor drains and pumping stations where necessary.
- iv) Drains shall be designed around buildings, roadside drain and other necessary locations to prevent flooding, settlement, erosion instability of soil and slopes. All perimeter drains shall be covered or concealed where necessary.
- v) A minimum drain reserve of 1.5 m wide shall be provided for roadside drains. Surface runoff, stream and river flow in the vicinity of the roadway shall be computed for major drainage systems which includes but not limited to perimeter drains, roadside drains, culverts, subsoil drains and interceptor drains.

vi) Final discharge point shall be identified and approved by the relevant Local Authorities. Drainage system outside the boundary of the project shall also be considered in overall project design. If necessary, the drainage system shall be upgraded in order to ensure adequate and fully functional drainage system.

3.8.2 Design Requirement

- i) Drainage system shall be designed with adequate gradients to enable self-cleansing flow and ease of maintenance.
- ii) Side walls of drains, wing walls and apron of culverts shall be properly designed and constructed to prevent erosion or scouring.
- iii) All structural design and the action (loading) for culverts and related components shall be in accordance with MS EN 1992 and MS EN 1991 respectively.
- iv) All deep sumps and drains shall be covered with heavy duty grating to ensure safety of pedestrian and vehicles. All drains at the access to buildings as well as public area shall be properly covered with concrete slabs or grating.
- v) Other safety structures such as parapet wall, guardrails, fencing, and handrail shall be provided where necessary.
- vi) Reinforced concrete struts shall be provided for all drain side walls to prevent failure of the drain.
- vii) On-site detention (OSD) shall be constructed and conform to the requirements of MSMA. The construction of detention pond shall include the system components at the inlet storage and outlet zone to cater outflow discharges without causing adverse effects on downstream properties.
- viii) The river reserve, buffer zone and riverbank protection design shall comply to Local Authorities requirement and in accordance with the Technical Requirements for Geological and Geotechnical Works.

4. ROAD WORKS

4.1 General

- i) The road Works shall consist of all required design and construction of the road network shall conform with the requirements of JKR Standard Specifications of Building Works, *Arahan Teknik (Jalan)* and other Local Authorities.
- ii) The road alignment shall be proposed by the Contractor. The starting point for the proposed alignment of the road network shall form a junction at the existing roads towards the Site.
- iii) The construction of roads and hardstanding shall generally be carried out only after completion of all drainage systems, services and ducts which may affect the Works, unless otherwise agreed by the P.D..
- iv) The road Works shall comprise the following major components:
 - a) Construction of access road(s) from the Site to the Federal/ State/ Municipal Road including all the works required by Local Authorities.
 - b) Construction of an internal road network within the Site;
 - c) Construction of earth retaining structure where necessary along the proposed road;
 - d) Construction of proper drainage system to drain out water from areas along the road to suitable discharge points;
 - e) Construction of road intersections, road markings, road furniture, traffic control devices, public utilities service culvert, relocation/ protection of existing services, street lightings, traffic lights, pedestrian sidewalk, landscaping, environmental protection and all other associated Works;
 - f) Construction of hard standing at required areas;
 - g) Preparation and execution of Traffic Management Plan (TMP); and
 - h) The Contractor shall carry out Traffic Impact Assessment (TIA) and/ or Road Safety Audit (RSA) when required by the Local Authorities.

4.2 Design Requirement

- i) All designs shall optimally conform to *Arahan Teknik (Jalan)* JKR, REAM Guidelines and other approved International Standard (when required) in respect of visual elegance, functional adequacy, safety, suitability, robustness, ease of maintenance, cost effectiveness and aesthetics.
- ii) The Contractor shall collect and analyse all available data, records, proposals, and drawings. Any further study, survey or investigation shall be carried out if additional information is required for the design and construction of the whole Works.
- iii) The Contractor shall verify ground details such as topographical features, existing tracks and locations of existing utility services to confirm the information contained in the existing survey drawings. Additional field survey shall be carried out if further information is required.
- iv) The Contractor shall prepare the specification on Work methods, materials and workmanship for the Works which is not covered by JKR Specifications.
- v) The Contractor shall identify all public utilities below and above ground affected by the Works and provision for relocation and protection of services to the satisfaction of the relevant utility authorities or companies.
- vi) The Contractor shall identify all associated drainage facilities comprising culverts, sub-surface and surface drainage Works and the relocation, repair and removal of existing drainage structures where required in full compliance to JKR/ JPS/ Local Authorities requirements.
- vii) The Contractor shall ensure that all other Works and services necessary to satisfactorily design, construct, complete and maintain the whole Works to comply with the Government's Requirement.
- viii) The road network system outside the boundary of the project shall also be considered in overall project design. If necessary, the road network system shall be upgraded in order to ensure adequate and fully functional road network system is provided for the project.
- ix) The Contractor shall carry out and prepare the following upon obtaining the approval of the preliminary design by the Government.

