

Denmark Light Industrial Area – Fire Protection System

Fire Protection Specification

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Revision

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Signature: _____

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PART A. Preliminaries

Refer to Head Contract for Preliminaries.

PART B. Project Specific Information

B.1 Project Outline

B.1.1 General

The Denmark Light Industrial Area – Fire Protection System project comprises the provision of a shared fire hydrant system infrastructure at the subdivided land at East River Road, Denmark.

This specification outlines the scope of the Fire Services installation and identifies the associated Technical Requirements. This specification must be read in conjunction with the nominated Reference Documents and Drawings.

B.1.2 Reference Documents

The following reference documents form part of this specification:

- Civil Drawings
- Structural Drawings
- Services Drawings
- Fire Engineering Brief / Report

The Fire Services work must be in accordance with this specification and drawings the whole of which must be deemed to constitute one document. Any major discrepancies between the contents these documents must be brought to the immediate attention of the Superintendent during the tender period.

No additional costs must be allowed for works specified in the reference documents.

B.1.3 Drawings

The following drawings must form part of this Specification and must be read in conjunction herewith.

Stantec Project No.	Drawing No.	Drawing Name
301250343	FP-000-00	Cover Sheet
301250343	FP-000-01	Notes and Legend
301250343	FP-100-00	Site Plan

The above drawing(s) and this Specification must be considered as co-operative and any work omitted from one but inferred or present in the other must form part of this Contract.

B.2 Project Specific Quality Assurance Items

The Fire Services Contractor must produce and submit to the Superintendent verified records as follows to confirm that the specified requirements have been achieved.

Item	Record	Frequency/Comments
Work Schedule	Work Schedule	One per project, as specified
Shop Drawings	Shop Drawings	As specified
Samples and Equipment Details	Sample/Equipment Details Certificate	As specified

		<p>Separate certificates to be submitted with each sample or equipment detail</p> <p>Use standard certificate from this specification</p>
Progress Claims	Progress claim and progress claim certificate	<p>As specified</p> <p>Separate progress claim certificates for each progress claim</p> <p>Use standard certificate from this specification</p>
Commissioning and Testing	Commissioning and Testing records / plan	As specified
Fire hydrant system	Self Certification	As specified
As Constructed Drawings	As Constructed Drawings	As specified
Practical Completion	Practical Completion Certificate Warranties	<p>One per project at Practical Completion</p> <p>Use standard certificate from this specification</p>
Maintenance and Operating Instructions	Provision of Maintenance and Operating Instructions	As specified
Maintenance	Maintenance log book	As specified
Final Completion	Final completion certificate	<p>One per project, two weeks prior to final completion</p> <p>Use standard certificate from this specification</p>

The Fire Services Contractor must note on the record where any item fails to meet the specified requirements and the planned remedial action to be taken.

If the Fire Services Contractor has accreditation to the relevant AS 3900 series Quality Standard then The Fire Services Contractors Quality Assurance procedures may be used provided that records are submitted covering the above items.

B.3 Fire Services General

Tenderers must complete the attached Tender Form and must provide a Schedule of Rates for the works specified (Refer Appendix A and B).

The Fire Services Contractor must perform the work of this Contract in such a manner as to conform with the general building programme and must provide for working in with other trades and Sub-Contractors under the general direction of the Builder in accordance with the clauses of the Conditions of Contract.

B.4 Scope of Work

B.4.1 General Description of Works

The Denmark Light Industrial Area – Fire Protection System project comprises the provision of of a shared fire hydrant system infrastructure at the subdivided land at East River Road, Denmark, including a fire hydrant ring main supplying each subdivided allotment with a common fire pumps and water storage tanks.

The individual allotments will be sold or leased in the future with a shared agreement between lot titles provided for shared access and shared maintenance costs between lots.

B.4.2 Scope of Work

The scope of works comprises the supply, installation, testing, commissioning, maintenance and defects liability, materials labour and equipment for the complete Fire Protection Services installation for the Denmark Light Industrial Area project at the subdivided land at East River Road, Denmark.

The work must include all necessary minor and incidental work required to implement the intent and meaning of this specification and associated drawings.

B.4.2.1 Fire Hydrant System

- Provision of fire hydrant pumps within housed enclosure and galvanised water storage tanks.
- Fire hydrant underground ring main within road reserve.
- Fire hydrant isolation valves with trafficable pits to each allotment with capped off supply for future extension.
- Provide isolation valve pit numbering system to correspond with Block Plans.
- Provision of fixed flow test installation to allow proving of system flow. Flow test water must discharge to Water Storage tank.
- Provision of monitoring of fire pumps and tank levels by security panel by third party monitoring service to Shire Approval. Signals to include pump run, pump fault and tank low level.
- Piping, pipe fittings, valves, pressure gauges, pipe hangers and support for the entire installation
- Fully hydraulically calculated pipework to be submitted for approval and work sheets as necessary for the production of all pre-fabricated components and for information required by other trades and authorities
- Block Plans at Brigade Booster Cabinet locations and at Fire Pump Enclosure
- Provision of Pressure Gauge schedules per Australian Standard requirements
- Provide a notice detailing the Fire Brigade's testing procedure
- Provision of all chains and locks in relation to isolation valves.
- Interfaces and coordination with other services
- Attendance at site and coordination with the main project program
- Signs required by the Code and Authorities having jurisdiction
- Detailed ("shop") drawings and schedules of equipment, fully depicting the entire installation, for approval prior to purchase or manufacture
- Testing and commissioning plan in consultation with Superintendent and Shire.
- Operations and Maintenance manuals, including As-Constructed documentation
- Submission of all necessary details to Authorities before, during and after construction, to ensure that the system complies with their requirements. Obtain all necessary certificates and payment of all fees
- Arrange inspections by the Department of Fire and Emergency Services and obtain their approval of the installation.
- Testing and commissioning including payment of fees to Witnessing Authorities, the Consulting Engineer, the Superintendent, including provision of materials, etc
- Arrange, manage and report results on Pre-commissioning, commissioning and witness testing of all fire systems under the scope of this Contract.

- Preventative testing and maintenance during the twelve (12) months period following practical completion
- Comprehensive maintenance and warranty of all new and upgrade plant during the construction period and for the defects liability period in accordance with AS 1851

The scope of works is summarised below and set out in more detail in the Specification and on the Tender Drawings.

B.4.3 Incoming Water Supply

The Fire Services Contractor must carry out the following scope of works associated with the provision of new incoming fire service water for the project:

- 1 x 150Ø new connection to the utilities main on East River Road
- The Fire Services Contractor must make application and pay all fees associated with new water connections, and must include the provision of Double Check Valve Assembly on the new incoming fire service supply

B.4.4 Shop Drawings

Provide shop drawings for all fire protection services, for approval prior to construction.

B.4.5 Painting

Paint and rust proof all exposed pipework and equipment.

B.4.6 Testing and Commissioning

Testing and commissioning of all works in accordance with the relevant Australian Standard and the Regulatory Authorities requirements.

B.4.7 Operating and Maintenance Manuals

Provide Operating and Maintenance Manuals as detailed in the Technical section of this Specification

B.4.8 Proprietor Instruction and Operator Training

Provide instructions on system operation to the Proprietor and allow to train the Proprietors nominated representatives in operation of the systems detailed in the Technical section of this Specification

B.4.9 Systems Maintenance

Provide preventative inspection and maintenance services during the Defects Liability Period in accordance with the Testing and Maintenance section of this Specifications and the requirements of AS1851 as relevant to the systems installed.

B.4.10 Authority Approvals and Certification

Provide all certificates required by the interested Authorities and Organisations for all services specified under this contract. These authorities and organisations must include but not be limited to the following: -

- Shire of Denmark
- Building Certifier
- Fire Brigades

All necessary details must be submitted to the Authorities and Organisations, before, during and after construction as required to ensure that the system complies with requirements and the obtaining of all necessary certificates, payment of all fees.

B.4.11 Other items

- Co-ordination of the fire protection services with the Civil, Structure and all other services

- All plant necessary for the execution of the Fire Services Contract other than where permission is granted to use the Builder's scaffolding in position
- Loading/unloading materials and handling to final position
- Demonstration of the fire protection system operation for the Regulatory Authority and the Engineer's satisfaction

B.4.12 Work by Other Trades

The following works and/or materials will be provided by other trades free of charge to the Fire Services Contractor.

Detailed requirements of these associated works must be provided to the respective trades by the Fire Services Contractor in the form of dimensioned drawings, sketches and memorandums.

B.4.12.1 Work Provided by Builder

- Concrete hard stands for fire services panel tanks. The Fire Services Contractor must provide the Panel Tanks
- Concrete plinths under equipment, including fire pump enclosure, 150mm high minimum
- Fire brigade hardstand
- Drainage provisions for fire pumps and tanks
- Excavation, backfilling and making good for all inground pipework
- Concrete thrust blocks, for inground pipework
- Use of hoist to raise equipment
- Security storage and site shed accommodation
- Temporary 240 Volts and 415 Volt power supply
- Toilets and temporary water
- Building of Unistrut pipe supports
- Access platform to fire services equipment located at high level
- Assistance setting out
- Supervision of site co-ordination
- The following signage:
 - Fire Brigade Booster connection signs should be located on the booster connection enclosure door. The signs must read "HYDRANT BOOSTER CONNECTION" in letters minimum 50mm high in contrasting colour to that of the enclosure door

It is recommended that the words be painted white on a black background. Final detail including material and colours to be approved by the Architect

- Supply a set of master keys to the fire brigade for access

*Refer to the Pipework and Fittings section of this Specification for specific requirements in relation to Roll Groove fittings

B.4.12.2 Work Provided by Electrical Services Contractor

- 415 Volt, 50 Hz three phase and neutral electrical supply to the Pump Control Panels. Wiring to be fire rated. Fire Protection Contractor to make all connections. Switches for these circuits must be clearly marked "FIRE PUMP MOTOR SUPPLY - DO NOT SWITCH OFF"

- Technically competent personnel, instruments and materials as required, in liaison and co-ordination with the Fire Services Contractor to facilitate Fire Services installation, testing and commissioning
- Drawings to other trades for co-ordination

B.5 Fire Services Equipment Schedules

B.5.1 Fire Pump Schedule

This schedule must be read in conjunction with the Centrifugal Pumps section of the Specification document.

B.5.1.1 Shared Fire Hydrant Fire Pump

Designation	FP1	FP2	JP
Service	Fire Hydrant System	Fire Hydrant System	Pressure Maintenance
Drive	Diesel	Diesel	Electric
Purpose	Duty	Standby	Pressure Maintenance
No. of	1	1	1
Pumpset	The fire pumps shall be provided with self contained enclosure.		
Location	Adjacent to fire water storage tanks		
Flow Rate	10 L/s	10 L/s	1.5 L/s
Estimated System Duty	1000kPa	1000 kPa	800 kPa
Electric Motor Duty (kW)	-	-	2.2 kW
Electric Motor Type/Speed	-		Vertical multi-stage 24 r/s
Diesel Engine Cooling	Water-cooled	Water-cooled	-

- Allowances must be made to the above pump duties to cater for flow of water to the diesel engine cooling circuit as specified by the engine manufacturer
- Motors/engines must have ample capacity to carry the loads imposed without overloading with maximum impeller fitted at the specified speed and minimum head
- Where two or more pumps of the same duty are required, they must be identical irrespective of prime mover

B.5.2 Pump Suction Tank Schedule

This schedule must be read in conjunction with the Water Storage Tanks section of the Specification document.

Designation	FT1/2
Location	Adjacent to fire pump enclosure
Minimum Required Effective Capacity	144 kL (each)

Material	Galvanised Steel
No. of	2
Approximate Internal Dimensions (each)	7320mm diameter x 4000 mm wall height (per tank)
Construction Type	Circular panel tanks including tank fill valves
Infill Valves	100 mm per tank
Overflow	100 mm per tank
Suction	100 mm each section
Pump Test Return	80 mm (Tank 1)
Drain Connection	50 mm each tank
Vortex Eliminator	Required
Cover	Steel Roof
Ladder	Stainless Steel inside fixed to wall – galvanized externally

B.5.3 Fire Pipe Schedule

The piping systems to be provided under this specification must conform with the following requirements.

Service	Material	Grade Code	Fittings Jointing	Design Pressure	Working Pressure
Fire Hydrant	Galvanised Mild Steel coupling	AS1074 “medium” or Rollgrove	Flanged, Welded	1700 kPa	1200kPa
Diesel Exhaust	Black Mild Steel	AS 1074 “Mild”	Welded	N/A	
Pipes Underground	HDPE PN16	FM	Flange welded or butt fusion	1700 kPa	1200kPa
Pipes Underground	Galvanised steel pipe (risers only)	AS1074 “Heavy”	Flanged Welded or Rollgrove coupling	1700 kPa	1200kPa
Pump/bleeds oil supply, air vents, drains	Copper	AS1432 Type B	Capillary brazed	N/A	

B.5.4 Valves and Fittings Schedule

The following valve list is indicative only of the types of valves required for various functions within the installation.

Valves from the one manufacturer are preferred throughout the project however, equal approved manufacturers may be accepted.

Valve Type	Duty	Manufacturer	Model	Remarks
Sluice	Isolation			<p>Ductile iron</p> <p>Flanged ends</p> <p>Fusion bonded epoxy resin coatings internally and externally</p> <p>Non-rising stem</p> <p>Anticlockwise turn off</p> <p>Hand wheel with flow direction indicators for valves in large pits and stem key spindle cap for valves below box</p>
Butterfly	Isolation	Victaulic	705	Above ground only
Gate	Pump Control	John	Fig 159 Fig 601	<p>Screwed connections up to 50mm dia</p> <p>Flanged or roll grooved connections over 50mm dia</p>
Sluice	Incoming Mains	Tyco	Figure 500	
		Dixon	Sluice Fig 57/50	
Check	Non Return Air Vents	John	Fig 48	Screwed connections up to 50mm dia.
Double Check	Backflow Prevention	Tyco	DC03	Flanged Connections
		Wilkins	Model 350	Flanged
Double Check Detector Assembly	Backflow Prevention with Metered Bypass	Tyco	DCDA03	Flanged Connections
		Wilkins	Model 350A	Flanged
Check	Non Return	Tyco	Fig CV1-F	Screwed flanged connections or roll grooved connections over 50mm
Wafer Check	Non Return	Tyco / Keystone	Figure 86	
Swing Check	Non Return	Viking	CF/CG300	
Remote Control Ball Float	Level Maintenance	Bermad	FP450-60	Flanged

Valve Type	Duty	Manufacturer	Model	Remarks
		Philmac	Fig 9651 Servo	Flanged connections
Gate	Isolation & Air Vents	John	Fig 59M	Screwed connections up to 50mm dia.
Lockable Plug Cocks	Alarm	Alderidge Test	Lock Open	Padlock approved by Local Authorities
Hydrant	Landing Valve	Galvins	38130RG	Roll Grooved pattern
Booster	Connections	Storz	Type with Captive cap	Screwed or Flanged to suit
Float switches	Level	KWIKALARM Alarm	Model K124 either 10mtr or 20mtr	Bracket mounted outside tank. Require 240 V GPO.

