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17 WORKS AREAS

17.1 General

- 17.1.1 The location and extent of the Works areas is shown in the Authority's Drawings. The Engineer reserves the right to adjust the boundary of these Works areas to suit site conditions and to accommodate other contractor's needs. No claims by the Contractor in respect of cost and time arising out of such adjustments in these areas shall be entertained.
- 17.1.2 Upon award of the Contract, the Contractor shall submit a plan to the Engineer for acceptance on how he intends to make use of the Works areas, giving the details of the facilities he intends to set up on each site.
- 17.1.3 The Contractor shall take note that the Works areas shown in the Drawings are indicative only and meant to assist in tender preparation. The actual extent of such areas and the layout of the Contractor's facilities shall be agreed and confirmed with the Engineer through a site survey conducted by the Contractor before taking possession of the Site. The Contractor shall note that the Area B, Area C and Area D shown in the Drawings are indicative only and the actual areas and boundaries are subjected to coordination and approval from relevant agencies/stakeholders. The Contractor shall comply with all requirements from relevant authority and the landowner at no additional time or cost to the Authority. In the event that the Contractor requires additional works area, the Contractor shall be responsible to secure all necessary approvals for access and occupational licenses from the landowner at his own time and cost.
- 17.1.4 The Contractor shall submit a detailed setting out plan of the Works areas, including site access(s), to the Engineer, relevant authorities and land owners for approval. Where required, such plans are to be endorsed by a Registered Surveyor.
- 17.1.5 The Contractor shall be responsible for forming the Works areas, constructing all temporary access roads, temporary services, temporary drainage and maintenance of the Works areas. All temporary works including piles, sheet piles and ground anchors used in the construction of the temporary facilities or Permanent Works shall be removed before Substantial Completion of the whole of the Works, unless otherwise accepted by the Engineer.

- 17.1.6 The use of ground anchors shall be avoided as far as possible unless otherwise accepted by the Engineer. Notwithstanding this, the Contractor shall seek the permission of and satisfy all requirements of the owner of the land affected by any ground anchors or other temporary works that encroach beyond the Works area boundary.
- 17.1.7 Where the Works area is not served by an access road, the Contractor is required to construct one. The surface of access roads shall be of rigid pavement. The Contractor shall survey the site and propose the alignment for the Engineer's acceptance prior to constructing them. Complete details of access roads and the integration with existing roads or temporary traffic management system including traffic schemes endorsed by appropriate Qualified Person shall be submitted to the relevant authorities for the approval prior to commencing the Works.
- 17.1.8 Where the Contractor provides a site access, he shall be responsible for all necessary protection to existing drainage systems complying with all necessary landowner and Authority / agencies' conditions and requirements.
- 17.1.9 The Contractor shall allow for all necessary precautions and or difficulties that may arise in the execution of the Contract relating to access to the site and the existing site conditions. No claims or whatsoever arising out of site constraints or conditions, shall be entertained by the Authority.
- 17.1.10 The Contractor shall allow for the payment of Temporary Occupation License (TOL) for the land occupied by the works areas in his Contract Price and shall be responsible for making the necessary payments, where applicable.
- 17.1.11 The Contractor shall comply with the minimum extent of noise barrier at the Works area, refer to **Clause 13** and **Clause 23** of the Particular Specification.

17.2 Work Site Area (WSA)

- 17.2.1 The Contractor shall construct and maintain the Worksite, WSA comprising Authority's office and storage areas, at worksite Area D as shown in Authority's Drawings. The Contractor shall coordinate and obtain all necessary approval from relevant agencies for the Worksite. Contractor shall pay all TOL fees and charges levied by the relevant authorities for the entire duration of occupation of the entire worksite Area D as defined in the Authority Drawing. The Contractor shall note that the proposed site office/worksite at Area D is currently occupied by Corona Nursery until 31 Mar 2024.