4.3 Detailed analysis and design of the Works;

- i) Scaled plans and drawings for the whole construction of the Works which include;
- ii) Layout plans of the road showing details of geometric elements, finished road level, existing ground levels and retaining structures;
- iii) Detailed setting out plans for the road alignment, intersections, slope protection, drains and culverts and other related structures all to a suitable scale including the invert levels and reduced levels at appropriate intervals and locations;
- iv) Typical cross-sections of the road, culverts, connecting roads, temporary diversion of roads and crossings, earth embankments and retaining walls showing the various dimensions of the elements at appropriate locations;
- v) Longitudinal sections of the road, culverts, connecting roads, temporary diversion of roads and crossings, earth embankment, retaining walls showing the existing levels, proposed levels, super elevation and also invert levels of drains and culverts;
- vi) Drainage and sub-soil drainage plans, showing details such as type, size, length and other dimensions of the proposed drainage system;
- vii) Structural drawings for the structures shall include the engineering design of the foundations and the design of the retaining structure;
- viii) Plans showing road layout, lane markings, traffic signs including advance directional signs;
- ix) Traffic Management Plan during construction;
- x) Land acquisition plans in case required;
 - a) Plans showing proposal for environmental protection and mitigation Works; and
 - b) Plans showing details of public utility services, which include ducting, trenches and manholes.
- xi) Traffic Impact Assessment (TIA) report and Road Safety Audit (RSA) report shall comply with *Arahan Teknik (Jalan)* and other requirements from Local Authorities.

- xiii) The geometric design of the road and bridge structures shall satisfy the minimum criteria for JKR R3/ U3 standard laid down in *Arahan Teknik (Jalan)* or REAM Guidelines where appropriate. In selecting the design alignment, the following requirement shall be considered:
- Minimum land acquisition and minimum overall construction cost;
 - Minimizing services relocation Works; and
 - Minimizing the number of rivers, stream/ canal crossing.

4.4 Relocation/ Protection of Utility Services

- The Contractor shall, during the design stage, liaise with all affected utility service providers or authorities with regard to existing utility installations on the necessity of relocation/ protection or diverting such installations. The Contractor shall, if required, establish exact locations of these installations by trial trenching. The Contractor shall put up detailed plans and proposals for the relocation, temporary or otherwise, of such services if affected by the Works.
- The Contractor shall also incorporate necessary safeguards to protect the existing services against damage or destruction during construction. Design and construction of such relocation/ protection Works shall be subjected to the approval of the respective utility service providers or authorities. The cost of such relocations and protection Works shall be deemed to be included in the Contract Price. These services should include utility gas pipes, electrical and telecommunication lines, water pipes and others.
- The cost of relocating and restoring utility facilities located at Federal road reserves, State road and river reserves shall be borne by utility service providers except for water distribution system and sewerage system. The Contractor shall abide with the latest "*Garis Panduan Perlindungan, Pengalihan dan Pemasangan Semula Utiliti dalam Pelaksanaan Program dan Projek Kerajaan*".

4.5 Works Under Water

The Contractor shall be deemed to have ascertained for himself before pricing, of the extent of the Work which will have to be carried out under water and his rates and prices shall include for all costs and charges arising out of such Works.

4.6 Pavement

The pavement for roadwork shall be of flexible and/ or rigid type and designed in accordance with the *Arahan Teknik (Jalan)* or REAM Guidelines.

4.7 Intersection and Access

The layout and type of control at the intersections shall be designed to suit the traffic volume.

4.8 Road Marking

The design shall cover all road markings such as centre line, edge line, chevron, arrows, etc. The marking shall be made from reflective paints. Types and colour of the markings shall be designed in accordance with *Arahan Teknik (Jalan) 2D/85* published by JKR.

4.9 Guardrails

The design of traffic guardrails shall be in accordance with REAM Guidelines.