B.6 Systems Interface and Controls

The following systems and interfaces are to be installed complete with manual, automatic and alarm controls as identified.

B.6.1 Fire Services Interfaces

B.6.1.1 Hydrant System

- Fire pump sets (diesel and pressure maintenance) and associated control panels including associated battery/battery charging plant
- Isolation valve security alarms

PART C. Technical

C.1 General Technical Requirements

Fire services installation to comply with the current edition of Building Code of Australia (BCA).

- The entire fire services installation must comply with local Water Authority and Department of Fire and Emergency Services requirements
- The entire fire services installation must comply with current Australian Standards where applicable and particularly the following:

AS 1851 - 2012	Routine Service Maintenance of Fire Protection Systems and Equipment
AS 2419.1 - 2005	Fire Hydrant Installation – System Design, Installation and Commissioning
AS 2941 - 2013	Fixed Fire Protection Installations - Pumpset Systems
AS/NZS 3000 - 2007	Wiring Rules
AS 3500.1 – 2003	Plumbing and drainage – Part 1: Water Services

C.2 Manufacturers literature and Details

Manufacturers literature giving detailed specification, physical appearance and size for the following equipment must be submitted for approval prior to purchase. Information must be submitted at least 2 weeks before approval is required.

- Pipework
- Valves – isolation and non-return
- Flow Switches
- Pressure Switches
- Pressure Guages
- Fire Pumps with enclosure
- Fire Tanks including liner detail

C.3 Shop Drawings

Refer to the Preliminaries for shop drawing requirements. Allow for the following additional requirements.

- Drawings must be prepared using AS 1102 drafting standard symbols
- Drawings must be provided with a legend of symbols, where applicable
- Shop drawings must all be on the same size drawing sheets and must be to the scale of not less than 1:100 and larger where necessary
- Shop drawings must be of the same size as the project drawings
- Shop drawings must cover the following parts of the work:
 - Hydrants system details and layouts
 - Fire Services Pump details and layouts
 - Fire brigade booster assembly details and layouts

- Fire tanks details and layouts

Three (3) copies of shop drawings must be submitted. Allow 2 weeks for return of shop drawings with approval and/or comments. When requested amend shop drawings and resubmit.

Note that shop drawings are reviewed for general principle of design only and approval of shop drawings by the Superintendent in no way relieves the Fire Services Contractor of his responsibility to comply with the requirements of this specification and associated drawings.

C.4 Materials and Workmanship

All materials, labour and plant must be provided by the Fire Services Contractor unless otherwise specified. All materials must be the best of their respective kinds and free from all defects.

Workmanship in each trade must be carried out in a first-class manner and in accordance with the true intent and meaning of this Specification and accompanying Drawings, General Conditions of Contract and to the entire satisfaction of the Architect.

So far as it is reasonably and economically practicable and where it is not prejudicial to the Proprietor to do so, the Fire Services Contractor must in the performance of the Contract use labour, materials, plant, equipment, supplies and services available within the local State.

All materials, equipment and work must comply with the appropriate Australian Standard Specification or Code, or if such have not been prepared with the appropriate British Standard.

All materials, equipment and work must also comply with the relevant rules and regulations laid down by any Statutory Authority having jurisdiction over such work, and must conform with the requirements of Insurance Underwriter's Codes.

Any workmanship, materials or installation, which on inspection by such authorities, is found to require modification to be acceptable to the authority concerned must be replaced, changed, modified, or otherwise put in a form to pass the relevant regulations. Such modifications must be at the expense of the Fire Services Contractor and at no cost to the Proprietor.

The Fire Services Contractor must take all necessary precautions with the supply and installation of equipment specified to prevent corrosion.

If, in the opinion of The Fire Services Contractor, equipment specified cannot be adequately protected against corrosion he must request an instruction regarding same from the Architect.

Any component or accessory showing signs of rust or corrosion during the maintenance period must be renewed or otherwise made good in an approved manner.

C.5 Incoming Water Supply

C.5.1 General

Incoming water supplies must be provided with Double Check Valve Detector Assemblies in accordance with Water supply Authority requirements.

Coordinate pipework installation and provision of inground pipework from the Water Authority main isolation valves at the boundary located within trafficable cast iron valve boxes.

C.6 Fire Hydrant System

C.6.1 Generally

Provide and maintain complete fully operational fire hydrant system to the building in accordance with AS 2419.1.

Provision for reticulated fire service from the fire ring main to each allotment and incorporating isolation valves and trafficable pits.

C.6.2 Water Supply

Water supply to the hydrant system must be to the requirements of AS 2419.1 and as identified in the Project Specific section of this Specification.

C.6.3 Design Criteria

The fire hydrant must be capable of the minimum flow and pressure at the most disadvantaged point in the system, in compliance with the requirements of the Building Code of Australia and the relevant Australian Standards.

C.6.3.1 Hydrants

The hydrant system flow rate and residual pressure must satisfy the requirements of AS 2419.1 Table 2.1 to 2.3 and Table E2 respectively.

C.6.3.2 Pipework

The hydrant pipework installation must include all equipment sized to achieve the flows and pressure specified.

C.6.4 Fire Brigade Booster

Provide and install at ground level in the enclosure provided 65mm couplings in accordance with the quantities identified in the project specific section of this specification in each fire brigade booster connection. The booster connection must have 65mm connections to fit Department of Fire and Emergency Services appliances complete with compatible valves, a 100mm diameter pressure gauge complete with shut off valve and chained blank caps. Pipe the booster connection through to the Fire pump enclosure.

Provide a permanent sign indicating the maximum allowable inlet pressure.

C.6.5 Testing

Subject the commissioned fire system to a series of pre-inspection tests during which time all necessary adjustments are to be undertaken to achieve perfect operation in accordance with Fire Brigade requirements.

Subject the adjusted system to performance tests as required by the Fire Brigade. Wait on and liaise with the Fire Brigade testing officers including fire pump manufacturer attendance at all Fire Brigade acceptance tests.

Subject the entire fire service to visual sighting and hydrostatic tests as required by the Water Corporation.

C.7 Pipework and Fittings

C.7.1 General

Acceptable materials and jointing procedures are defined below. Alternative materials and/or jointing procedures may be employed in accordance with AS 2419.1.

1. Pipework of 50mm nominal diameter or less:
Medium weight black steel to AS 1074, screwed and socketed
2. Pipework above 50 mm nominal diameter:
Medium weight black steel to AS 1074 flanged and welded
3. Drain pipework of 25 mm nominal diameter or less:
Annealed copper tube to AS 1432 Type B with flanged or screwed union connections
4. Drain pipework above 50 mm nominal diameter:
medium weight galvanised steel to AS 1074 screwed and socketed

This section of the Specification covers the supply and installation of all piping systems including valves and associated fittings.

The drawings indicate the size of pipes and the manner in which the various systems are to be run. They do not, however, purport to show all minor pipework offsets, hangers, method of fixing and clearances, all of which must be co-ordinated with other trades, measured on site or ascertained from the drawings. Such co-ordination will include allowance for light fittings, ductwork structure, plumbing and other services. All piping arrangements must be shown in detail on shop drawings and approved in general detail prior to commencement of installation.

All piping systems must be complete with all valves, supports, vents, anchors, drains and fittings necessary for the full operation of the system and must be connected to such items as pumps, tanks and ancillary equipment to the recommendation of the equipment manufacturers and in accordance with the requirements of the Regulatory Authorities, good engineering practice and to approval.

Irrespective of the need or otherwise for flexible connections, connection to pumps and similar equipment must be arranged in such a manner as to eliminate undue strains and vibration in piping and equipment.

Prior to installation, all pipework must be thoroughly cleaned and during installation, all open ends must be kept covered in an approved manner to prevent the ingress of dust and general building debris. Responsibility must be accepted for all damage to equipment due to dust and debris left in the pipework during installation.

All work must be installed in an approved manner to meet structural and architectural conditions. Special care must be taken to achieve a neat and workmanlike appearance and arrangement with all necessary provision for concrete shrinkage, thermal movement, grading, alignment and access for maintenance, to approval. All pipework must be laid out and constructed such that it will be adequately free for contraction and expansion and must be located with at least 50mm clearance between external surfaces of pipes, adjacent services or building structures. Provisions must be made for replacement of each piped service without disturbing other services and that support hangers and brackets are independent.

C.7.2 Piping and Materials

C.7.2.1 General

All piping must be of the best available quality and must be supplied clean in full standard straight lengths, free from any defects such as mill scale, rust, burns, dents, kinks and with all ends sealed against the ingress of foreign matter and protected against mechanical damage. All piping must be kept in a clean condition at all times during storage, fabrication, installation and testing.

Where electro fusion welding is proposed qualified tradesmen are to have current competence certification from the manufacturer.

C.7.2.2 Steel Piping

All steel tubing must be of the ERW, continuous weld, butt weld or hot finished seamless carbon steel type complying with the requirements of AS 1074, AS 1835 and AS 1836, ATSM 53 Grade 'B', ASTM 106 or APL 15L Grade 'B' as appropriate.

All steel piping must have wall thicknesses as suitable for the design working pressure specified. Steel tubes must be of Australian origin where possible

Where galvanised pipework is used it must be hot-dip galvanised. It must be cold formed and electric resistance welded mild steel pipe made from hot-rolled steel strip and then Hot-dip galvanising after forming, welding and cutting to length must protect the pipe internally and externally.

The wall thickness of pipes must exceed those specified in Table 3.1.2 of AS 4118.2.1 - 1995, giving them a suitable pressure rating for use in AS 2419.1 fire hydrant systems.

The steel used to manufacture must conform to the relevant requirements of ASTM A 135-01, providing improved resistance to impact at 0°C.

The hot-dip galvanised coating of pipes must conform to the requirements of AS/NZS 4792. Coating Class HDG300, the minimum coating mass being 300 grams/m².

The pressure rating must be suitable for use in fire hydrant installations in accordance with AS 2419.1

Pipes must be suitable for use with rolled-groove type couplings and fittings of suitable diameter and groove profile, also suitable for joining by shouldered-end couplings, or by butt-welding.

Hot-dip galvanised fire hydrant pipe must comply with the requirements of:

1. SSL Active Fire Listing Scheme
2. AS2419.1
3. Underwriters Laboratories Test Procedures and Follow-up Service

C.7.3 Pipe Supports

Pipework must be independently supported and not utilise supports, hangers or brackets provided for other services, such as electrical cabling.

All pipes must be adequately and substantially supported and appropriately restrained both horizontally and vertically by use of hangers, brackets, pedestals, clips and anchors designed to suit the requirements of each piping system.

All piping exposed to view in such locations as plantrooms, service tunnels and on roof areas must be supported from common supports and must be run in neat groups.

Where pipe supports and associated fittings are exposed to moisture or the external elements, they must be hot dip galvanised after fabrication to AS 1650 and must be isolated by non-conductive materials between dissimilar metals to approval.

Contact between dissimilar metals must be prevented by non-conductive isolating materials between contact surfaces to approval.

C.7.3.1 Support Loadings and Spacings

All piping must be supported with hangers or pedestals designed to withstand the combined weight of pipe, pipe fittings, valves, fluid in the pipes and service and erection stresses and loads and must be capable of keeping the pipe in proper alignment and must not exceed the following recommended spacing.

Where rolled grooved coupling joints of approved type are installed, pipework supports must be provided at both sides of each coupling joint.

Spacings may be adjusted on approval, to other than specified where allowed by relevant standard codes or where recommended by the piping materials manufacturer.

All pipework must be laterally restrained in a similar manner to maintain alignment under all conditions (at not greater than 6000 centres).

In addition to the above, consideration must be given to providing supports at no further than 1m from any change of direction and at other specific locations as follows:

Pipework Function	Location of Support
Mains	Not more than 1m from end of run
Joints	Refer to specific requirements for Rolled Grooved couplings

C.7.3.2 Fixed Supports

Where no allowance need be made for expansion, contraction or vibration, hanger rods may be fixed direct to floor slabs, structural members or to support brackets fixed to floor slabs, walls or structural members. Alternatively, the pipes may be clamped directly on to support brackets fixed to floor slabs, walls or structural members.

Where two or more pipes are to be run in parallel and adjacent to each other, they may be supported from common channel section rigid brackets or trapeze type supports fixed to floor slabs, structural members or walls as appropriate for pipe sizes up to and including 100mm. For pipe sizes larger than 100mm the supports must be of standard rolled steel channel sections.

All proprietary type channel sections must be installed and used strictly in accordance with the manufacturer's recommendations particularly in respect of maximum allowable loadings and within permissible stress limitations of AS 1250.

All supports must comply with all appropriate Codes and Statutory requirements and all loadings on buildings floor slabs, structural members and walls must be to the approval of the appropriate authority in this matter and no fixings to the building floor slabs, structural members or walls must be made until such approval has been obtained.

All supports, brackets, pedestals and other ferrous fixings must be fully detailed on shop drawings for approval prior to manufacture.

Pedestals for supporting pipes on the underside in the plantrooms and on roof areas must be fabricated from mild steel, hot dip galvanised after fabrication and fixed firmly to floor slabs, structural members or wall brackets as appropriate and all to approval.

C.7.3.3 Anchors

Anchors must be provided where necessary to provide reactions for expansion devices and flexible type connections to prevent excessive expansion or contraction forces in pipework from being transmitted to equipment.

On steel pipes, anchors may be either fully welded to pipe unless otherwise indicated on the drawings.

C.7.4 Pipe Expansion

Provision must be made in all piping arrangements for expansion under operating conditions and for dimensional alterations to the building structure due to such factors as concrete shrinkage, wind loadings and earthquake codes as applicable to current regulations.

Where the above operating conditions are applicable and the pipe runs are straight in any direction for a distance of 30m or more, on one side of an anchor point, pipe deviations must be provided to approval.

Where required, solid anchorages of welded structural steel construction must be provided (set in concrete if necessary).

Where it is not practicable owing to space limitations to provide allowance for expansion as previously described, approved type stainless steel bellows may be used subject to these meeting the system pressure and temperature requirements.

C.7.5 Jointing

C.7.5.1 General

Joints may be made by any one of the following methods. Where a particular type of joint is shown on the drawings, this type must be employed. Joints must not be made within the thickness of walls of slabs.

C.7.5.2 Galvanised Steel Pipe

- Screwed and socketed, up to 50mm size
- Screwed flanges, 65mm diameter or over
- Underground pipe, 65mm diameter or over, to be welded and hot dip galvanised after fabrication
- Mechanical grooved coupling, 65mm diameter or over

C.7.5.3 Screwed Joints

Screwed joints must comply with AS 1722 and AS 1572. Threads must be accurately cut to match the profile length and taper of the joining valve on fitting.

Screwed joints must be made with fine hemp and an approved compound.