- 17.2.2 The Contractor shall carry out the necessary site clearance, demolition works, utility detection and diversion works, earthworks, tree felling/transplanting, etc for the construction and completion of site office and storage areas at Area D.
- 17.2.3 The Contractor shall refer to **Clause 5** of the Particular Specification for details on the Authority's Office.
- 17.2.4 The Contractor shall submit and secure planning and other necessary approval from relevant authorities for the site office area upon the termination of the lease by Corona Nursery. The requirements to be provided by Contractor for WSA are given below and shall be completed and ready for occupation by the Key dates as given in **Appendix B** of the Particular Specification. These shall include but not limited to the following:
- (a) All access roads shall be provided with concrete pavement with pedestrian walkway;
 - (b) Perimeter hoarding with gates for the entire WSA with signs warning the public of danger and to keep away. Fencing with gates for Authority's office. The Contractor shall also provide perimeter drains for the whole area. Maintenance is to be done for the perimeter hoarding, fencing, gates and drains.
 - (c) Temporary drainage system shall be designed and implemented by QECP in accordance with the relevant authorities' requirements for the WSA;
 - (d) Wash bay, manpower and equipment to clean all vehicles leaving the site, including provisions to hold and treat the wastewater to an acceptable condition for discharge into public drains;
 - (e) Perimeter lighting, access road lighting and general lighting of adequate level (minimum hundred (100) lux) to support the operations at the WSA
 - (f) The Contractor shall provide access, security control and housekeeping.
- 17.2.5 The Contractor shall terminate, dismantle and remove all temporary services/utilities/drainage and reinstate the Site (refer to final reinstatement **Clause 12.20** of the Particular Specification).

- 17.2.6 The Contract Price shall be deemed to have included all costs associated with the above plus running costs such as electricity, water, telephones, provision of full time security and etc, unless otherwise specified.

17.3 Location and Access to Site

- 17.3.1 The overall layout plan of the Works is shown on the Authority's Drawings.
- 17.3.2 The Contractor shall be deemed to have acquainted himself with the actual site conditions and allowed for any contingency with regard to the means of access and any site restrictions including making good all works affected, disturbed or damaged to match the existing.
- 17.3.3 Access taken from private properties and adjacent developments shall not be permitted without the approval from the private properties owners, other relevant authorities and the Engineer. The Contractor shall be responsible for seeking such approvals if he wishes to secure such accesses and shall comply with all conditions and requirements including all necessary protection to existing drainage facilities, landscaping, services etc. as may be imposed.
- 17.3.4 The Contractor shall ensure that all approved accesses do not impose any constraints and hazards to existing establishment or to works by other contractors.
- 17.3.5 In cases where the Contractor requires more land outside his Contract Boundary to carry out construction, the Contractor shall liaise with the owners of the properties for the temporary use of the land. He shall be deemed to have included this in his Contract for additional time taken, potential delays and additional cost incurred arising from such arrangement.
- 17.3.6 The temporary access to the site shown on the Authority's Drawings is indicative. The Contractor shall design and construct the access road to suit his requirements.
- 17.3.7 The Contractor shall consult and seek approval from the relevant authorities before commencement of work. On Completion of the Whole of the Works (CWW), he shall remove all temporary provisions for reinstatement subject to the acceptance of the Engineer and handover to the relevant authorities/agencies.

- 17.3.8 The Contractor shall maintain all the existing road accesses. The Contractor shall consult and seek approval from the relevant authorities / agencies and stakeholders on any road diversion and shall remove all temporary provisions for reinstatement subject to the acceptance of the Engineer and handover to the relevant authorities / agencies upon completion of his works.

17.4 Photographs

- 17.4.1 Detailed photographic records, a survey and inventory of the existing conditions of the Works areas shall be prepared prior to the commencement of Works and submitted to the Engineer for acceptance. This shall include but not limited to photographic record of all existing landscape, street furniture, facilities and fixings affected by the Works and as-built survey drawings of existing roads including road furniture, road kerb, roadside drain alignment, traffic signs, traffic lane marking, etc. Where requested, the Contractor shall also provide a copy of photographs documenting the existing conditions to the landowner or any other relevant authority or stakeholders.