4.10 Traffic Control Devices

The Contractor shall provide adequate traffic control devices and roadside furniture such as directional signs and pavement markings all in accordance with JKR *Arahan Teknik (Jalan)*.

4.11 Traffic Impact Assessment (TIA)

- i) Traffic Impact Assessment shall be carried out by the Traffic Engineering Consultant appointed by the Contractor to determine future traffic growth and its resultant impact on the traffic movement in and around the vicinity of the proposed development.
- ii) The study area shall cover all roads and intersections within the vicinity of the proposed project area. However, the Contractor shall ascertain for himself the extent of the study area so that its coverage is sufficient for getting all the required data for the proper completion of the study.

- iii) The feasibility of the proposal will have to be based on the outcome of the traffic impact assessment that will be done in accordance with Term of Reference for TIA in **Appendix B1 - 1**. In no uncertain term shall the Contractor be absolved from his responsibility over the report and its recommendations.
- iv) The Traffic Impact Assessment Report shall comply with the requirements of the latest *Arahan Teknik (Jalan)* 38/2018, *Arahan Teknik (Jalan)* 11/87, *Arahan Teknik (Jalan)* 8/86, Malaysia Highway Capacity Manual, or relevant international guidelines.
- v) In consultation with the relevant government authorities and in accordance with the latest *Arahan Teknik (Jalan)*, JKR Malaysia/REAM Guidelines, the Traffic Engineering Consultant shall recommend the number of lanes required, the layout of junctions, and the time phasing for existing, or if necessary, propose traffic light and the optimum mitigation to cater for the future traffic demand where the exact locations of the proposed intersections are to be identified based on their connections to the existing road network at appropriate distances from each other, in accordance with the projected traffic, function and hierarchy of the proposed roads and bridges.

4.12 Traffic Management Plan (TMP)

- i) Traffic Management Plan (TMP) shall be carried out by the Contractor in accordance with the *Arahan Teknik (Jalan)* 2C/85 Temporary Signs and Work Zone Control prepared by JKR.
- ii) Traffic Management Plan (TMP) is required for all Work zones of the project. Each Work zone will have a specific TMP with a specific reference number to it. These TMPs shall have reference numbers and are to be displayed for easy access during inspection and audit visit. Whenever there is a change of traffic management on Site, these must be reflected in the TMP being displayed. Approved TMP shall be forwarded to the P.D. for final approval and acceptance.
- iii) Temporary control devices and signs during construction shall be in compliance with relevant *Arahan Teknik (Jalan)* JKR and REAM Guidelines with respect to traffic control devices, temporary signs and Work zone controls.

- iv) The Contractor shall include in his design any temporary Work or diversion that is needed during the construction period. All temporary Works shall be able to cater for uninterrupted flow of traffic for the period concerned. All temporary control devices and signs shall be in accordance with the Standard Road Specification and Arahan Teknik (Jalan) "Manual on Traffic Control Device, Temporary Signs and Work Zone Control" published by JKR.

5. EXTERNAL WATER RETICULATION SYSTEM

5.1 General

- i) The Contractor shall design and construct the external water reticulation system to provide reliable and sufficient water supply to the proposed project. The design shall harmonize with other utilities and surroundings to meet the Client's needs in terms of functionality, durability, ease of operation and maintenance.
- ii) The Contractor shall design, construct, complete and commission the external water reticulation systems to cater for the total demand of the proposed project.
- iii) The criteria for estimating daily and total water demand shall be based on the Uniform Technical Guideline (UTG) by *Suruhanjaya Perkhidmatan Air Negara* (SPAN) or as per specified by State Water Authority/ Service Provider (SWA).
- iv) The SWA shall provide the source of water supply. The Contractor shall liaise with SWA to identify and connect to the approved supply mains. In case the supply is insufficient, the Contractor shall propose alternative supply subject to the approval of the P.D./ Local Authority.
- v) The Works may comprise but not limited to the following items:
 - a) Tapping from the approved SWA supply mains;
 - b) Distribution pipes from tapping points to elevated water tank or roof top storage tanks of the proposed buildings with/ without pumping system or suction tank depending on the available pressure at the tapping points;
 - c) Suction tank, booster pump and pump house complete with Mechanical & Electrical (M&E) system and automatic control system, where pumping system is required;

- d) Elevated water tank;
 - e) Instruments and meters; and
 - f) Testing and commissioning.
- vi) Any item which is not specifically stated in the Scope of Works but is necessary for the completion of the project shall deem to be included and provided for in terms of design and pricing.