C.7.5.4 Welding

All welding and welding procedures must conform to the following codes and requirements:

AS 1554	Metallic Arc Welding for mild steel construction
AS 1674	Fire Precautions in Cutting, Heating and Welding Operations
AS 1796	Certification of Welders and Welding Supervisors

Welding must be done only by qualified welders.

Any welder may be asked by the Superintendent to carry out a test weld. Should the test weld not meet the required standard the welder must be removed from the project.

Welding or branch piping must not protrude into the main pipe, which may cause flow restriction.

C.7.5.5 Mechanical Grooved Coupling and Fittings

Mechanical grooved couplings must be approved by the Water Authority and the relevant Fire Authority.

Roll grooved couplings must not be mechanically cut. Roll grooves must conform to ANSI/AWWA C606-06 Table 5 and tested with the go/nogo tool supplied by that same manufacturer.

Valves and other manufacturers equipment that will be interconnected via roll groove couplings must have roll grooves formed in strict conformance to ANSI/AWWA C606-06 Table 5.

Roll groove couplings and fittings of different manufacture must not utilised to connect a common joint. Ensure all connection points within the pipe reticulation network utilise the same brand type couplings and fittings.

Gaskets must be approved synthetic rubber, inserted in the groove using lubricant approved by the manufacturer. The roll Grooved coupling must be capable of withstanding the pressure requirements of AS 2118 or other Codes relevant to that particular pipe material and pressures the system will be subject to.

C.7.5.6 Flanges

Flanges must comply with AS 2129 Flanges for Pipes, Valves and Fittings Code. Minimum pressure/temperature rating in accordance with Table 'E'.

Welded-on flanges must be done with the pipe demounted. Screw threads of screwed flanges must finish just inside the back of the flange boss.

Flanges and bolts must be galvanised when joining galvanised piping.

C.7.6 Valve Identification & Locks

All valves must be marked for identification purposes. Each valve provided with operating handwheel must have a circular aluminium or brass disc fixed under the valve handwheel retaining nut. The valve identification mark must be stamped on the disc in symbols 10mm high.

Details of all proposed identification marking numbers must be submitted for approval at the appropriate time.

Where valves are required to be locked to comply with the relevant code, leather straps and padlocks must be provided to approval. All locking facilities must meet the requirements of the relevant Local Authority.

C.7.7 Gauge and Instrument Fittings

Pressure gauge tappings, pressure gauges and flow measurement fittings as shown on drawings, or where necessary, must be installed for the successful operation, commissioning and recording of each system in accordance with all relevant Codes.

Approved pockets must be installed in pipework for all gauges and instruments in positions where no adverse effects occur to flow conditions and of such material that electrolytic action is avoided (mild steel, bronze, stainless steel or brass as appropriate).

Bosses for pressure gauge tapplings and similar purposes must be of the standard inside fitted type, welded at right angles to the pipes and tapped as required for each application. The lengths and outside diameter of pipe bosses must be kept to a minimum consistent with pipe sizes.

C.7.7.1 Gauge Panels

All gauges on pump assemblies and similar equipment must be neatly installed on to a pressed galvanised sheetmetal gauge panel painted to approval, located clear of vibrating equipment and where required, incorporate pulse snubbers or siphon connecting tubes.

Pet cocks or gate valves must be used for isolation of pressure gauge connections and incorporate handles suitable for padlocking in "open" position to the requirement of the relevant Codes.

C.7.7.2 Pressure Gauges

Pressure gauges must be selected with scales suitable for the system pressure range, with normal standing or operating pressures located within the mid-point zone of the scale range and identified with red adjustable point.

C.7.7.3 Pressure Gauge Schedule

A pressure gauge schedule must be developed and installed per the requirements of AS2118

C.7.8 Flow Measuring Devices

Connections for flow measuring devices must be installed as required or where shown on the drawings. These devices must be of common manufacture and model throughout the project and must be of the low-pressure loss type. Pitot tube type such as "Annubar" or approved equal must be used. Unless otherwise specified, orifice plate types will not be accepted.

Flow measuring devices must be installed in accordance with the instructions of the manufacturer and in locations providing adequate lengths of straight pipe on either side of the device in accordance with such recommendations.

A brass plate stamped to indicate all relevant piping data, gauge ranges and flow or temperature co-efficient must be fixed to the pipe adjacent to the device.

One set of gauges designed for use with the flow measuring devices must be supplied prior to completion of the project. The gauges must be complete with suitable padded wooden or steel box to protect the gauges from movement and damage when being carried. The gauge scale range must be suitable for use throughout the expected range of flow with the design flow at approximately mid scale.

C.7.9 Valves and Fittings

C.7.9.1 General

All valves and fittings must be the standard products of approved valve manufacturers as scheduled. A list of the proposed valves must be submitted for approval prior to installation and in some cases, sample valves may be required to be inspected for approval.

Valves must be entirely suitable and correctly sized for each application and unless otherwise shown must be of pipeline size.

All valves and fittings must be suitable for the system design pressure and in any case, not less than 1000 kPa design pressure.

All valves and accessories must be installed in positions easily accessible for operation and maintenance. Pressure gauges and similar instruments must be readily visible after installation. Valve packings must be suitable for the duty and, upon completion of piping system and before placing it in service, such packings must be examined and where necessary replaced.

The connection between each valve and adjacent lines must be made with either flange or union to permit removal of the valve without dismantling piping. Flanges must be suitable for the system design pressure and in any case, not less than Table 'E' of AS 2129.

All valves for services under the jurisdiction of a Regulatory Authority, must be stamped with the approval of that Authority.

C.7.9.2 Isolating Valves

- 50mm diameter or less:
 - Wedge type gate valves with cast gunmetal body, brass stem and gunmetal wedge of approved manufacture
 - Full flow ductile iron butterfly valve
- Above 50mm diameter:

Wedge type gate valves with cast iron body, brass stem, cast iron wedge with bronze disc ring seats and bronze seat of approved manufacture.

 - Full flow ductile iron butterfly valve
 - Micro switch must be provided to indicate the "On/Off" status of each isolation valve
 - The electrically monitored valves must be equipped with micro switch mounting bracket for detection of hand wheel movement

Each stop valve must be secured with "Open/Close" by a strap and padlock under the master key system and suitably labelled to identify the area of protection they control.

C.7.9.3 Check Valves

Check valves must be of the full swing type check type with bronze body and stainless steel disc and seat of approved manufacture. Check valves must be of Tyco Manufacture Model CV-F1 or approved equal.

Check valves of 50mm nominal diameter or larger may be of the spring loaded, double-disc type subject to approval by the Architect.

C.7.9.4 Pressure Switches

Pressure switches must be double-acting, of the diaphragm, bellows or Bourdon tube type of approved manufacture.

Pressure switch for the control of fire pump must be of proprietary made constructed of heavy gauge, dust proof steel casing with enamel finish suitable for mounting on pipe lead for hydraulic operation

The pressure switch must be properly selected for the range and working pressure and must have a sensitivity of better than 30 kPa.

The pressure switch must be operated by mercury switch and must have an external adjustable device

C.7.9.5 Pressure Gauges

Pressure gauges must be of the Bourdon tube type complying with the requirements of AS 1349.

Maximum scale reading and graduation intervals must be in accordance with AS 2419.1.

C.7.10 Underground Pipework Installation

Underground pipework must be adequately protected with a protective wrapping arranged in two applications. The first application must be installed with a minimum 50% overlap when covered in a reverse spiral formation over the previous layer. Tape widths must be as recommended by the manufacturer for the size of pipe to be covered but must be not less than 75mm wide for pipework up to 50mm dia.

C.7.10.1 Pipework Installation

Pipework must be laid in accordance with manufacturer's instructions.

Pipework must generally be laid to follow final ground surface contours but must not vary in a vertical plane within the tolerance of 20mm in a distance of 6m.

Horizontal alignment of a completed length of pipework is laid beneath areas of normal usage but where passing under areas of vehicular traffic must be subject to a minimum cover of 750mm or as otherwise directed.

A sand bed of 75mm minimum thickness over earth or 150mm minimum thickness over rock must be provided and compacted to a dense tight state using water and vibratory tamping.

The pipework must be topped with 100mm minimum thickness of sand compacted carefully by watering and hard or light vibratory tamping to a dense tight state.

Pipework must be maintained internally in a clean condition during construction with the last laid pipe at the end of a day's work being suitably sealed to prevent entry of foreign material.

External coatings must be retained in good condition until backfill material is added to cover.

Thrust blocks must be installed in systems with unrestrained anchors.

C.7.10.2 Excavation, Trenching and Backfilling

All excavated material not required or acceptable for backfill must be disposed of and removed from site.

Backfilling must only be commenced on completion of hydrostatic testing following inspection and approval from the Engineer or Regulatory Authorities.

C.7.10.3 Excavation/Trenching

Excavation must be performed in a safe and methodical manner utilising all necessary sheeting, shoring and bracing with means to enable pumping or baling of surplus water from the works.

Excavation must be sized to provide minimum clear space of 100mm between pipe and trench face and arranged in conjunction with laying of pipe so that it is extended only as far as necessary to enable satisfactory execution of the pipe installation. Unless noted otherwise, the depth of excavation must be such that a minimum cover of 450mm and 750 mm for pipework must be provided under unpaved and paved area respectively.

Where over-excavation occurs, approved fill material must be placed and compacted to the required level to approval.

At least 72 hours notice of required inspection must be given. No new work must be placed in excavation until these have been approved.

C.7.10.4 Backfilling of Trenches

Backfilling of trenches must be carried out in the following manner:

C.7.10.5 Bedding and Initial Covering of Pipework

Washed sand must be used for bedding and initial covering of pipework with dry densities measured in accordance with AS 1289 using Test E3.1 or E3.3.

A compacted sand bed of 75mm minimum thickness over earth or 150mm minimum thickness over rock must be provided. The pipework must be topped with 100mm minimum thickness of sand compacted carefully by watering and hard or light vibratory tamping to a dense tight state.

C.7.10.6 Final Backfilling (Paved Area)

Selected granular fill must be placed in uniform horizontal layers, not exceeding 250mm loose thickness and each layer compacted before placing the next layer.

The minimum acceptable degree of compaction, which must be achieved, is a dry density ratio of 100% using STANDARD compaction in accordance with AS 1289 E1.1.

For this project, subgrade preparation and sub-base formation are important elements in the performance of the pavement. Consequently, allow for field density tests of the subgrade fill and sub-base of excavations as set out below to approval.

The Fire Services Contractor will be responsible for the pavement testing required by the Proprietor's representative and will have all such tests performed by an approved NATA testing authority.

The Fire Services Contractor will keep the proprietor's representative informed of the progress of the work and must promptly perform the tests where and when required by the Proprietor's representative.

The following tests will be required:

- Laboratory Modified AASHO Compaction tests (including optimum moisture content)
- Field density tests on the wet-mix crushed rock
- Laboratory CBR (Soaked) tests
- Field CBR tests

Laboratory tests must be carried out in advance of field tests. The Fire Services Contractor must be advised of any change in the source of crushed rock.

Approximate frequency of testing is given as follows but this may be varied considerably at the discretion of the Engineer once the consistency of the work has been assessed.

Material	Test	Frequency
Subgrade material	Field density	one per 400 sq.m
Subgrade material	Field CBR	one per 400 sq.m
Sub-base material	Field density	one per 1000 sq.m
Laboratory tests	Modified AASHO	8 No.
	Modified CBR 6 No.	

C.7.11 Painting and Corrosion Protection

All pipework and equipment covered by this Specification must be cleaned, primed and painted to the Superintendents approval.

Cleaning must be carried out using approved solvents and surface wire brush treatment as required to provide a satisfactory base for painting.

Primes must be approved, anti-corrosive, metal primers. Galvanised pipework must be primed with an approved acid-etch metal primer.

After priming, surfaces must be painted with an approved undercoat, compatible with the subsequent finish coats.

Surfaces must be finally painted with two finish coats of oil and petrol resistant Fire Brigade Signal Red enamel paint of approved manufacture. All exposed pipework will be painted including pumproom equipment as per AS 2941. Pipework identification must be in accordance with AS 1345 and the requirements of the DFES WA.

Any painting or finishing of pipework or equipment which is deemed by the Architect to be defective or to have experienced excessive deterioration during the Maintenance Period, must be made good to the Architect's satisfaction at The Fire Services Contractor's cost.

C.8 Pumps

C.8.1 General

Pumps must be of approved manufacture selected to comply with the requirements of this Specification.

Tenderers must include provision for inspection of pumps and associated equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

The Fire Services Contractor to ensure adequate deterioration factor applied to pump care.

All pumps must deliver the specified water quantities against the respective system resistances without objectionable noise and vibration. The scheduled duties are for estimating purposes only and may be altered to approval.

Responsibility must be accepted for assessment of the actual resistance for each piping system and equipment installed.

All pressure drops through equipment offered must, be allowed to suit the piping arrangements prepared as part of the shop drawings. The pump duties as scheduled herein must not be used for technical purposes when ordering equipment.

Provide suitable start/stop push button together with pump running indicator lights and alarm buzzers adjacent to Fire Brigade Booster cabinet to enable fire personnel to exercise control of the Fire Hydrant Pumps.

Pumps must be of ample design and construction to withstand the hydraulic and other forces encountered under normal operating conditions.

Where pumps are required for direct connection to town mains, selection must be made to ensure that each pump is capable of performing to maximum flow rate conditions as related to the most favourable building fire zone area for the particular Hazard Classification all as defined in AS 2941 and AS 2419 as applicable. Variable Speed drive controllers must be provided to account for fluctuations in town main pressure.

Pump selection shall be capable of satisfying the Australian Standard requirements for provision of 130% flow @ 80% pressure for all duty points.

Prior to manufacture of such pump sets, performance curves relating to maximum and minimum duties combined with town mains input; characteristic duty at hydrant valves and square law curve for the most hydraulically favourable area of the particular installation, must be submitted for approval.

In addition, pump suction sizes must be provided at least one size larger than the discharge. Pipeline connection sizes must be such that the suction pipe velocity does not exceed 3.7 m/s at maximum flow rate conditions of the pump.

Valves with pump suction and discharge pipework must be pipeline size and not pump suction or discharge sizes.

C.8.2 Diesel Pump Engines

C.8.2.1 General

Diesel engines must be a naturally aspirated or supercharged direct coupled four stroke, solid injection, water cooled, high-speed diesel unit complying with AS 2941.

A variable speed control system must be used to limit the total discharge head.

C.8.2.2 Cooling System

The engine cooling system must be of the arrangement detailed below:

Water cooled radiator/jacket system served by hydrant systems as applicable, during operation. System capacity must not be affected by loss of water to the engine cooling circuit by arranging pump capacity to be increased to compensate if necessary.

The engine manufacturers acceptance of the cooling system proposed for installation must be obtained and submitted.

The ambient temperature within the pump room for diesel engine operation must be considered. The cooling system must be sized for this application based on a maximum 10°C temperature rise when measured by water, radiator or air discharge outlet temperature.