17.5 Site Conditions, Restrictions and Access by Others

- 17.5.1 The Contractor is advised that there may be other contractors of the Authority, Government/Statutory Bodies and utility agencies working in the same Works areas. The Contractor is responsible for restricting his workers from entering the site(s) of other contractors in and around the vicinity of the Works areas and taking all necessary precautions to prevent any trespassing and damage arising from nuisance of any kind. Warning lights and signs are to be installed as required. The Contractor shall ensure that there is no interference with the works carried out by others.
- 17.5.2 The Contractor shall confine the work activities including storage of construction materials, movement and packing of equipment, machinery and plants within the allocated Works areas.
- 17.5.3 The Contractor shall control his workforce and those of his sub-contractors to ensure that his workers do not loiter in public areas or facilities and do not disturb the public.
- 17.5.4 In the event of complaints relating to the Contractor's workforce using public areas or leaving rubbish in public areas, the Contractor shall provide cleaning, pest control, patrols to ensure workers are not loitering, and any other measures required by the Engineer. All associated costs shall be deemed included in the Contract Price.

- 17.5.5 The Contractor shall make suitable provisions for and shall control vehicles that provide transport to the workforce and/or all other vehicles to the Works areas so that roads are not blocked and there is no inconvenience to the public.
- 17.5.6 The Contractor shall coordinate with Interfacing Contractors and Utilities Agencies and their contractors / sub-contractors for their works and worksite requirements within the Contractor's Works areas. The Contractor shall submit the coordinated site utilization plan including such access dates and durations to the Engineer for acceptance. The Contractor shall therefore plan his site utilization to minimize any impact that may be caused by such interfacing and sharing of worksite. All cost and time required for these are deemed to be included in the Contract.
- 17.5.7 The Contractor shall note the pedestrian flow on site and make his own arrangements, subject to the acceptance of the Engineer, for provision of all necessary temporary footpaths, crossings, covered linkways, lighting, and other protection measures, etc throughout the course of his Works.

17.6 Contractor's Working Areas

- 17.6.1 The Authority has pre-consulted with landowners to use the areas shown on the Authority's Drawings for the Contractor's site office and working space. The Contractor shall note that the areas shown in the drawings are indicative only, and is subjected to actual site adjustment and availability at time of application by the Contractor. Any changes to the TOL rate shall be deemed included in the Contract Price.
- 17.6.2 The Contractor shall note that the use of land area in worksite Area A as shown in the Authority's Drawings would only be made accessible from 1 March 2024 onwards. The Contractor shall make allowance for the works interfacing with CR2016 in his programme to possess part of or the whole of Area A from 1 March 2024 onwards, subject to interfacing with CR2016 and the Engineer's acceptance. The Contractor shall make necessary provisions, coordination, attendances and others as required in **Clause 7**.
- 17.6.3 The Contractor shall note that the use of land area in worksite Area C as shown in the Authority's Drawings would only be made accessible from 15 June 2026 onwards. The Contractor shall make allowance for the works at Entrance 2, interfacing with SIM in his programme and make necessary provisions, coordination, attendances and others as required in **Clause 7**.

- 17.6.4 Any in-principle approval secured by the Authority is subject to the terms and conditions stipulated by SLA and other relevant authorities. The Contractor shall liaise directly with the landowner, and relevant authorities, such as but not limited to SLA, HDB and NParks, for his TOL application and the applicable TOL rates, terms and conditions. The Contractor shall ensure that the requirements are strictly complied with. Any non-compliance may result in the approval being revoked.
- 17.6.5 The Contractor can source for his own land space and pay all costs, rents or charges in connection with the usage of the land during the period of construction of the Works, including any period of time extension. The location of any such land proposed by the Contractor shall be subject to acceptance by the Engineer.
- 17.6.6 Any storage areas used by the Contractor shall be paved with concrete. Notwithstanding any other provisions for hoardings and barriers, the Contractor shall erect a metal hoarding of minimum 2.4 metres height throughout the perimeter of the storage area. The access provided for the storage area shall be properly paved with concrete and maintained throughout the Contract Period.
- 17.6.7 The Contract Boundary may include additional area for working space and additional area for road diversion. These areas shall not be used to locate site office, batching yards, casting yards, storage areas or for any purpose other than for the direct construction of the Works. The Contractor shall liaise with the relevant authorities should he require usage of the land other than for the direct works and shall pay the required TOL and related fees to the relevant authorities.
- 17.7 Removal of Temporary Works and Facilities**
- 17.7.1 Within three (3) months from the date as stated in the Certificate for CWW, the Contractor shall remove from the Works areas workshops, storage sheds, temporary piles, temporary foundations, temporary sewer pipes and other utilities and all other temporary structures and reinstate the site to its existing conditions to the acceptance of the Engineer. The Contractor shall maintain all reinstated areas until they are handed over to the landowner or relevant authority or stakeholder. The Contractor shall attend to any defects to his reinstatement works during the Defects Liability Period.
- 17.7.2 Reinstatement means replacement to match the original condition unless otherwise stated and may extend beyond the Contract Boundary affected by the Contractor's works. The Contractor shall reinstate the Works area to the satisfaction of the landowner and relevant authorities.