5.2 Design Requirement

- i) The design, construction, installation, testing and commissioning of the system shall comply with UTG and other relevant authorities' requirements.
- ii) The external water supply system outside the boundary/ limit of works within the vicinity of the project shall also be considered in overall project design for the purpose of tapping from the approved supply mains. The water supply system shall be upgraded, where necessary to ensure adequate and fully functional external water reticulation system for the project.

5.3 Approvals

The Contractor shall obtain the approval of relevant authorities for the Works, related to water consumption demand, power supply and consent of landowners. The Contractor shall pay all fees, charges or contributions to the relevant authorities where applicable, unless otherwise stated in the Pre-Bid Document.

5.4 Distribution Pipes

- i) The Contractor shall provide complete and functional distribution pipes for external water reticulation and fire hydrants for the project.
- ii) In case of available pressure at the tapping point is not adequate, pumping system shall be provided for the distribution of water to all the building blocks of the project. The system shall consist of suction tank, pump house, M&E equipment and pumping mains to the roof tanks.

- iii) The Contractor shall design and construct external elevated water storage tank of nominal capacity equivalent to the required storage of the total water demand subject to practicality and number of blocks in the project. Water supply shall be pumped to this storage tank and distributed by gravity to all the buildings' roof tanks.
- iv) All valves shall be adequately and strategically provided.
- v) Hydrants of minimum size of 100mm shall be adequately installed to the approval of *Jabatan Bomba dan Penyelamat Malaysia (JBPM)*. All hydrants shall be of double outlet type. Separate hydrant line and meter shall be proposed subject to the approval of SWA.
- vi) All pipes shall be anchored or restrained by thrust blocks where necessary.
- vii) Storage and Suction Tanks
- viii) The Contractor shall design and construct an approved product by SWA for storage and suction tanks as follows:
 - a) Reinforced concrete tank;
 - b) Stainless steel tank; and
 - c) Steel tank with coating and lining (Glass Fused/ Glass Coated/ Epoxy Lining/ HDPE Lining/ Composite Stainless-Steel Lining).
- vii) Materials for all water tanks shall be approved by the P.D..
- viii) The capacity of the suction tank shall be minimum one third of the total storage requirement subject to SWA/ Client's requirement. Minimum daily water demand shall be in accordance with UTG or as per specified by SWA whichever is higher. For medical, security and other special buildings/ complexes, storage capacity requirements shall not be less than two (2) days of total water demand.

5.5 Pumping Station and M&E Works

All Works shall be designed and constructed in conjunction with Technical Requirements for Mechanical Works, Technical Requirements for Electrical Works and UTG.

5.6 Instrument and Meter

5.6.1 The Contractor shall propose, supply, install, calibrate and commission all instruments and meters that are necessary to the highest standard of operation, reliability and safety. The instrumentation panel shall be installed within the pump house in conjunction with Technical Requirements for Electrical Works.

5.6.2 The instruments required shall be but not limited to the following:

- i) Flow meters at suitable location in order to register water consumption.
- ii) Separate meters shall be installed for cafeteria/ canteen, staff quarters if required; and
- iii) In-situ level indicator or meter for suction and elevated tanks.

5.6.3 Location of Pipelines

The pipelines shall not be laid beneath a road pavement unless otherwise approved by the P.D.. Exceptions to this requirement shall include pipelines crossings at road junctions and when laying service pipes to serve individual buildings.

5.6.4 Ancillary Works

The Scope of Works shall cover all other ancillary Works necessary for the completion of the project.

5.6.5 Testing and Commissioning

All piping, metering and instrumentation system including equipment after installation shall be tested and commissioned. The Contractor shall carry out tests on all individual sections of each system and the system as a whole to the required performance. The testing and commissioning shall be carried out by qualified and competent personnel and shall be witnessed by the P.D. or his representative and SWA.

- i) If the whole or parts of the installation or equipment fail, the Contractor shall be required to carry out necessary modification or replacement of the same at his own cost.

- ii) All energy and water consumed during the testing and commissioning shall be borne by the Contractor. A complete record of the tests and results of such tests shall be submitted in two (2) sets to the P.D..