The cooling water discharge must be run to the nearest drain. Water discharge must be visible and cooling water must only circulate when the engine is operating.

C.8.2.3 Fuel System

The diesel engine must be suitable for operation using Class "A" fuel oil to BS 1864 or equivalent.

A fuel storage tank must be provided with minimum capacity to operate the engine for a period of 4 hours at maximum performance condition.

Copper fuel piping must be run from the fuel storage tank to the engine fuel inlet.

Connection to the engine must be with adequate bends and fixings to avoid deterioration due to vibration. The oil pipework system must be bled of air by means of screwed plug cocks. A gate valve must be installed in the fuel line adjacent to the fuel tank and provided with a means of locking in the open position. A fuel filter of an approved type with readily replaceable elements must be included adjacent to the engine in a easily accessible location.

C.8.2.4 Starting and Control System

The diesel engine controller must serve the diesel driven fire pump and the controller must conform to the requirements of AS 2118, AS 2941 and AS 3000.

The controller must incorporate all circuits and associated with the following:

- Automatic Starting (cyclic cranking))
- Manual Starting
- Speed Sensing
- Alarm and Status indicating
- Automatic Resetting to stand-by start position on shutdowns
- Control circuit operation
- Battery Low voltage indication (aural and visual)
- Indicator lights and aural alarm test facility
- The Indicator lights must be of the filament (two individual type), neon or LED type. The voltage applied must not exceed 80% of the rated voltage of the lights. All lights must be accessible for accessibility and must be colour coded as follows:
 - Power Supply to fire pump controller – Green
 - Phase Failure - Red
 - Failure of engine to start automatically - Red
 - Automatic Start Circuit disconnected - Red
 - Pump Running – Red
 - Battery Charger supply failure - Red
 - Battery Low Voltage – Red
 - Fuel Low Level - Red

- Aural Alarms silenced – Red
- The controller must incorporate but must not be limited to having the following features:
 - Duty Selector Switch (On/Off/Manual)
 - Voltmeter and Ammeter
 - Manual start pushbutton (6 starting attempts)
- Pilot lamps for:
 - Controller not set to "ON"
 - Low oil pressure
 - High engine jacket temperature
 - Engine overspeed
- Audible alarms at the pump station for conditions such as fail to start, power failure, low oil pressure, high engine jacket temperature etc
- Outlet contacts, voltage free bar external alarms such as fail to start and power failure, low oil pressure, etc

The diesel driven fire pumps must be actuated upon the sensing of a drop of system pressure within the trunk main. The pressure sensors must be set to operate when the pressure in the trunk main has fallen to a value of not less than the highest design pressure requirement for the system.

On receiving the signal to start the controller circuits must perform the following functions:

- Activate the fuel system
- Open cooling water solenoid valve
- Crank the engine
- Disconnect the starting motor upon engine start
- Allow the engine to run unit manually shutdown

If the engine must fail to start after 6 starting attempts or 1-1/2 minutes of cranking, the controller must disconnect the starter motor and activate the visual and audible alarm to indicate overcrank/failure to start.

A time delay relay must be provided which will on receiving a signal from the electronically driven pump controller delay automatic starting of the diesel engine for 10 seconds.

Batteries must not be installed in the Fire Pump Controller or below the fuel tanks, as per AS 2941.

C.8.2.5 Starting System

Provision must be made for both automatic and manual starting of the engine pump set.

The engine must be capable of cold starting in ambient conditions, which may vary 5°C - 40°C, without the use of any form of heating, i.e. glow plugs or similar.

The engine must accept full load and provide full pumping capacity within the minimum possible time from receipt of start up signal and must not exceed 15 seconds.

Automatic starting must be initiated by a fall in pressure in the water supply pipe and provide for several starting attempts with the starter capable of cranking the engine for a minimum of three (3) continuous minutes.

Manual starting must be by crank handle (if engine size permits) or electric starter motor. For electric starter motor manual starting must be arranged as an emergency provision comprising pushbutton non-locking switch protected by a lead/wire-

sealed spring closing hood. The switch must be wired in parallel with control pressure switches and without means of isolation. The manual start must be labelled "EMERGENCY MANUAL START".

C.8.2.6 Lubrication System

The engine must be provided with an adequate self-contained lubricating oil system with sump capacity sufficient for at least 12 hours continuous operation at full load, without replaceable elements.

To enable sump to be easily drained, piping must be run from sump connection clear of base and terminated in a suitable plugged valve.

C.8.2.7 Exhaust System

Provide diesel exhaust pipework complete with thermal and acoustic insulation and galvanised steel so that it can discharge directly to outside air at a height above the ground level to be approved by the Architect or Consulting Engineers prior to fabrication and site installation.

The complete exhaust system must be installed to the engine manufacturer's approval and designed to match the permissible backpressure on the engine under all load conditions.

Flexible exhaust connections must be provided within the engine exhaust system.

Silencers must be installed adjacent to the engine exhaust outlet and adjacent to the discharge point to ensure noise levels do not exceed the criteria specified by the Regulatory Authorities and acoustic report where provided.

Exhaust piping and silencers must be located at a minimum height of 2200mm above pump room floor level unless otherwise shown. Suitable traps or dead legs must be provided in the exhaust pipe system to prevent condensate drain to engine. Condensate drains must be run to suitable sump or similar.

All exhaust pipes must be insulated/lagged with 25mm high temperature sectional insulation finished with a fire retardant bonded surface. Where pipework is exposed to weather or view, insulation must be sheetmetal clad and fabricated from full size standard sheets of either the best quality zincanneal 0.56mm thick where subject to mechanical damage and 0.46mm elsewhere, or not lighter than 0.6mm best quality bright aluminium.

Sheetmetal must be accurately and neatly cut and rolled to the required sizes with beaded transverse joints and applied to provide tight fitting jackets with not less than 30mm lap joints. Longitudinal joints must be staggered and, on horizontal pipes, faced away from view preferably in the 10 o'clock position with the top uppermost. All joints must be made with self-tapping screws spaced at not more than 100mm intervals or alternatively secured the sheathing with galvanised or stainless steel straps spaced at not more than 450mm centres.

Metal sheathing for bends and curved equipment surfaces must be in the form of lobster back segments secured with self-tapping sheetmetal screws spaced at frequent intervals or straps as appropriate.

All joints exposed to weather or located in moist locations must have all joints fully soldered or sealed with synthetic rubber sealing compound.

Metal cladding must be double flashed with fully soldered joints where protruding through external walls or floor slabs to approval.

C.8.3 Jacking / Pressure Maintenance Pumps

C.8.3.1 General

Jacking / Pressure Maintenance pumps must be supplied complete with the specified pumps, drivers, controls and ancillary items.

The pumping equipment must be installed as recommended in the applicable standard and acceptable to the Regulatory Authority.

C.8.3.2 Pumps

Pumps must be vertical multistage centrifugal pump suitable for fire service application.

Pumps must not transmit hydraulic thrust loads to the electric motor and will be supplied with its own integral thrust bearing.

The mechanical seal of the pumps must have two silicon carbide faces and be of a standardised design.

The lower bearing of the pumps must be a plain bearing of the silicon carbide and lubricated by the pumped liquid. The lower bearing will be sited above the first impeller (to ensure the bearing is not affected by sedimentation from the pumped liquid).

C.8.3.3 Electric Motor

The pump driver must be a vertical flange mounted ball bearing induction motor. The motor must have a minimum enclosure protection rating to IP54 and must be of GRUNDFOS manufacture or approved equivalent.

C.8.3.4 Fittings

The pump manufacturer must supply brass 32NB pipe fittings, non-return valve on the pump discharge, suction and discharge lockable valves.

- A lockable test outlet for flow measurement must be supplied to comply to AS 2941
- A pipe union downstream of the suction valve and a pipe union upstream of discharge valve must be provided to facilitate service as required by AS 2941

A 63mm glycerine filled pressure gauge suitable for the unit working pressure must be installed to indicate discharge pressure.

A hydro pneumatic diaphragm type tank must be supplied that is suitable for the working pressure of the system.

C.8.3.5 Electrical Fittings

The unit must be controlled by a pressure switch set to activate the pump when the pressure at the unit falls below the required pressure. The pressure switch will stop the pump set when the valve has been turned off and the pressure rises to the required pressure. The unit must be fitted with a device to prevent short cycling of the pump set and consequential motor burn out.

C.9 Water Storage Tanks

C.9.1 General Requirements

Provide water storage tanks as identified in the Pump Suction Tank Schedule section of this Specification and where indicated on the drawings.

Comply with AS2304, AS 2419.1 and AS 3500 requirements.

Install float operated servo type water filling valve and provide Air gap to comply with AS 3500.1.

Tank level indicators must be the float indicating type on the side of the tank with Empty Half & full and to be made of stainless steel.

Signage to be provided on the side of Tank nominating the effective capacity of the Tank as per AS 3500 and AS 2419 as appropriate.

C.9.2 Sectional Panel Tanks / Modular Tanks

Sectional panel tanks must be constructed of 0.8 mm thick grade galvanised steel panels strengthened by a 4mm thick backing of high-grade fibre reinforced plastic. The tank must be outside bolted with chemical resistant high-grade silicone rubber.

The tank must be complete with reinforcing stays, drain, float, valve, overflow pipe to discharge over a floor waste, external and internal access ladder, pipe connections, dust cover with access opening and level indicator as per AS 3500.

The tank must be assembled on site under the supervision of the manufacturer.

All walls must be assembled on site under the supervision of the manufacturer.

All walls must be erected in straight lines; all vertical and horizontal edges must be true to vertical and horizontal respectively.

The access ladder must comply with the requirements of AS 1657 Code for Fixed Platforms, Walkways, Stairways and Ladders - design construction and installation. External ladders to be hot dip galvanised. Internal ladders must be stainless steel.

The roof must be flat construction with galvabond open web beams, purlins and brackets including a 600mm square manhole and cover. Roof material must be Dualclad Zincalume sheets and scaled at the edges to provide proofing against vermin.

C.10 Fire Systems Testing and Commissioning

C.10.1 General

The entire system specified herein must be fully tested and commissioned to the satisfaction of the Principal, Superintendent or their respective nominated representatives and the relevant approving Authorities.

All necessary competent personnel, equipment and materials must be provided to carry out testing and commissioning of the installation covered by this Specification, at a time agreed with the head contractor/superintendent.

All tests must be carefully pre-planned and scheduled to ensure that they are co-ordinated with the work of other relevant trades involved and that they are carried out in a safe and efficient manner with the minimum of inconvenience to all concerned.

Subject the commissioned fire system to a series of pre-inspection tests during which time all necessary adjustments are to be undertaken to achieve perfect operation in accordance with Fire Brigade requirements.

Complete commissioning tests must be carried out including:

- Water Systems - Static, flow and pressure tests
- Electrical Systems - Controls and power circuits
- Pump Sets - Capacity tests and operation
- Gauges and Instrumentation - Functions, identification and operation
- Test required by the Regulatory Authorities

All other testing, checking and adjusting must demonstrate that the capacity of the installed equipment and systems complies with the Specification, Drawings, applicable Codes, Statutory requirements and Regulations.

All such commissioning and testing must be completed prior to the certification of Practical Completion. Each item of equipment individually and each system as a whole, must be checked and adjusted to approval to verify compliance with the design duties and generally as follows:

C.10.2 Testing of Piping

Each pipework system must be tested as a whole or in sections as the work proceeds in accordance with all appropriate Regulatory Authorities and Australian Standard Code requirements and as follows.

Test pressures must be applied during the construction period and prior to the pipelines being painted with each section being blanked until further tests are made.

Where necessary, all equipment must be "blanked off" to prevent excessive pressures to equipment, seals or other similar parts of the system.

Care must be taken that the pressures used do not overstress any part of the system due to working pressure or static head. If such is likely to occur, permission must be obtained to vary the test condition.

Leaking joints in welded and silver soldered pipes must be remade in accordance with the appropriate Australian Standard for the system being tested. Leaking joints in screwed fittings must be fully remade and must not be caulked. All faulty joints must be retested after rectification and tests repeated as necessary until the entire system is satisfactory.

C.10.3 Water Systems

Flush out and thoroughly clean all water systems and equipment prior to start up of all Plant.

All water piping and connections to equipment must be pressure tested to the requirements stated on the relevant Australian Standards.

All pressure and flow actuated controls, relief devices, bleeds, vents and drains must be checked and proved to approval.

All water flow rates must be adjusted to within 5% of the specified flow rates and in a manner to the approval of the Regulatory Authority.

Manufacturer's test certificates must be provided for all proprietary manufactured items (such as tanks, pumps, diesel sets, system pressure vessels) required to operate under pressure and such certificates must comply with the appropriate Clauses of this Specification and all applicable Codes, Statutory Requirements and Regulations.

C.10.4 Hydrant System commissioning tests

Commissioning must be completed in accordance with the requirements of AS 2419 "Section 7, Testing" with all tests witnessed to the satisfaction of the Regulatory Authorities.

Subject the commissioned fire system to a series of pre-inspection tests during which time all necessary adjustments are to be undertaken to achieve perfect operation in accordance with Fire Brigade requirements.

C.10.5 Fire Pumps Testing Procedure

Testing procedures must be carried out strictly in accordance with AS 2941 where the pump sets are to be tested via a direct discharge to drain.

The solenoid test per floor is not a correct procedure for pump testing; which may result in development of excessive pressures as a result of hydrant design.

Testing procedures must be arranged as follows:

- Pump Test - start up from fall in combined reticulation system pressure, only from opening discharge valve to drain. The pumps should then be isolated
- Test solenoids to be reset to allow automatic jacking pump to revert system to selected standing pressure. The 25mm bypass valve around the 3mm orifice can be opened to increase the rate of rise in pressure. Pump sets to be placed back on auto after standing pressure is achieved, to avoid over pressurisation/automatic starting

C.10.6 Gauges and Instrumentation

All controls must be adjusted and activated by competent personnel provided by the manufacturer or his authorised agent. A complete log of the settings and readings of all controls, gauges and instruments must be maintained at suitable intervals throughout the commissioning period. These must include readings from all permanently installed gauges, ammeters and similar instruments.

In addition, portable instruments as necessary must be provided to check the log readings for which permanent gauges or instruments may not have been provided including: Ammeter readings for all motors; Megger tests of all electrical equipment; Voltage tests; Speeds of all rotating equipment; Water flows and pressures in each system; Gas flows and pressures in each system; System response time.

Insulation resistance tests in accordance with AS 3000 must be recorded for all new and/or altered alarm.

Using a voltmeter with an accuracy of better than 0.5% of reading test battery charger output voltage under the following conditions:

- Input voltage of nominal - 10% - full load

- Output voltage must vary by no more than 2% during these tests
- The output current of the battery charger under short circuit conditions must be measured and must be not more than 120% of rated full load current
- With the battery charger voltage plus 3% test the fire indicator board for correct operation by operating every switch on the board to every position
- With the mains supply switched off and a voltage equivalent of 2.1 volts per cell applied to the battery leads, test the fire indicator board for correct operation by operating every switch on the board to every position. Verify operation of the ancillary equipment controls as applicable

C.10.7 Electrical Systems

All materials and equipment must be tested in accordance with the relevant publications of the Standards Institution both at the manufacturer's works and on site as applicable. Certificated manufacturer's test certificates must be provided in duplicate within two weeks after the equipment leaves the manufacturer's works.