- 17.7.3 The Contractor shall also rectify, to the acceptance of the Engineer, any defect caused by him during the course of the Works. All costs incurred shall be borne by the Contractor.

17.8 Work Site Access Control

- 17.8.1 The Contractor shall provide work site access control to ensure that only properly identified and authorised persons (including personnel from Interfacing Contractors) in proper personal protective equipment are granted access into the work site. To facilitate effective work site access control, the Contractor shall provide perimeter hoarding around the work site, access and exit gates with provisions for the Biometric System for employee identification.
- 17.8.2 The Contractor shall provide the biometric system at gates as required in **Clause 13** and **Clause 27** of the Particular Specification.
- 17.8.3 The Contractor shall provide Radio Frequency Identification (RFID) Tracking System as specified in **Appendix A** of the General Specification.
- 17.8.4 The Contractor shall provide all personnel with distinctive badges showing the employee's name, contact number and his role. Employees new to this Contract (less than three (3) months or other timeframe the Engineer may instruct) shall be identified with his supervisor/buddy's name and contact number. Each employee shall display his badge in a prominent manner while on the Site. The Contractor shall establish a system of badge control acceptable to the Engineer.
- 17.8.5 The Contractor shall erect access and exit gates with height limit gantry and security drop-bar to regulate incoming and outgoing vehicles. The vehicles authorized to enter and park within the worksite shall be identified, for example with a decal. The entry and exit points shall be controlled and managed by guards during working and non-working hours. The entire site including the gates shall be well lit with floodlights during hours of darkness (7.00pm to 7.00am).
- 17.8.6 The Contractor shall erect robust and lockable full height fencing at its contract/site boundaries. All ingress/egress points shall be manned by qualified guard(s). The Contractor shall submit Site Security Plan for the various stages of work, reviewed every quarterly, and subject to the Engineer's acceptance.

17.9 Project Signboards and Hoardings

- 17.9.1 The Contractor shall design, supply, erect and maintain a Project signboard at each major Works area to the acceptance of the Engineer. The Contractor shall provide and erect a minimum of two (2) large free standing Project signboards including steel columns, foundations and plaque with LTA logo.
- 17.9.2 The costs of relocating the Project signboards affected by the Works shall be borne by the Contractor. Each signboard shall be removed shortly before the Contractor surrenders the worksite to relevant authorities, agencies or parties.
- 17.9.3 The Project signboards shall be in accordance with the details and requirements given in Standard Details of Road Elements (SDRE). The Contractor shall erect the project signboards at locations as accepted by the Engineer, within two (2) months from the Contract commencement date, or such period as the Engineer may otherwise accept. The Contractor shall maintain the signboards for the duration of the Contract.
- 17.9.4 The Contractor shall provide, erect and maintain in good condition throughout the duration of the Contract new temporary hoardings for the entire worksite. These hoardings shall include, but not limited to gates, access doors and fastenings and shall meet the requirements of the Engineer and the relevant authorities.
- 17.9.5 Notwithstanding any requirements indicated in the Authority's Drawings, the Contractor shall design, construct and maintain hoardings in accordance with the Authority's standard details in **Appendix Q** of the Particular Specification.
- 17.9.6 The Contractor shall provide and maintain greening to the hoardings. The type of greening is indicated in **Appendix AY** of the Particular Specification. The Contractor may be required to engage the community to design artwork to be printed on the hoarding. The Contractor shall submit his hoarding proposals to the Engineer for acceptance.
- 17.9.7 The Contractor shall remove hoardings on CWW, and as required by his construction phasing and methodology, unless otherwise stated or instructed by the Engineer. If required, the Contractor shall hand over the hoardings to the Authority or third party; in such instances the Contractor shall provide all relevant as-built information, and QP endorsements as required.