5.6.6 Operation and Maintenance

The Contractor shall provide two (2) sets of Manual of Operation & Maintenance of all facilities including pump-sets, instrumentation control, metering system and itemized list of equipment and spare parts which the manufacturers consider as essential to be kept in ready stock for operation and maintenance.

5.6.7 Defect and Liability Period

The defect and liability period shall be as mentioned in the Pre-Bid document. The Contractor shall be responsible for all the maintenance and operation of the completed Works throughout the above said period. The Contractor shall repair or replace all defects and carry out scheduled and preventive maintenance Works throughout defect liability period.

6. SEWERAGE SYSTEM

6.1 General

- i) The sewerage Works shall consist of design, construction and installation of the sewerage pipelines and a Sewage Treatment Plant (STP) for the site as described in the Scope of Work.
- ii) If there is an existing public sewer system for the area, the sewerage pipelines within the sites shall be connected to the system.
- iii) The Works to be carried out shall include the following:
 - a) Sewerage pipelines including STP or all the pipework connecting to the public sewer;
 - b) Connection of building soil drainage system to the sewerage pipelines;
 - c) Maintenance services of the above Works and equipment throughout the period stated in the Conditions of Contract;

- d) The design, construction, installation, testing and commissioning of the system shall comply with SPAN and relevant authorities' requirements; and
- e) Demolition of any part or all of the existing sewerage system where required.

6.2 Design Requirements

- i) The design, construction, installation, testing and commissioning of the system shall comply with the Malaysian Sewerage Industry Guideline (MSIG) published by SPAN and JKR Standard Specifications for Building Works.
- ii) The Contractor's proposal for the Works shall include the following details and information:
 - a) Description on the scope of Works;
 - b) Layout plan including sections, details and components of the system;
 - c) Design report;
 - d) Material and component specifications; and
 - e) Original technical information for all proposed system.
- iii) The STP shall be optimally designed for minimum maintenance.
- iv) The sewerage system outside the boundary/ limit of works within the vicinity of the project shall also be considered in overall project design for the purpose of connection to the public sewer/ existing sewer line/ STP. The sewerage system shall be upgraded, where necessary to ensure adequate and fully functional sewerage for the project.

6.3 Approvals

The Contractor shall obtain the approval of relevant authorities for the Works, related to population equivalent (PE), sewerage pipe network and system, power supply and consent of landowners. The Contractor shall pay all fees, charges or contributions to the relevant authorities where applicable, unless otherwise stated in the Pre-Bid Document.

6.4 Sewer Pipeline

- i) Sewer Pipelines shall be laid in a straight line, tightly jointed and at correct gradient to ensure smooth flow of the effluent and prevent blockages or damages to the pipes.
- ii) Adequate cover and bedding shall be provided to all pipes to avoid damage due to external loads and ground condition. Backfilling shall be done after satisfactory leaking test.
- iii) All materials shall conform to relevant Malaysian Standards. The type and minimum diameter of pipes used shall meet the requirements set by SPAN or the relevant authorities.
- iv) The sewerage system shall be designed to flow by gravity unless site condition dictates otherwise.
- v) The sewer pipes shall not be laid under the road pavement without proper protection.

6.5 Manholes

- i) Precast concrete manholes shall conform to MS 881 – Specification for Precast Concrete Pipes and Fittings for Drainage and Sewerage and BS EN 1917 – Specification for Unreinforced and Reinforced Concrete Manholes and Soakaways. Manholes shall be constructed with precast concrete sections surrounded by in-situ concrete.
- ii) Manhole covers shall be watertight and capable of withstanding external loadings and conforming to MS 1228/ EN 124 – Code of Practice for Design and Installation of Sewerage Systems.
- iii) All manholes shall be of precast concrete and installed at not more than 100 meters apart and at all junctions and turning points.
- iv) The location of manholes on roadways shall be avoided.

6.6 Inspection Chamber

- i) Precast concrete inspection chambers shall conform to MS 881 – Specification for Precast Concrete Pipes and Fittings for Drainage and Sewerage and BS EN 1917 – Specification for Unreinforced and Reinforced Concrete Manholes and Soakaways.
- ii) Inspection chamber cover and frame shall comply with BS EN 124. The location of inspection chambers on roadways shall be avoided.

- iii) All inspection chambers shall be of precast concrete or clay brickworks and installed according to Mechanical drawings.