The complete installation must be progressively and finally tested to ensure that it complies with the specification, is mechanically and electrically safe and that it will operate correctly under normal, emergency and fault conditions.

All control, protection and operative devices must be checked for correct adjustment and rating. All test equipment must be provided as required.

Record of test results must be kept and two copies must be provided at the completion of the work. The format must be to approval.

All faulty materials and equipment must be rectified free of charge. Faulty manufactured items must be rectified by the manufacturer, again free of charge.

C.10.8 Tests at Manufacturer's Works

In addition to the clause above the following tests must be undertaken:

- All termination and gland provisions must be checked to ensure that they are suitable for all cables to be installed on site
- All clamps, fixings and terminations must be mechanically checked
- All switchgear, contactors and control gear must be mechanically and electrically operated as applicable

C.10.9 Tests on Site

The following tests must be undertaken on site:

- All clamps, fixings and terminations must be mechanically checked
- All power and control equipment must be put into operation and tested under normal, emergency and fault conditions (power fault conditions may be simulated)
- All defective equipment including all faulty lamps must be replaced
- All phase identifications must be checked to ensure they match throughout the installation. In this regard correct phase sequence will not be deemed sufficient proof
- Long runs of conduits must be checked to ensure that there are no expansion problems
- The operation all motors, starters, electrical interlocks, indicating/recording instruments, associated equipment, status indicating lights, associated flashers, relays and the like must be checked with operation proven under working conditions

C.10.10 Pump Sets

The testing of the complete diesel engine and pump sets must be completed to the satisfaction of approving authorities and the Engineer, in accordance with AS 2941 "Fixed Fire Protection Installation - Pumpset Systems".

Pre-delivery shop testing and certification must be carried out as detailed in AS 2941 - Section 10 with performance test data sheets issued as described within Appendix B.

Following installation, commissioning must be in accordance with Appendix D with reports issued for each pumpset and its associated ancillary system jacking pump.

C.10.11 Test Records

Test log sheets proposed to be used during the performance tests must be submitted for approval at least 4 weeks prior to the commencement of the tests.

C.10.12 Test and Installation Instruments

All instruments and appliances necessary to complete the performance tests specified must be supplied for the duration of the tests.

Gauges and instruments provided as permanent parts of the installation may be used during performance testing.

Test instruments proposed for use during performance testing must all be checked for accuracy by the manufacturer or an approved laboratory. Calibration certificates must be provided for each of the instruments to be used prior to the commencement of tests.

All instruments provided as part of the installation must be checked and calibrated as specified above and again after 6 months of normal operation. Any instrument, which will not hold calibration must be replaced.

C.10.13 Commissioning and Performance Data

Copies of all data recorded during commissioning of the installation must be provided together with all necessary inspection certificates from authorities having jurisdiction and appropriate manufacturer's pressure test certificates and performance curves or tables for the following items:

- All pumps (including Q-H, NPSH and BKW curves applicable to the diameters and speeds of the installed impellers together with details of the installed, minimum and maximum impeller diameters)
- Manufacturing guarantees in respect to motors, tanks and other items requiring performance
- Data covering all other specific items of equipment installed
- Noise level tests

Practical Completion will not be granted until all data, certificates and performance curves referred to above have been received and approved.

All commissioning and performance data records must be included in Section 2 of the Operating and Maintenance Manual.

C.10.14 Baseline Data

All Baseline Data required by the respective Australian Standard must be provided. Practical Completion will not be granted until Baseline Data has been received and approved.

All Baseline Data records must be included in Section 2 of the Operating and Maintenance Manual.

C.10.15 Handing Over

The following procedure must be adopted prior to handing over the installation:

- All preliminary testing, checking, adjusting and verification of interlocks of the installation must be carried out before forwarding notification that the installation is considered to have reached Practical Completion

- After inspection and when the Regulatory Authority is satisfied and agrees that the installation is ready for handing over, the plant must be finally commissioned and Operating and Maintenance Manuals, together with "as installed" drawings must be provided
- All spare items must be supplied and in position

Practical Completion will be certified only after the plant has been inspected and approved and the above requirements fulfilled.

C.10.16 Installation Block Plan

A block plan diagram must be provided in the form of a permanent diagram constructed to resist water and fading. The diagram must include the following information:

- The layout of the protected areas and adjacent streets
- A diagram of water supplies including sizes and locations of Supply Authority mains and valves (dimensioned), storage tanks (capacity and locations) and pump duties
- The location and telephone number of the fire station to which the system is connected
- The location of the main switchboard, distribution boards and starters and ratings of electrical services associated with all pumps and details of auxiliary power supply, if applicable
- The year of installation of the system and of any major extension thereto

C.10.17 "As Installed" Drawings

At Practical Completion three (3) complete copies of all "as installed" drawings must be supplied, correctly brought up to date to present true and accurate representation of the actual installation and to a scale of not less than 1:50.

The following must be included in these drawings:

- Complete layout drawings showing fire systems actual size and locations of all pipes, valves, outlets and gauges and the final measured pressures at all relevant locations
- Complete equipment layout drawings with full identification of each and every item of equipment
- Complete piping layout drawings showing the actual size and locations of all water and other lines applicable to the system(s)
- Complete schematic flow and control diagrams of all water and electrical systems incorporated in the installation. The drawings must show all motorised, automatic and hand-operated controls such as valves, relief valves, cutouts, flow measuring devices, solenoid valves, bleeds, vents, drains, strainers, gauges, bypasses, sight glasses and all similar items pertinent to the functioning of the installation
- Where applicable the drawings must include the settings, throttling ranges and differential bands of all controls, cutouts and other variable or adjustable items. All items must be clearly identified as to type and function
- Also included should be readings of all pressure gauges across each item of equipment, including strainers

The above drawings must be neatly prepared and bound in the Installation Operating and Maintenance Manual, with one additional copy supplied on CAD (.dwg) file to suit the computer system advised during the construction period by the Engineer.

Where the quantity of drawings involved is too great to conveniently bind in the Operating and Maintenance Manual, then a separate matching cover must be supplied for each of the drawing sets. Application can be made for approval to use full size drawings in this arrangement.

C.10.18 Instructions in Plantrooms

Additional copies of the Operating Instructions must also be framed behind glass or transparent plastic and mounted in a prominent position in the appropriate plantrooms. In addition, control and wiring diagrams must also be framed and mounted in a similar manner to the abovementioned operation instructions.

C.10.19 Power, Fuel and Water for Testing

All power, fuel, water and other facilities consumed prior to Practical Completion, must be included in the works covered by this Specification.

Power, fuel and water consumed after Practical Completion will be provided free of charge by others.

C.10.20 Certification Approvals

Supply, compile and co-ordinate all requirements associated with the certification of essential services as required by BCA. This must include submission to the Approving Authority, together with payment of fees, correlation of installers certified forms.

Obtain approval certificates from the local Municipal Council, Fire Brigade and all Regulatory Authorities.

The certified requirements must be submitted to the Approving Authority with due consideration of programme for practical completion and/or handover to the Proprietor in order to obtain a Certificate of Occupancy/Classification.

C.11 Operating and Maintenance Manual

On completion of fire systems commissioning and satisfactory performance tests supply, prior to Practical Completion, three (3) copies of Operating and Maintenance Manuals (O&Ms). One (1) set of O&Ms must be mounted in the Fire Control Centre with one (1) set forwarded to the Engineer and the remaining one (1) sets must be forwarded to the Proprietor.

The Manual must include a full description of the installation and function of the various systems involved and instructions to cover every action necessary for the efficient operation and maintenance of the installations. The Manual must be neatly prepared and bound in a blue vinyl hard-back folder with stamped lettering on the front

In addition, the words "OPERATING AND MAINTENANCE MANUAL" and the Denmark Light Industrial Area and the year of installation must be stamped in lettering along the spine of each folder.

The contents of the Manual must be in the following general format:

C.11.1.1 Section 1 Index

The Index must subdivide each section including lists of drawings, equipment and similar for quick reference.

C.11.1.2 Section 2 General Description and Capacities

This section must be subdivided between mechanical system and electrical system components.

Full details of fire system and equipment designed criteria/capacities and similar information must be included as applicable. Such information must also include the operating and maintenance requirements specifically detailed within the appropriate Australian Standards applicable for design, installation maintenance of these systems.

Copies of all data relating to commissioning testing/records must be included as a sub-subsection of the individual system sub-sections applicable.

C.11.1.3 Section 3 "As Installed" Drawings

This section must include all "as installed" post contract drawings (minimum 1 x A3 set and USB/CD with soft copy).

C.11.1.4 Section 4 Equipment

This section must be subdivided as for Section 2 and must list all system items of equipment installed complete with manufacturer's name, model and/or type no., serial no., size design ratings (i.e. all relevant data necessary for re-ordering or replacing).

All major pump equipment must be broken down to individually identifiable items such as motors, engines, drive belts, bearings, glands and similar components.

C.11.1.5 Section 5 Installation Maintenance & Operating Instructions

This section must be subdivided as for Section 2 and manufacturer's installation, maintenance and operating instructions must be included for each item of equipment, such as motors and pumps. A comprehensive maintenance schedule to be followed throughout the Maintenance and Defects Liability Period must also be included.

C.11.1.6 Section 6 Routine Testing Procedure

This section must be subdivided into sub-sections, one for each system or functional sub system. Each sub-section must describe, in clear English understandable to a non-technical person, the extent and frequency of routine tests to be undertaken pursuant to the applicable codes and requirements of the Authorities having jurisdiction. The latter requirements must specifically include all particular requirements for the building concerned as specified by the Fire and/or Building Authorities. Liaise with interfacing trades to ensure description is consistent for all services.

C.11.1.7 Section 7 Plant Operating Instructions

This section must be subdivided as for Section 2 and a complete description and correct sequence of all actions necessary to start-up, operate and shutdown all plant for emergency operation must be included. These instructions must include full information on such items as normal and abnormal gauge readings, instrument settings and control points, differential time delays, oil levels, water temperatures and all similar relevant variable and adjustable items, to permit checking and adjustments where practicable and identification of hazardous conditions or malfunction of the plant. In addition, the instructions must include information on the immediate action to be taken in the event of hazardous conditions arising and conclude with the following sentence in large lettering.

C.11.1.8 Section 8 Certification and Warranties

Provide copies of all self certification, third party certification and plant and equipment warranties.

"FOR SERVICE - CALL (TELEPHONE NO.)"

C.12 Maintenance

C.12.1 General

Test and maintain the entire installation, including all specified and required procedures during the construction period and for the duration of the Maintenance Period.

C.12.2 Testing

The Fire Services Contractor must:

- Make all necessary adjustment such that the complete installation is left in a satisfactory and reliable operating condition after completion of each test procedure
- Record adjustment particulars in the log book
- Service the whole of the system at his own expense during the defects liability period and construction period
- Perform all tests as required each installed system relevant respective Australian Standard

The results of all tests must be entered in a logbook provided by the Fire Services Contractor.

The Fire Services Contractor must provide all necessary testing equipment and any costs involved must be borne by the Fire Services Contractor.

C.12.3 Maintenance

Provide corrective maintenance and repair to all fire equipment and systems which become defective, or is found to be defective, during the Defects Liability Period, including the making good of any resulting damage.

In addition, provide preventative maintenance of the fire services for the full duration of the Defects Liability Period, in accordance with this section.

Prepare and retain copies of all service reports, including details of all preventative and corrective maintenance work carried out and copies of log book entries. At the completion of the maintenance period or at any other time when requested submit a copy of all records to the Architect.

C.12.3.1 Preventative Maintenance

Generally, the routine preventative maintenance must include the inspections, testing and such other checking as may be considered necessary at the time.

Notify the Proprietor's representative on arrival and log details of all visits.

Preventative maintenance must be in accordance with AS1851-2012 and must include all weekly, monthly, six-monthly and annual maintenance activities.

PART D. Appendices

D.1 Appendix A - Tender Offer Details

D.1.1 Tender Summary

Tenderers must submit a breakdown of the total tender price including administration cost and profit for each section of the works. The amounts included in the Total Tender sum including overhead costs and profit margins are as follows:

(a)	Fire pumpsest with enclosure	\$ _____
(b)	Fire water tanks, tank liners, ladders and fittings, including pipework to and from pump room	\$ _____
(c)	Fire hydrant ring main, including isolation valves and pits	\$ _____
(d)	Fire brigade booster cabinet and assembly	\$ _____
(e)	Monitoring of fire pumps and tanks	\$ _____
(f)	Testing and Commissioning	\$ _____
(g)	Miscellaneous including: - As Constructed Drawings, Operating and Maintenance Manuals - Spare Parts Provision - Painting and labelling of all equipment & materials - Comprehensive Maintenance - Training of the operators for proper operation of the entire system	\$ _____
(h)	Provisional Sums (specify)	\$ _____
(i)	TOTAL TENDER AMOUNT (EXCLUDING GST)	\$ _____
(j)	GOODS & SERVICES TAX (10%)	\$ _____
(k)	TOTAL TENDER AMOUNT (INCLUDING GST)	\$ _____

Name of Tenderer: _____

Contract: _____

D.1.1.1 Provisional Sum Inclusions

Description	Cost	GST	Total

D.1.1.2 Fire Contractors Previous Experience

Similar projects recently completed

<u>Project</u>	<u>Date</u>	<u>Value</u>

D.1.1.3 Fire Contractors Personnel

Project / Contract Engineer:

Name _____

Qualification _____

Experience (list previous projects responsible for and value of same)

Project Supervisor:

Name _____

Qualification _____

Experience (list previous projects responsible for and value of same)

Project Foreman:

Name _____

Qualification _____

Experience (list previous projects responsible for and value of same)

D.1.2 Schedule of Technical Data

Note: This Schedule of Technical Data will be used for assessing tender submissions and will not relieve the Tenderer from compliance with the requirements of the specification. Code numbers, trade names, model numbers, classification, etc must be thoroughly checked for compliance with the specification by the Fire Services Contractor prior to ordering any equipment.

D.1.2.1 Jacking / Pressure Maintenance Pumps

Manufacturer _____

Model _____

Type _____

Performance

Capacity – l/s _____

Total Pressure –k/W _____

Motor Power – k/W _____

Motor Speed - -k/W _____

Construction Material:

Casing _____

Impeller _____

Shaft _____

Seals _____

Base _____

D.1.2.2 Diesel Pumps

Manufacturer _____

Model _____

Type _____

Performance

Capacity – l/s _____

Total Pressure – k/Pa _____

Motor Power – k/W _____

Motor Speed – r/s _____

Construction Material:

Casing _____

Impeller _____

Shaft _____
Seals _____
Base _____

D.1.2.3 System Components

In-ground Pipework

Manufacturer _____
Type _____
Working pressure _____

Pressure Gauges

Manufacturer _____
Model _____
Type _____

Brigade Booster Connection

Manufacturer _____
Model _____
Type _____

Pressure Switch:

Manufacturer _____
Model _____
Type _____

Pressure operating range _____

Electrical rating _____

NOTE: This form must be submitted in duplicate.