- 17.9.8 Any public access ways that are affected by the hoarding layout shall be provided with an alternative route which allows for seamless connection. The temporary accessways, including staircases, shall be of sufficient width to permit two-directional passage and shall be of minimum 2.4 metres headroom.
- 17.9.9 Notwithstanding requirements to the contrary, the hoarding panel shall be green in colour or as approved by the Engineer, flat panel type with minimum height of 2.4 metres. The Contractor shall propose and install, where necessary, design/graphics on the hoarding for directions/stakeholders' request to the Engineer's acceptance. The Contractor shall install graphic panels supplied by the Authority. The fixings on the hoarding shall be neatly concealed. The minimum thickness of hoarding shall be 0.6 millimetres with nominal width of 300 millimetres. The hoarding panel shall be fixed to a structural framework spaced at appropriate distances designed by a Professional Engineer.
- 17.9.10 The Contractor shall note that the Authority's term contractor may provide Visual Identity (VI) panels on the completed hoardings. The Contractor shall coordinate with the term contractor to make space provision for the VI panels and maintain and upkeep the installed VI panels until Substantial Completion of the whole of the Works. All replacement of damaged VI panels will be carried out by the term contractor at the Contractor's cost. The Contractor shall install and maintain the Authority's visual identity panels on the hoardings, and shall relocate and re-install them whenever the hoarding are shifted or replaced. The VI panels shall be installed at locations, spacings and levels decided by the Engineer, and the Contractor shall obtain the Engineer's agreement before installing the panels.
- 17.9.11 The Contractor shall also ensure that warning notices / signboards are put up to advise and warn the public on safety issues.
- 17.9.12 The Contractor shall provide sufficient signs on the hoarding to indicate directions to lead to the amenities obscured by the hoarding.
- 17.9.13 The Contractor is to design and provide hoarding with temporary roof shelter along pedestrian walkway where his Works or worksite has impacted existing sheltered walkway and is subjected to Engineer's approval.
- 17.9.14 The Contractor shall provide sufficient lighting at the perimeter of the hoardings where there is a footpath for the public or at other locations where directed to do so by the Engineer.

17.9.15 Half-height hoarding (with clear acrylic on the upper part) shall be installed at the corner of road junctions or any location deemed necessary to improve sight distance of vehicles for better road and pedestrian safety, to the acceptance of the Engineer.

17.9.16 All hoardings and signboards erected by the Contractor must be maintained in good condition. The Contractor shall repair the hoardings and/or signboards whenever necessary or as directed by Engineer. All sharp edges shall be permanently smoothed or concealed; taping is not permitted.

17.10 Water, Temporary Lighting and Power

17.10.1 The Contractor shall provide and maintain a temporary water supply and distribution system sufficient for the execution of the Works (including the works to be executed by System-Wide Contractors, Interfacing Contractors, sub-contractors, suppliers, and any other party to whom the Contractor is responsible for providing attendance). The temporary water supply installation shall comply with the requirements of the Public Utilities Board (PUB). The Contractor shall alter, adapt, maintain the temporary water supply as necessary, remove the installation upon completion of the Works, and reinstate all works disturbed to the satisfaction of the Engineer and PUB.