6.7 Pump Station and M&E Works

- i) If a pump station is required, the system shall be designed in accordance with the following documents:
 - a) Malaysian Sewerage Industry Guideline (MSIG) published by SPAN
 - b) MS 1228 – Standard Code of Practice for Design and Installation of Sewerage Systems.
- ii) All Works shall be designed and constructed in conjunction with Technical Requirements for Mechanical Works and Technical Requirements for Electrical Works.

6.8 Standard of Effluent Discharge

The standards of effluent discharge from sewage and wastewater treatment plant shall comply with Standard A of the Environmental Quality Act.

6.9 Sewage Treatment Plant (STP)

- i) In general, the STP shall be planned and designed with the following consideration:
 - a) The STP shall be activated sludge system and shall be approved by SPAN or relevant authorities;
 - b) Compliance with effluent quality requirements;
 - c) Optimized capital and operating costs of the plant; and
 - d) Meeting local environmental and aesthetic requirements, including the proximity to the nearest habitable premise, direction of the prevailing winds, local zoning requirements, socio economic aspects and compatibility of the treatment processes with the present and future land receiving waters.
- ii) Warranty for Sewage Treatment Plan (STP)

- iii) The system provider's guarantee against any defects or damages during a period of five (5) years from the date of Certificate of Practical Completion due to any defect, fault or insufficiency in design, material or workmanship or against any other failure which an experienced Contractor may reasonably contemplate but shall not include normal replacement and maintenance. The terms of the guarantee shall be such as approved by the P.D..

6.10 Testing and Commissioning

The method of testing shall be generally as laid down in the MS 1228 – Malaysian Standard Code of Practice for Design and Installation of Sewerage Systems and MSIG by SPAN.

6.11 Operation and Maintenance

- i) The Contractor shall provide two (2) sets of Manual of Operation & Maintenance of all facilities including pump-sets, instrumentation control and itemized list of equipment and spare parts which the manufacturers consider as essential to be kept in ready stock for operation and maintenance.
- ii) The given descriptions for the above Civil Works and Plant in this clause are for general guidance and are non-exhaustive; the full requirements of the Contract are as indicated or implied further in the Document.

1.0 Background of Traffic Study

- i. The Government is desirous to carry out the project “(**NAME OF PROJECT** (***bold/capslock***)”
- ii. As such, a Traffic Impact Assessment (TIA) study has to be carried out to determine future traffic growth and its resultant impact on the traffic movement in and around the vicinity of the proposed development.
- iii. **Attachment A** shows the location of the above-mentioned project while the other information needs to be referred to Client Brief of Requirement (CBOR) in the needs statement.

2.0 Objective

The TIA shall be carried out with the following objectives;

- a) To assess the existing traffic condition, with particular reference to the performance of the road network in the study area.
- b) To forecast the potential future traffic generated resulting from the proposed development and to assess its impacts on the road network.
- c) To propose mitigation measures so as to curb possible future traffic congestion in the transportation system within the vicinity of the proposed development project.

3.0 Criteria for Warranting TIA

Criteria for Warranting TIA shall be based on Arahan Teknik (Jalan) 38/2018 Guidelines for Traffic Impact Assessment.

4.0 Scope of TIA Study

- i. Define the study area/boundary (**to consult and obtain approval from the Approving Authority**) which shall include:
 - a) All the adjacent junctions within the vicinity of the proposed development area as a baseline study.

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- b) Any junction where the additional traffic volume resulting from the proposed development is more than 10% of existing traffic volume.
- ii. Determine existing traffic pattern, which includes primary and secondary data collection.
- iii. Provide information on land use and development within the vicinity of the proposed development project.
- iv. Forecast Trip for the completion of the development and for a minimum of ten (10) years after completion of the development. If the completion of the development is more than 10 years (for staged development), it shall include the interim analysis for the completion year of the project with sequential steps of Trip Generation, Trip Distribution and Trip Assignment based on the latest Trip Generation Manual published by the Highway Planning Department, Ministry of Works (HPD, KKR) or other relevant source of references.
- v. Analyse impacts of projected generated traffic in area of study.
- vi. Propose mitigation measures for all negative impacts on Level of Service (LOS), safety aspects and others.