Dated.....this day of.....20xx

Signature of Tenderer.....

Company.....

Address.....

.....Phone.....

D.2 Appendix B - Schedule of Contract Rates

Tenderers must submit the following Schedule to allow assessment of variations:

D.2.1 Composite Rates:

The following rates must include for the supply and delivery of all materials, transport, erection and labour to complete the installation of the following elements in the works:

Description	Unit	Cost/Unit	GST	Total/Unit
Stand-down of Works	Day			

Hourly Labour Rates (including GST):

Period	Labour 1	Labour 2	Labour 3	Labour 4	Labour 5	Labour 6
Ordinary Time						
Time and a Half						
Double time						

Name of Tenderer: _____

Contract: _____

D.2.2 Piping Systems Rates

Unit rates including the supply and installation of straight lengths of pipework per metre run:

Pipe Diameter (mm)	HDPE	Medium Galvanised
80	\$_____	\$_____
100	\$_____	\$_____
150 (equivalent)	\$_____	\$_____
200 (equivalent)	\$_____	\$_____

D.2.3 Fire Hydrant System Rates

Unit rates including the supply and installation of each item of equipment:-

Item	Design phase	Construction phase	Power/water on phase
100ø valve	\$_____	\$_____	\$_____
150ø valve	\$_____	\$_____	\$_____

D.3 Appendix C - Quality Assurance Certificates

Fire Services

Quality Assurance Certificate

Sample or Equipment Detail

Project: Denmark Light Industrial Area – Fire Protection System

Project No: 301250343

Fire Services Contractor: _____

Description of Sample or Equipment Detail:

Manufacturer/Supplier: _____

Model No/Catalogue No: _____

Does sample or equipment proposed meet the requirements of the specification and drawings? **YES/NO**

If no, provide details and reasons for deviations.

Fire Services Contractors Signature: _____

Date: _____

Fire Services
Quality Assurance Certificate
Progress Claim

Project: Denmark Light Industrial Area – Fire Protection System

Project No: 301250343

Fire Services Contractor: _____

Original Contract Sum \$ _____

Adjusted Contract Amount at this date \$ _____

(Includes approved variations only)

We certify that we have completed work on this Contract to the value of \$ _____

Amount previously claimed \$ _____

Amount claimed in this certificate \$ _____

Breakdown of progress claim attached in accordance with specification **YES/NO**

Details showing calculation of adjusted contract amount attached **YES/NO**

We certify that the work completed and materials used comply with the specification, drawings,
instructions and variations. **YES/NO**

If no attach details of any alterations.

Fire Services Contractor Signature: _____

Date: _____

Fire Services
Quality Assurance Certificate
Practical Stage Completion

Project: Denmark Light Industrial Area – Fire Protection System

Project No: 301250343

Fire Services Contractor: _____

We confirm that:

The Fire Services installation is complete and ready for operation **YES/NO**

If no, attach details of any work that is incomplete.

The Fire Services installation complies with the specification, drawings, instructions and variations. **YES/NO**

If no, attach details of any deviations

Fire Services commissioning and testing has been completed and results recorded. **YES/NO**

Fire Services as Constructed Drawings and Operating and Maintenance Manuals have been provided **YES/NO**

Fire Services Contractor Signature: _____

Date: _____

Fire Services
Quality Assurance Certificate
Final completion

Project: Denmark Light Industrial Area – Fire Protection System

Project No: 301250343

Fire Services Contractor: _____

Date of Practical Completion:

Date of Final Completion:

We confirm that:

All Fire Services defects brought to our attention have been rectified

YES/NO

If no, attach details of any defects that have not been rectified.

We have recently inspected the Fire services installation and it is in efficient working order.

YES/NO

Date of inspection:

Fire Services maintenance has been carried out in accordance with the specification and we have retained copies of records of all preventative and corrective maintenance work.

YES/NO

Fire Services Contractor Signature: _____

Date: _____

D.4 Appendix D – Flow Test Result

REF: 39353/TL/19
DATE: January 30, 2019
EMAIL: denplumb@westnet.com.au
ATTENTION: Mr M. Hockley

RE: RESIDUAL FLOW AND PRESSURE TEST REPORT
COMMERICAL PREMISES C/- DENMARK PLUMBING - LOT 556 McINTOSH ROAD, DENMARK

The residual flow, pressure test and report for the above premises has been carried out to identify the on-site capabilities of the Hydrant Fire Fighting system.

The flow test result for your premises is a **FAIL** as per the following information.

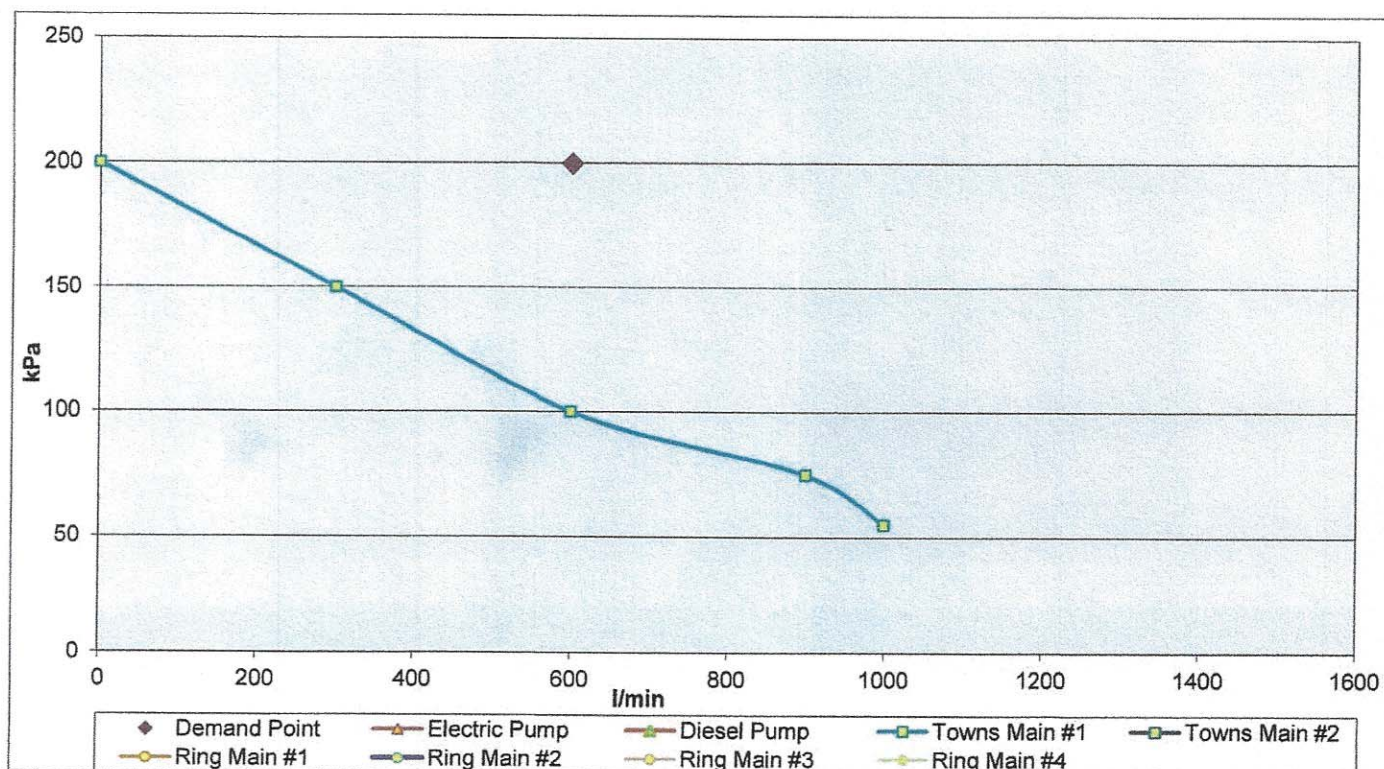
The flow requirement for your premises to achieve is a minimum flow of:
600 litres per minute & maintain a residual pressure of **200 kPa**.

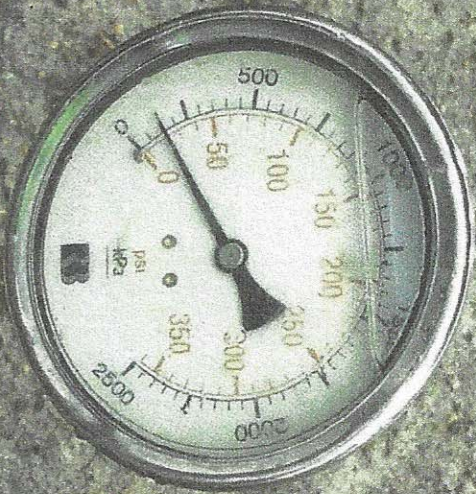
The Flow Test Outcomes are as Follows:

On this occasion we **HAVE BEEN ABLE** to flow the Street Hydrant at 8:15:00 AM
dated Thursday, January 24, 2019.

The location of the Hydrant flowed: **Street Hydrant - Centre Corymbia Crescent**

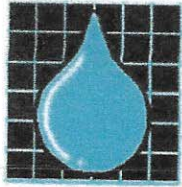
Please also refer to the below graphic depiction of the flow test result:





PROTECTOR Fire Services
For Service:
• Maintenance
• Refills
• Sales
• Training
Ph: (08) 9248 8824
www.ghostfire.com.au

PROTECTOR Fire Services
For Service:



Hockley's
**DENMARK
PLUMBING SERVICE**

Email: denplumb@westnet.com.au

Merv Hockley 49 Strickland St
(PO Box 49) Denmark WA 6333

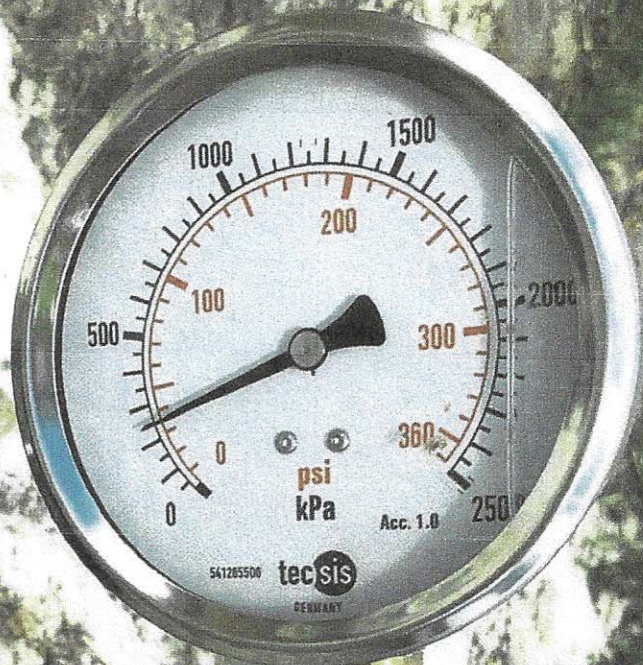
ABN: 28 286 783 658
Lic Nos: PL 1927 PL 6239

Phone : 9848 1210

STATIC PRESSURE TEST REPORT FOR LIGHT INDUSTRIAL AREA

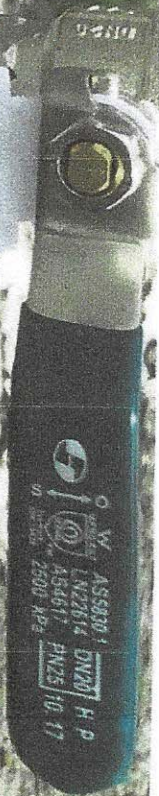
LOT 556 MCINTOSH ROAD DENMARK

HYDRANT LOCATION	PRESSURE TEST READING
FIRST HYDRANT ON MYCENA STREET OPPOSITE LOT 11	250 Kpa
CENTRE HYDRANT AT THE NORTHERN END CORYMBIA CRESCENT ADJACENT TO LOT 2	200 Kpa



OPP LOT 11

BVGAW20
BALL VALVE
G&W 20MM F/F
Tubco HYDRABOSS



D.5 Fire Brigade Minutes

DFES Meeting Minutes

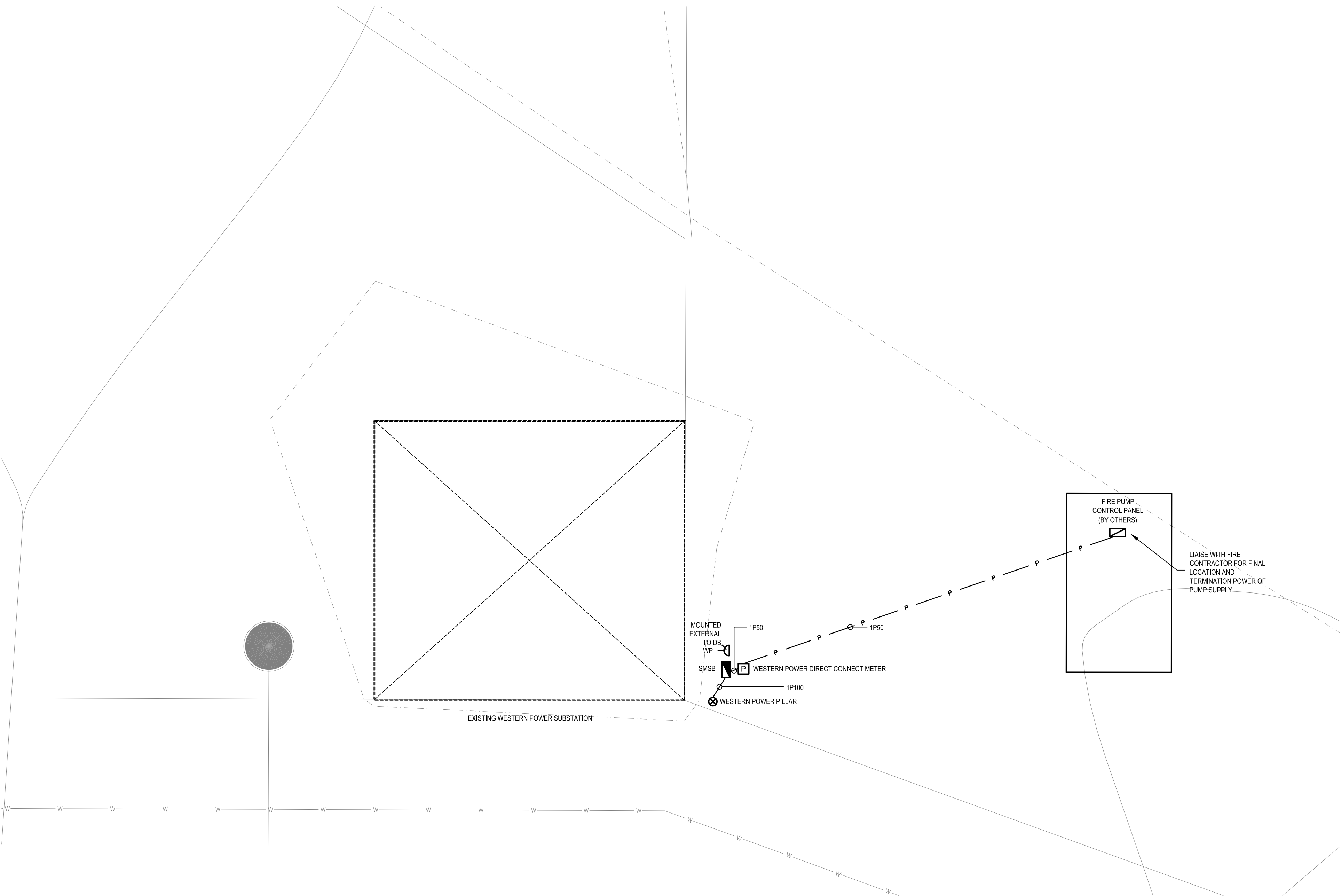
Project: Denmark Light Industrial Area – Precinct Fire Infrastructure
Project No: 301250343
Meeting held on: 06 May 2021 via Microsoft Teams