17.10.2 The Contractor shall provide all necessary temporary lighting and electrical power required for the Works including that for System-Wide Contractors, Interfacing Contractors, sub-contractors, suppliers and any other party to whom the Contractor is responsible for providing attendance. The Contractor shall alter, adapt, maintain the temporary lighting and electrical power provision as necessary, and clear away all temporary lighting on completion. The Contractor shall refer to **Clause 7** on interfacing requirement with other parties, including but not limited to on utilities billing.

17.10.3 All such supplies of 60A and less shall incorporate a current-operated Earth Leakage Circuit Breaker (ELCB) with direct tripping sensitivity of 20/30mA and tripping time within 0.1 second.

17.11 Provision of Bulk Bins and Dumping of Debris and Waste

17.11.1 The Contractor shall not dump construction debris, rubbish and waste at the site, vacant plot of land, roadside or drains.

17.11.2 All rubbish, construction debris and waste arising from the Contractor's occupation of the Site or Works must be collected, stored and removed off the site daily.

- 17.11.3 The Contractor shall provide suitable bulk bins for construction debris. For storage of all inorganic waste such as building debris, dust, litter, timber etc, the bulk bins shall be of size not less than one cubic metre each. Separate bins with tight lid covers shall be provided for the storage of organic waste and each bin shall be of capacity not less than 85 litres.

17.12 Worker's Rest Areas

- 17.12.1 The Contractor's and his sub-contractor's workers shall not rest at public places. As such, the Contractor shall provide at least 2 (two) dedicated and adequately sized worker's rest areas at or above ground level within the Site.
- 17.12.2 The locations of the workers rest areas shall be as far away from commercial, residential, and public areas as practicable. The proposed locations and layouts shall be submitted to the Engineer for acceptance. The workers rest areas shall be fully hoarded up, kept clean, well ventilated and lit, with adjoining toilets, and shall be arranged and equipped such as to cause no nuisance to the public and local residents. Fire-fighting equipment shall be provided and maintained. A designated smoking area shall be provided and no smoking at all other areas shall strictly enforced. The Contractor shall also provide sufficient water points, temporary lighting, temporary fans, tables and benches at the worker's rest area.
- 17.12.3 The worker's rest areas are for use during break times only. Upon completion of a day's work, workers are to be transported to their place of residence off-site. Workers are not to be housed at rest areas.

17.13 Closed Circuit Television (CCTV) Monitoring System

- 17.13.1 The Contractor shall note the requirements for remote monitoring stated in **Clause 44** of **Appendix A** of the General Specification.
- 17.13.2 The Contractor shall supply, install, operate and maintain a CCTV system with High Definition (HD) Digital Internet Protocol (IP) CCTV cameras with pan/tilt/zoom (PTZ) and speaker functions, including all necessary ancillary and expandable equipment for the monitoring of traffic and work situation at the Site(s). The Contractor shall also supply, install, operate and maintain other types of HD Digital IP CCTV cameras but not limited to 360-degrees views and long range functions to suit site conditions and monitoring requirements subject to the Engineer's acceptance. The CCTV system shall be capable of being controlled by the Video Management System with microphone located at the Remote Monitoring System Control Centre in the Authority's office.

- 17.13.3 In addition to locations mentioned in **Clause 17.13.2**, The Contractor shall propose and provide CCTV coverage and monitoring for footpaths, linkways and walkways impacted by his works and within the whole Site(s). The Contractor shall submit his CCTV proposals to the Engineer for acceptance.
- 17.13.4 The HD Digital IP cameras and Video Management System shall conform to Profile S specifications of ONVIF (Open Network Video Interface Forum) requirements for inter-operability between IP-based devices. The Contractor shall also provide System Development Kit (SDK) to allow connection and interfacing of the cameras with third party systems. The Contractor shall coordinate with, and shall agree with such external agencies as may be required by the Engineer on the interfacing designs and the scope of provisions of the SDK by the Contractor.
- 17.13.5 The CCTV system shall be erected on visible poles/structures at strategic locations to provide full surveillance coverage of the ongoing works within the whole Site(s). The Contractor shall shift and relocate the HD Digital IP cameras including all necessary ancillary and expandable equipment in accordance with the site utilization plans and traffic diversion plans. The Contractor shall provide up-to-date coverage of the concerned areas and any hardware, software, upgrades and changes required to relocate the CCTV cameras shall be provided at the Contractor's own cost. The Contractor shall propose the locations of cameras to monitor the entire worksite area including all ground level and underground areas for acceptance by the Engineer.
- 17.13.6 Notwithstanding the HD Digital IP cameras provisions required under **Clause 17** of the Particular Specification, the Contractor shall also supply, install, operate and maintain:
- (a) HD Digital IP cameras at all designated ingress and egress of each work zones are required to support facial recognition function as set out in **Clause 22.4** and **Appendix AW** of the Particular Specification to allow bi-directional tracking of the movement of workers. The cameras shall be able to be mobilised with shifting of work zones;
 - (b) HD Digital IP cameras at all construction vehicular accesses are required to support pedestrian intrusion detection function as set out in **Clause 22.4** and **Appendix AW** of the Particular