5.0 Roles & Qualification of The Consultant

- i. Role of the Consultant:
 - a) Consultant can be a Professional Engineer with Practicing Certificate (PEPC) or a team of specialists in a firm led by a qualified PEPC.
 - b) Consultant who has been commissioned by the Client to carry out the TIA shall act independently and professionally, without interference or influence from any party. The Consultant shall directly or indirectly look after the interests of the general public and the local community.
 - c) The Consultant shall evaluate the planning and design of the project in promoting sustainable modes of transportation. Optimisation of road capacity by means of traffic management measures should be carefully studied and taken into consideration.
 - d) Communicate and liaise with the Approving Authority to demonstrate the traffic planning and proposal for the development/redevelopment project and identify any possible adverse traffic impacts.

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- e) Propose mitigation and remedial measures to minimize the impact of possible traffic congestion on completion of the proposed development /redevelopment project.
- ii. TIA Consultant, represented by a qualified Consultant, i.e. the professional employed by the TIA Consultant firm, and must possess the following qualifications:
 - (a) A qualified Civil Engineer specializing in traffic/ highway/ transport engineering who is registered with the Board of Engineers, Malaysia as a PEPC;
 - (b) Have minimum of six (6) years' experience in civil/ traffic engineering, of which a minimum of three (3) years' experience in TIA; and
 - (c) Have attended a formal training course in Traffic Study/TIA e.g.: Course on TIA, Traffic Study, Trip Generation Manual, Traffic Engineering Software and others that are organised by the Board of Engineer Malaysia (BEM), Public Works Department Malaysia (JKR), or other approved by BEM/JKR such as the HPD KKR, Malaysian Highway Authority (LLM), Institute of Engineers Malaysia (IEM), Institute of Higher Learning, Malaysia and Road Engineering Association Malaysia (REAM).
- iii. The Consultant Firm must be registered with the Ministry of Finance (MOF) under the Traffic Study (Kajian Trafik) Code 340202 or the Transport Network Study (Kajian Rangkaian Pengangkutan) Code 340201 whichever is applicable or whatever relevant to traffic engineering as required by MOF.

6.0 Deliverables by The Consultant to Jabatan Bekalan Air (JBA)

- i. The deliverables of the TIA Study by the Consultant and how they are to be managed are as follows:

a) Final TIA Report

Final deliverables produced by the Traffic Engineering Consultant and to be submitted to JBA at the end of the study period. Contents of this report shall be in compliance with Chapter 12 of the ATJ 38/2018 Guidelines for Traffic Impact Assessment.

Submission shall be five (5) hardcopies and two (2) softcopies (including traffic model/simulation) to JBA, unless requested otherwise.

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All reports submitted shall be duly signed by the Consultant and shall bear the professional stamp and company seal.

The Consultant shall table the TIA Report to the JBA in accordance with the latest ATJ 3/2011-Garis Panduan Untuk Memproses Permohonan Pembangunan Tepi Jalan Persekutuan.

7.0 Methodology and Output of TIA Study

The TIA study methodology and expected output resulting from the proposed mitigation measures shall comply with the requirements of the latest Highway Capacity Manual Malaysia and Arahan Teknik Jalan (ATJ) JKR, or relevant international guidelines approved by JBA (Refer **Attachment B**).

8.0 Analysis

Based on the roads and interchanges analysis software such as SIDRA or its equivalent, the Consultant shall develop, validate and calibrate existing roads and intersections for the study.

The Consultant shall carry out traffic simulation of existing condition, upon completion and ten (10) years after completion by using simulation software such as Dynasim, PTV Vissim or its equivalent as approved by JBA.

The cost of purchasing all software shall be borne by the Consultant. All databases and models developed and utilized in the Study shall be handed over to the Government at the end of the Study.

9.0 Findings

In consultation with the relevant government authorities and in accordance with the latest Arahan Teknik (Jalan), JKR Malaysia, the Consultant shall recommend the number of lanes required, the layout of intersections, U-turns, and the time phasing for existing, or if necessary, propose traffic light and the optimum mitigation to cater for the future traffic demand where the exact locations of the proposed intersections are to be identified based on their connections to the existing road network at appropriate distances from each other, in accordance to the projected traffic, function and hierarchy of the proposed roads and bridges.

10.0 Validity Period of TIA study

If the time lapse between the dates of a TIA study undertaken and its submission is more than two (2) years, the TIA must be updated to reflect the current traffic conditions of the locality. Notwithstanding the abovementioned time lapse, the Approving Authority may ask for an updated TIA as deemed necessary.