Present

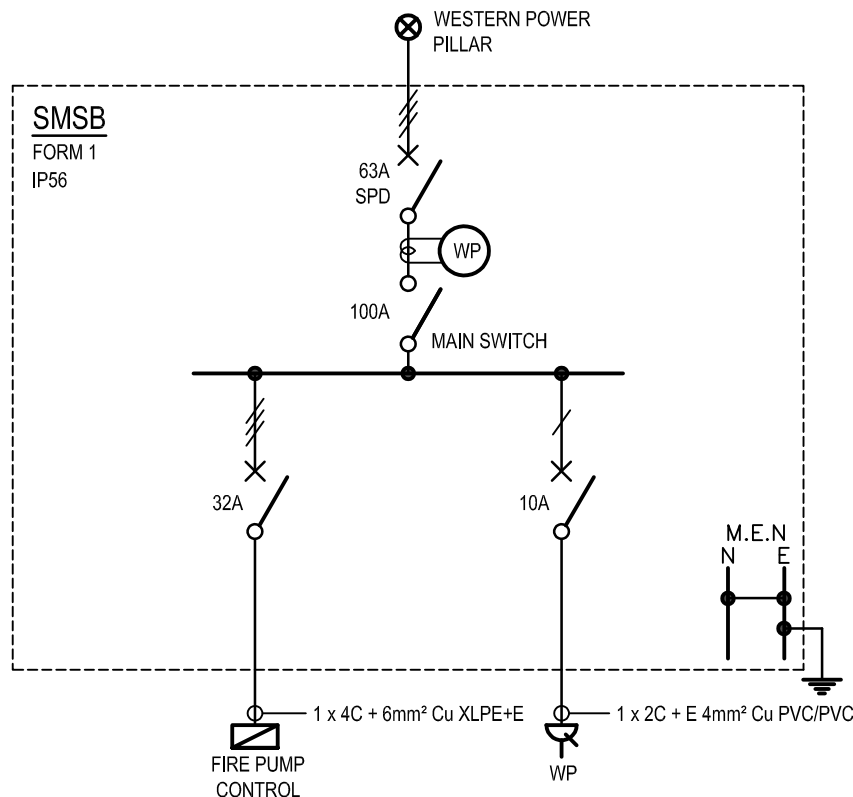
Pauric McCaughey	(PM)	Department of Fire and Emergency Services	(DFES)	pauric.mccaughey@dfes.wa.gov.au
David Smith	(DS)	Department of Fire and Emergency Services	(DFES)	david.smith@dfes.wa.gov.au
Graham Blackmore	(GB)	Shire of Denmark	(SOD)	graham.blackmore@denmark.wa.gov.au
David King	(DK)	Shire of Denmark	(SOD)	david.king@denmark.wa.gov.au
James O'Donnell	(JOD)	Stantec	(STC)	James.odonnell@stantec.com
John Pezzin	(JOP)	Stantec	(STC)	john.pezzin@stantec.com

Minutes	
1.	<h3>Introduction</h3> <p>The purpose of the meeting was to introduce the proposed Denmark Light Industrial Area (LIA) project and in particular discuss the proposed Fire Protection design and Fire Engineered Performance Solution.</p> <p>The development will achieve compliance with the Building Code of Australia (BCA) based on a combination of satisfying the prescriptive Deemed-to-Satisfy provisions and a Performance Solution.</p>
2.	<h3>Summary</h3> <p>JOD (STC) advised the Shire of Denmark have recently subdivided land at East River Road in Denmark into smaller allotments to allow for future sale or lease in the commercial / industrial area. The newly subdivided lots vary in size and are provided to allow for future warehouse / building developments.</p> <p>It is anticipated that future buildings will likely exceed 500sqm and as a result require provision of a Fire Hydrant and Hose Reel System for each separate lot in accordance with Building Code of Australia. Due to the low town mains flow and pressure in the area each separate lot would require fire pumps and tanks for fire hydrant fighting purposes.</p> <p>Shire of Denmark is now proposing to provide Fire Hydrant System infrastructure including fire pumps and tanks to service all subdivided lots in lieu of standalone separate systems per lot. This proposal is considered to establish a Shared Fire System arrangement where a shared agreement between lot titles provided for shared use, access and maintenance costs between lots is provided.</p> <p>The key features of the building include:</p> <ul style="list-style-type: none">• Class 7b and Class 8• Fire sprinkler protection requirements to future buildings at this point is unknown and not addressed as part of this meeting.

Minutes	
3.	Fire Protection Services Discussions
3.1	<p>JOD (STC) advised the proposed fire infrastructure locations and configurations for the development as follows:</p> <ul style="list-style-type: none"> • New fire hydrant system pumps (2 x diesels) and 2 x full storage tanks to support new precinct fire hydrant ringmain. • New pumproom/enclosure located in proximity to East River Road. • New fire booster cabinet adjacent fire pump and tank infrastructure with feed hydrants and booster inlets. • Infrastructure to be provided on separate lot (Crown Land). • Infrastructure to be managed by Shire with shared agreement to titles. • Fire Hydrant coverage to sites / buildings not addressed as part of this project.
4.	Performance Solution Discussions
4.1	<p>A single Performance Solutions will be implemented in the design, as follows:</p> <ul style="list-style-type: none"> • The fire hydrant system and infrastructure serving the light industrial area will be shared between different tenants. It is likely that fire hydrants will be located in the privately owned allotments in order to achieve compliant coverage. <p>The Fire Engineered Performance Solution will be reliant on agreements implemented to ensure the fire hydrant system is maintained in accordance with the Australian Standards despite the allotments being privately owned.</p> <p>The Shire of Denmark noted that the proposal had been discussed at recent council meetings. The Shire agreed to provide documentation of these discussions for inclusion in the Fire Engineering Brief/Report.</p>



FIRE PUMP ROOM
SCALE: 1:5



ABBREVIATIONS

- SMSB - DENOTES SITE MAIN SWITCHBOARD
- 1P100 ——— DENOTES 32mm UNDERGROUND CONDUIT
P ——— DENOTES HD PVC POWER CONDUIT
C ——— DENOTES WHITE CLASS 12 COMMUNICATIONS PIPE
1 DENOTES NUMBER OF CONDUITS

LEGEND

- ⚡ WEATHERPROOF DOUBLE GPO
- ⌘ RCD CIRCUIT BREAKER
- ⌘ CIRCUIT BREAKER
- ⌘ SINGLE PHASE
- ⌘ THREE PHASE
- ⌘ POWER PIT
- ⌘ DISTRIBUTION BOARD
- ⌘ DISTRIBUTION BOARD/CONTROL PANEL (BY OTHERS)
- P — POWER AND COMMUNICATIONS CONDUIT
- ⌘ WP WESTERN POWER DIRECT CONNECT METER

SPECIFICATION NOTES

- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ELECTRICAL SERVICES SECTION OF THE SPECIFICATION, THE ARCHITECTURAL DRAWINGS AND ALL OTHER RELEVANT SERVICES DRAWINGS.
- ALL EQUIPMENT AND ACCESSORIES SHALL BE NEW UNLESS NOTED OTHERWISE.
- FINAL POSITION OF ALL EQUIPMENT TO BE DETERMINED ON SITE PRIOR TO INSTALLATION. REFER TO ARCHITECTURAL FITOUT DRAWINGS.
- RATINGS AND TERMINATIONS OF ALL EQUIPMENT TO BE CONFIRMED WITH SUPPLIER/MANUFACTURER'S RECOMMENDATIONS PRIOR TO INSTALLATION.
- THE BUILDER SHALL ENGAGE THE SERVICES OF A LICENSED ELECTRICAL CONTRACTOR TO UNDERTAKE THE ELECTRICAL SERVICES AND ASSOCIATED WORKS.
- ALL WORKS ARE TO BE INSTALLED IN ACCORDANCE WITH THE AUSTRALIAN STANDARDS IN PARTICULAR AS/NZS 3000 "THE WIRING RULES." ALL ASSOCIATED MANDATORY STANDARDS, THE BUILDING CODE OF AUSTRALIA AND ALL REGULATORY AUTHORITIES REQUIREMENTS.
- THE EXTENT OF WORKS INDICATED ON THE DRAWINGS CALL FOR THE PROVISION OF SYSTEMS COMPLETE IN EVERY RESPECT, FIT AND READY FOR CONTINUOUS SAFE EFFICIENT OPERATION, THE ELECTRICAL CONTRACTOR SHALL THEREFORE SUPPLY, DELIVER, INSTALL, TEST, COMMISSION AND SET TO WORK THE SYSTEMS INDICATED ON THE DRAWINGS. THE FINISHED INSTALLATION SHALL BE COMPLETED WITH ALL NECESSARY ANGLIARY AND MINOR ITEMS, WHETHER EXPRESSLY INDICATED ON THE DRAWINGS OR NOT.
- ALL EQUIPMENT TO BE SUPPLIED AS PART OF THESE WORKS SHALL BE NEW UNLESS INDICATED OTHERWISE. ALTERNATIVE EQUIPMENT SHALL NOT BE INSTALLED UNLESS PRIOR WRITTEN APPROVAL HAS BEEN GRANTED BY THE CLIENT OR PROJECT MANAGER, SUCH APPROVAL SHALL BE TO THE DISCRETION OF THE CONSULTING ENGINEER, CLIENT OR PROJECT MANAGER.
- THE ELECTRICAL CONTRACTOR SHALL FULLY CO-ORDINATE ALL WORKS WITH THE OTHER TRADES PRIOR TO INSTALLATION. NO EXTRA COSTS WILL BE PAID FOR VARIATIONS IF CO-ORDINATION WAS NOT CARRIED OUT PRIOR TO THE INSTALLATIONS OF THE POWER SUPPLIES.
- THE ELECTRICAL CONTRACTOR SHALL INSPECT THE SITE PRIOR TO SUBMITTING A PRICE AND ENSURE THAT ALL SUNDRY ASSOCIATED WORKS ARE INCLUDED, WHETHER INDICATED ON THE DRAWINGS OR NOT.
- LOCATIONS OF EXISTING SERVICES SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE EXACT LOCATIONS AND EXTENT OF EXISTING EQUIPMENT SHALL BE VERIFIED ON SITE BY THE ELECTRICAL CONTRACTOR PRIOR TO WORK COMMENCING.
- LOCATIONS OF ALL NEW OUTLETS ETC SHOWN ON ELECTRICAL DRAWINGS ARE INDICATIVE. THE EXACT LOCATIONS, MOUNTING HEIGHTS ETC SHALL BE DETERMINED FROM THE ARCHITECT'S DIMENSIONED PLANS, SECTIONS, ELEVATIONS AND DETAILS.
- WHERE EXISTING EQUIPMENT IS INDICATED TO BE REMOVED, REMOVAL SHALL INCLUDE MAKING SAFE, DISCONNECTION OF SUBCIRCUIT WIRING, REMOVAL OF CABLING, CABLE SUPPORTS AND EQUIPMENT AND MAKING GOOD.
- ALL NEW LIGHT SWITCHES, OUTLETS AND CONNECTIONS SHALL BE LABELLED WITH THEIR RESPECTIVE CIRCUIT AND DISTRIBUTION BOARD NUMBERS WITH COLOURED IPA MARKERS. CIRCUIT SCHEDULES AT DISTRIBUTION BOARDS AFFECTED BY THESE WORKS SHALL BE UPDATED WITH NEW TYPED CIRCUIT SCHEDULES.
- PROVIDE POWER SUB CIRCUIT FROM DISTRIBUTION BOARDS TO ALL OUTLETS, FITTINGS AND APPLIANCES. POWER SUB CIRCUITS TO BE SIZED AS PER DRAWING LAYOUT. GENERAL POWER SUB CIRCUITS TO BE 20A MACB PROTECTED AND WIRED WITH 1 X 2C+E 4mm² Cu PVC/PVC CABLE, UNLESS OTHERWISE NOTED.
- IRRESPECTIVE OF THE CIRCUIT PROTECTION RATING AND CABLE SITES DETAILED IN THESE NOTES, THE COMPLETE ELECTRICAL INSTALLATION SHALL BE IN ACCORDANCE WITH AS3000. ALL SUBMAIN AND SUB-CIRCUIT CABLES SHALL BE INSTALLED ACCORDANCE WITH AS3008 TO SUIT THE FOLLOWING:
 - CIRCUIT PROTECTION RATING
 - CONDITIONS WHERE THE CABLES ARE INSTALLED
 - DERATING
 - VOLT DROP NO GREATER THAN 5% AT THE FINAL POINT OF CONNECTION
- ALL LUMINAIRES SHALL BE CLEANED PRIOR TO PRACTICAL COMPLETION.
- SUBMIT FOR APPROVAL COMPLETE WORKING DRAWINGS WITH PANEL LAYOUTS OF EACH SWITCHBOARD BEFORE MANUFACTURE.
- ALLOW TO CARRY OUT PHASE LOAD TESTING AFTER CLIENT OCCUPATION, AND LIAISE WITH CLIENT TO TEST AND RE-BALANCE LOAD DISTRIBUTION ACROSS PHASES. THE MAXIMUM OUT OF BALANCE BETWEEN ANY PHASE SHALL BE 10%.
- PROVIDE 12 MONTHS DEFECTS LIABILITY FOR THE WORKS FROM THE DATE OF PRACTICAL COMPLETION.
- PROVIDE THREE OFF HARD COPIES OF "AS-BUILT" DRAWINGS, OPERATION AND MANUFACTURER'S INFORMATION MANUAL, INCLUDING DATA SHEETS OF ALL LUMINAIRES, LAMP REPLACEMENT ORDERING DETAILS AND EMERGENCY LIGHTING SYSTEM LOG BOOK. MAINTENANCE/OPERATION MANUALS SHALL BE IN BOUND HARD COPY FORMAT. SUBMIT 1 COPY FOR APPROVAL PRIOR TO CONTRACT COMPLETION.
- ELECTRONIC FILES OF THE LATEST ARCHITECTURAL DRAWINGS WILL BE PROVIDED UPON REQUEST. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ACCURATE "AS CONSTRUCTED" DRAWINGS IN ELECTRONIC AUTOCAD AND HARD COPY FORMATS.
- PROVIDE PERMANENT LABEL AT THE SITE MAIN SWITCHBOARD TO SAY "IN THE EVENT OF FIRE, DO NOT SWITCH OFF" IN ACCORDANCE WITH AS3000.
- EXACT CONDUIT RUNS TO BE DETERMINED ON SITE.
- AVOID LOCATING PITS ALONG FOOT PATH, WHERE CABLE PITS ARE REQUIRED ALONG THE PATH WALLS, PITS SHALL BE FINISHED PLUSH WITH THE FINISH LEVEL OF THE IN SITU CONCRETE.
- ALL CONDUITS SHALL BE SEALED TO PREVENT INGRESS OF WATER AFTER INSTALLATION OF CABLING.
- WHERE POSSIBLE, POWER AND COMMUNICATION CONDUITS SHALL BE INSTALLED IN COMMON TRENCHES WITH OTHER SERVICES TRADE. ENSURE THAT THE MINIMUM REQUIRED SEPARATION IS MAINTAINED BETWEEN SERVICES THAT RUN IN COMMON TRENCH IN ACCORDANCE WITH AS3000.
- LIAISE WITH WESTERN POWER FOR THE WORKS REQUIRED.
- ALLOW TO UNDERTAKE ALL "CUSTOMER SCOPE OF WORKS" AS PER WESTERN POWER REQUIREMENTS.