Specification. The cameras at shall be able to detection pedestrian intrusion into construction access; and

- (c) HD Digital IP cameras at strategic locations to support other anomalies detection as set out in **Clause 22.4** and **Appendix AW** of the Particular Specification.

- 17.13.7 The HD Digital IP cameras shall be equipped with at least 2 megapixels, weatherproof to IP 67 standard and capable of operating in a range of lighting conditions from 100K lux to 1 lux or low light conditions. The Contractor shall maintain the CCTV system to ensure continuous operation of the CCTV system without interruption including provision of stand-alone power supply system if required on Site(s). The Contractor should visit the Site(s) within one (1) working day upon receiving the notification of the CCTV system failure. The Contractor shall provide a bypass solution (interim measure) or rectify the CCTV system within three (3) working days.
- 17.13.8 The CCTV system shall also make provision for the Engineer to have live video streaming of CCTV videos and/or images and controlling of CCTV cameras via local private network or LTA office network to be determined by the Authority's representatives in compliance to the IT Connectivity Requirements minimally to the standard of 802.11 IEEE. It shall also use the Advanced Encryption Standard-Counter Mode with Cipher Block Chaining Message Authentication Code Protocol that is minimally 256-bit AES CCMP encryption from the Remote Monitoring System Control Centre at the Authority's Office to monitor the activities on Site(s).
- 17.13.9 The CCTV system shall facilitate viewing of live and recorded videos and/or images from the Windows-based personal computer(s) provided by the Contractor. The personal computer(s) shall be hardened in accordance to center of internet standard 2 and always having the latest patches and anti-virus signature updated and equipped with a digital PTZ keyboard to allow the Engineer to switch between the live and recorded images seamlessly for different worksites. Access to viewing and controlling of all cameras shall be via individual standard web browser and/or wireless network by the authorized users. If such wireless connections are not available or deemed unfit for installation, the Contractor shall provide separate localize network to support the CCTV system and Video Management System. The Contractor shall access the CCTV system only from the Remote Monitoring System Control Centre at the Authority's Office.

- 17.13.10 The Contractor shall ensure that the bandwidth of the communication link is sufficient to cater for the video channels between the Site(s), offices, and the Authority's site office, project office and head office. The system shall be equipped with platforms that support video sharing and allow these to be streamed to the Authority's offices, including the head office at 1 Hampshire Road. The Contractor shall pay all fees associated with the setup of the local private network or extending using the Authority's office network. The Contractor shall also pay for all the recurrent charges until the Completion of the whole of the Works. The Contractor shall not in any circumstances terminate CCTV system supply without the approval of the Engineer and relevant authorities.

- 17.13.11 The Contractor shall propose, design, size, develop and configure Video Management System with microphone function located at the Remote Monitoring System Control Centre to view and record all CCTV videos and/or images. All necessary hardware, middleware, software and network equipment shall be designed, supplied, delivered, installed and developed for the system.