11.0 Approval Process and The Consultant Responsibility

Notwithstanding the validity period of the TIA study as per Clause 11 of the TOR, the Consultant is still responsible in discharging his duty and obligations until approval of the TIA Final Report is obtained from the Approving Authority.

12.0 Government Indemnity

The Consultant shall take all necessary measures and be responsible for any damages to life and property that may arise out of their works and shall take all necessary insurance cover to indemnify the Government from any claims for compensation that may occur due to their negligence.

13.0 Ownership of Documents & Data

On completion of the Study, the Consultant shall hand over to JBA all relevant data collected and other related documents prepared and such materials in softcopies and hardcopies shall become the property of JBA.

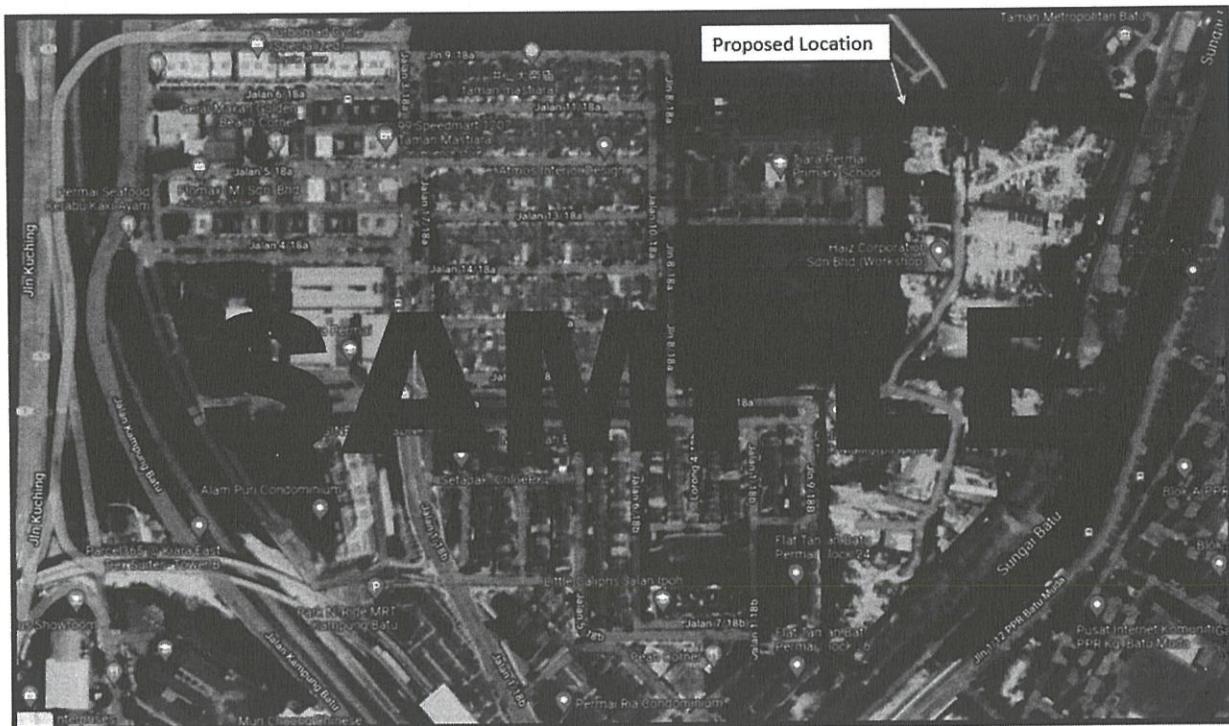
All traffic data collected and models (including traffic simulation) developed during the course of the Study shall be handed to JBA and become its property.

Attachment A

PROPOSED PROJECT LOCATION

The project site is located beside **Name of Road in District/State**

Figure 1: Proposed Project Location



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Attachment B

1. Highway Capacity Manual Malaysia 2006
2. Highway Capacity Manual Malaysia 2011
3. ATJ 38/2018 - Guidelines for Traffic Impact Assessment
4. ATJ 8/86 (Pindaan 2015) - A Guide on Geometric Design of Roads
5. ATJ 11/87 (Pindaan 2017) - A Guide to The Design of At-Grade Intersections
6. ATJ 12/87 - A Guide to The Design of Interchanges
7. ATJ 13/87 (Pindaan 2017) - A Guide to The Design of Traffic Signal
8. Latest Road Traffic Volume Malaysia (RTVM)

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