- 17.13.12 The Video Management System shall allow the user to simultaneously view and record H.265 video streams from cameras continuously for 24 hours. The H.265 video streams captured shall be stored centrally within the Video Management System's archive storage space at a minimum stream capture resolution of 4 Common Interface Format (CIFs) 1920 x 1080 pixels at 30 frames per second (FPS). The Contractor shall ensure that the capacity of the Video Management System's archive storage space is sufficient to correspond with the HD Digital IP cameras installed on Site(s) for one (1) month storage retention period.

- 17.13.13 Standard-based video compression techniques shall comply with specifications as stated in ISO/IEC 14496 and shall be deployed to achieve optimal compression ratios while ensuring no or little loss of image/video quality. The video container format proposed for the images recorded in the Video Management System shall be limited to open-source container formats and/or common multi-media container formats such as *.avi, *.mov and *.mp4. It shall be possible to playback the Video Management System recordings directly from the Windows-based personal computer using commonly available PC media player applications (e.g. windows media player, VLC player) without conversion or export, etc.

- 17.13.14 The Video Management System shall allow the user to view the recorded video streams with details not limited to the following:

- (a) Date of video stream capture;
 - (b) Time of video stream capture;
 - (c) Camera ID; and
 - (d) Local Name.
- 17.13.15 The Contractor shall provide facilities in the System for archiving/exporting any stored video streams into external storage devices as back-up, e.g. portable hard disk, thumb drive, etc. All recordings are the property of the Authority and no copy, distribution and use of the footages and recording by the Contractor is allowed without the written consent of the Authority and or the Engineer.
- 17.13.16 The Contractor shall ensure that the CCTV system with HD Digital IP cameras are suitably protected against damage, vandalism and adverse climatic condition throughout the Contract period. The Contractor shall carry out preventive and reactive maintenance servicing on a regular basis. All HD Digital IP cameras put up by the Contractor must be maintained in good condition. Any damaged HD Digital IP cameras shall be replaced where necessary or as directed by the Engineer. The costs shall be deemed included in the Contract Price.
- 17.13.17 Remote Monitoring System Control Centre
- 17.13.17.1 The Contractor shall setup a Remote Monitoring System Control Centre at the Authority's Office according to the requirements stipulated under **Clause 5** of the Particular Specification and to serve as the base for central CCTV system control and monitoring of all construction activities, including the soil loading and disposal works, traffic conditions, all ingress and egress of the worksite and the worksite.
- 17.13.17.2 The Contractor shall provide a Video Management System with microphone dedicated solely for CCTV system monitoring under this Contract where all CCTV videos and images will be stored and reviewed. The Contractor shall provide at least two (2) Windows-based desktop

Personal Computers (PC) for the Engineer to monitor all construction activities. All PCs shall meet the following minimum requirements:

- (a) 27" LED monitor;
- (b) The most up-to-date Generation Intel processor;
- (c) 16 GB RAM;
- (d) hard disk storage able to store 30 days' worth of CCTV footage;
- (e) At least two (2) USB 3 ports accessible at the front of the PCs;
- (f) At least four (4) HDMI ports to support display of 1920 by 1080 resolution; and
- (g) The most up-to-date windows operating system that is compatible with the Video Management System.

- 17.13.17.3 The Contractor shall also supply and install minimum one (1) set of 85" FHD TV screen for the Windows-based desktop PC in Remote Control Centre to display the live video streaming of CCTV images from all HD Digital IP cameras.
- 17.13.17.4 All hardware supplied shall be of new manufacture (i.e. not second hand, reconditioned or used items). Any software/firmware provided shall be the original legal copy and virus free. The Contractor shall indemnify the Authority against all claims of infringement of copyright, patents, etc.
- 17.13.17.5 The Contractor shall provide and install the latest anti-virus and latest Microsoft Office software on all PCs provided under the Contract and shall ensure that the anti-virus software is updated regularly as recommended by the software vendor. During the Contract period, any licensing cost for the use of the software supplied shall be borne by the Contractor.
- 17.13.17.6 The Contractor shall be responsible for the maintenance of the PCs and all computer hardware and software supplied. For the software, this shall include all upgrades and enhancements by the supplier. The Contractor shall provide new replacement PCs and software installation if they are not functioning properly, subject to the Engineer's acceptance.