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Project

DENMARK LIGHT INDUSTRIAL AREA -
FIRE PROTECTION SYSTEM

Title

LEGEND, SPECIFICATION NOTES, FIRE
PUMP ROOM LAYOUT AND SINGLE LINE
DIAGRAM

Project No.	WAPC No	Scale
301250343	-	1:5
Revision	Drawing No.	
B		

Datum:

Coord:

STORMWATER DRAINAGE

- SW.1. GENERAL
- SW.1.1. ALL THE WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DRAWINGS AND THIS SPECIFICATION AND WILL BE SUBJECT TO INSPECTIONS AND APPROVAL OF THE RELEVANT LOCAL AUTHORITY AND SUPERINTENDENT.
- SW.1.2. ANY INSTRUCTIONS FROM THE AUTHORITY PERTAINING TO THE WORKS SHALL BE REQUESTED BY THE CONTRACTOR TO BE IN WRITING AND KEPT FOR FUTURE RECORD. A RECORD OF THIS SHALL BE SUBMITTED TO THE DESIGN ENGINEER.
- SW.2. TOLERANCES
- SW.2.1. GRADES STEEPER THAN 1:50 - PLUS/MINUS 10% OF DESIGN GRADE AND PLUS/MINUS 20mm OF DESIGN INVERT LEVEL.
- SW.2.2. GRADES FLATTER THAN 1:50 - UP TO 10% STEEPER, BUT NOT LESS THAN 5% FLATTER THAN DESIGN GRADE AND PLUS/MINUS 10mm OF DESIGN INVERT LEVEL.
- SW.3. MATERIALS
- SW.3.1. ALL WORKMANSHIP AND MATERIALS USED IN THE WORKS SHALL CONFORM TO THE CURRENT AUTHORITY'S STANDARD WHERE SUCH STANDARD EXISTS. WHERE SUCH STANDARD DOES NOT EXIST, THE CURRENT AUSTRALIAN STANDARD SHALL APPLY.
- SW.3.2. CONCRETE PIPES (RC)
- SW.3.2.1. CONCRETE PIPES SHALL BE PRE-CAST REINFORCED CONCRETE PIPES CONFORMING TO AS 4058. PIPE CLASSIFICATION, AS DEFINED IN AS 4058, SHALL BE 'CLASS 2' UNLESS NOTED OTHERWISE ON THE DRAWINGS.
- SW.3.2.2. PIPES SHALL BE SOCKET AND SPIGOT RUBBER RING JOINTED UNLESS OTHERWISE AUTHORISED BY THE SUPERINTENDENT. RUBBER RING GASKETS SHALL CONFORM TO THE REQUIREMENTS OF AS 1646.
- SW.3.3. PVC PLAIN PIPES
- SW.3.3.1. RIGID PVC DRAINAGE PIPES AND FITTINGS SHALL BE CLASS STORMWATER HD WITH SOLVENT CEMENT TYPE JOINTS, MANUFACTURED IN ACCORDANCE WITH AS 1254.
- SW.3.4. PVC AND PE SLOTTED PIPES
- SW.3.4.1. SLOTTED PIPES AND ASSOCIATED FITTINGS AND JOINTING PROCEDURES SHALL COMPLY WITH AS 2349.1 'PERFORATED DRAINAGE PIPE AND ASSOCIATED FITTINGS' AND AS 1254 'PVC PIPES'.
- SW.3.4.2. UNLESS NOTED OTHERWISE ON THE DRAWINGS, SLOTTED RIGID PIPE SHALL BE DN100 CLASS 400 TYPE 1 PVC PIPE, AND SLOTTED FLEXIBLE PIPE SHALL BE DN160 CLASS 400 CORRUGATED PE PIPE.
- SW.4. PEGGING OF ACCESS CHAMBERS AND HEADWALLS
- SW.4.1. EACH ACCESS CHAMBER SHALL BE PEGGED AND LEVELLED BY THE CONTRACTOR'S ENGINEERING SURVEYOR.
- SW.5. PIPE BEDDING
- SW.5.1. PIPES SHALL BE BEDDED ON A CLEAN SAND BEDDING. PIPES CONSTRUCTED IN DRY SAND CONDITIONS SHALL BE BEDDED ON A SHAPED TRENCH BASE. PIPES CONSTRUCTED IN WET GROUND CONDITIONS SHALL BE BEDDED ON A CRUSHED ROCK (MAXIMUM 20mm PARTICLE SIZE) BEDDING.
- SW.6. SOURCE ROCK FOR ROCK PROTECTION AND ROCK PITCHING
- SW.6.1. SOURCE ROCK FOR ROCK PROTECTION AND ROCK PITCHING SHALL CONSIST OF CLEAN, SOUND, DURABLE, HARD ROCK. ROCK USED SHALL BE FRESH TO SLIGHTLY WEATHERED. ROCK THAT IS LAMINATED, FRACTURED, POROUS, OR OTHERWISE PHYSICALLY WEAK IS UNACCEPTABLE. FLAT SLAB-LIKE ROCK PIECES, WITH BREADTH OR THICKNESS LESS THAN ONE THIRD OF ITS LENGTH ARE NOT PERMITTED UNLESS GROUTING IS SPECIFIED.
- SW.6.2. ROCK FOR ROCK PROTECTION SHALL BE OF VERY HIGH TO EXTREMELY HIGH STRENGTH, AS DEFINED BY AS 1726.
- SW.6.3. ROCK FOR ROCK PITCHING SHALL BE OF MEDIUM TO HIGH STRENGTH, AS DEFINED BY AS 1726.
- SW.6.4. ROCK SIZES FOR ROCK PROTECTION SHALL BE IN ACCORDANCE WITH THE DRAWINGS.
- SW.6.5. ROCKS FOR ROCK PITCHING SHALL BE NOMINALLY 300MM UNLESS NOTED OTHERWISE ON THE DRAWINGS.
- SW.7. BACKFILLING
- SW.7.1. THE TRENCH BACKFILL DENSITY SHALL BE TESTED IN ACCORDANCE WITH THE EARTHWORKS AND QUALITY ASSURANCE - DRAINAGE SECTIONS OF THIS SPECIFICATION.
- SW.7.2. BACKFILL UNDER EXISTING ROAD PAVEMENTS SHALL BE TO 95% MMDD WITH 2% CEMENT STABILISED BACKFILL.
- SW.8. QUALITY ASSURANCE
- SW.8.1. THE CONTRACTOR SHALL PRODUCE, AND SUBMIT TO THE SUPERINTENDENT, VERIFIED STORMWATER DRAINAGE RECORDS AS FOLLOWS:

- MATERIALS SUPPLIER'S CERTIFICATES CONFIRMING MATERIALS MEET THE REQUIREMENTS OF THE STORMWATER DRAINAGE SPECIFICATION.

- DRAIN SET-OUT SURVEY RECORD - 1 PER DRAIN LINE

- DRAIN CONSTRUCTION SURVEY AS-CONSTRUCTED DETAILS - 1 PER DRAIN LINE, INCLUDING THE FOLLOWING DETAILS:

(I) PIPES - PLAN LOCATION, U/S AND D/S INVERT LEVELS, DIAMETER, LENGTH, GRADE, MATERIAL, CLASS AND BEDDING DETAILS;

(II) ACCESS CHAMBERS - PLAN LOCATION, TYPE, COVER LEVEL, BEDDING DETAILS;

(III) HEADWALLS - PLAN LOCATION, SIZE, INVERT LEVEL, TYPE, BEDDING DETAILS; AND

(IV) ROCK PROTECTION - PLAN LOCATION, TYPE, ROCK SIZE, ROCK TYPE, THICKNESS/DEPTH.

- BEDDING, SIDE SUPPORT, OVERLAY AND REFILL CONTRACTOR'S CERTIFICATES CONFIRMING COMPLIANCE WITH THE STORMWATER DRAINAGE SPECIFICATION - 1 PER DRAIN LINE;

- COMPACTION CERTIFICATES CONFIRMING COMPACTION MEETS THE REQUIREMENTS OF THE STORMWATER SPECIFICATION . FREQUENCY TO BE 1 CERTIFICATE PER DRAIN LINE, WITH TESTING AT EACH LAYER, NEAR ACCESS CHAMBERS AND ALONG LINE.
- SW.8.2. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE SUPERINTENDENT SHOULD ANY ITEM FAIL TO MEET THE SPECIFIED REQUIREMENTS, AND ADVISE OF THE PLANNED REMEDIAL ACTION TO BE TAKEN.
- SW.8.3. QUALITY ASSURANCE INFORMATION SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.
- SW.9. AS-CONSTRUCTED REQUIREMENTS
- SW.9.1. THE "AS CONSTRUCTED" SURVEY SHALL BE CARRIED OUT AND THE RESULTS RECORDED BY THE CONTRACTOR'S LICENCED SURVEYOR, THE COSTS OF WHICH SHALL BE INCORPORATED INTO THE CONTRACTOR'S LUMP SUM TENDER.
- SW.9.2. THE SURVEY SHALL INCLUDE ALL INVERT LEVELS AT ACCESS CHAMBERS, ENTRY PITS, IN-GROUND DRAINAGE RETENTION AND INFILTRATION STRUCTURES, HEADWALLS AND ENDWALLS, CENTRE TO CENTRE DISTANCE OF PITS, DISTANCES FROM CENTRE OF PITS TO HEADWALLS OR ENDWALLS, SIZE OF PIPES, TYPES OF PIPES AND BEDDING, LOCATION OF PITS IN RELATION TO ADJACENT BOUNDARIES, REDUCED LEVELS OF ACCESS CHAMBER AND ENTRY PIT COVERS.
- SW.9.3. "AS CONSTRUCTED" DRAWINGS, SHALL BE PRODUCED BY THE CONTRACTOR AND INCLUDED IN THE LUMP SUM TENDER.
- SW.9.4. THESE DRAWINGS, WHEN COMPLETED, SHALL BE SIGNED AND CERTIFIED AS ACCURATE AND CORRECT BY THE CONTRACTOR'S LICENCED SURVEYOR AND CONTRACTOR BEFORE SUBMITTING IN HARD-COPY, AND DIGITAL FORMATS TO THE SUPERINTENDENT FOR THEIR APPROVAL.
- SW.9.5. THIS INFORMATION SHALL BE SUBMITTED TO THE SUPERINTENDENT PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.



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Project

DENMARK LIGHT INDUSTRIAL AREA -
FIRE PROTECTION SYSTEM

Title

CIVIL SPECIFICATION - SHEET 3 OF 3

Project No.	WAPC No	Scale
301250343	-	-
Revision	Drawing No.	
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EARTHWORKS

E.1.	AUSTRALIAN STANDARDS
E.1.1.	EARTHWORKS SHALL BE COMPLETED IN ACCORDANCE WITH: * AS 3798 GUIDELINES ON EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS. * AS 1289 METHODS OF TESTING SOILS FOR ENGINEERING PURPOSES. * AS 2870 RESIDENTIAL SLABS AND FOOTINGS - CONSTRUCTION. * AS 1726 GEOTECHNICAL SITE INVESTIGATIONS.
E.2.	CONTRACT DETAILS
E.2.1.	THIS CONTRACT IS A LUMP SUM CONTRACT AND IS NOT SUBJECT TO ADJUSTMENT FOR RISE OR FALL OF COSTS. THE LUMP SUM TENDER SHALL INCLUDE ALL PROVISIONAL SUMS. IT IS THE TENDERER'S RESPONSIBILITY TO VISIT AND INSPECT THE SITE, TO MAKE THEIR OWN ASSESSMENT OF THE CONDITIONS OF THE SITE AND THE WORK INVOLVED, PARTICULARLY IN RELATION TO ROCK, UNSUITABLE CLAYS AND GROUNDWATER. UNFORESEEN DIFFICULTIES FOR WHICH PROVISION HAS NOT BEEN MADE IN THE TENDER WILL IN NO WAY RELIEVE THE CONTRACTOR FROM THE FULL EXECUTION OF THE CONTRACT.
E.3.	DUST CONTROL
E.3.1.	THE CONTRACTOR IS RESPONSIBLE FOR CONTROLLING AND MINIMISING THE GENERATION OF DUST ON THE SITE.
E.3.2.	THE CONTRACTOR SHALL COMPLY WITH THE PROVISIONS INCLUDED IN "A GUIDELINE FOR MANAGING THE IMPACTS OF DUST AND ASSOCIATED CONTAMINANTS FROM LAND DEVELOPMENT SITES, CONTAMINATED SITES REMEDIATION AND OTHER RELATED ACTIVITIES" PUBLISHED BY THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION IN JANUARY 2011. THIS SHALL INCLUDE, BUT IS NOT LIMITED TO, SUBMISSION OF A DUST MANAGEMENT PLAN TO THE SUPERINTENDENT AND THE LOCAL AUTHORITY WITHIN 14 DAYS OF THE DATE OF ACCEPTANCE OF TENDER. DUST GENERATING WORKS SHALL NOT COMMENCE ON SITE UNTIL APPROVAL IS RECEIVED BY THE SUPERINTENDENT AND LOCAL AUTHORITY.
E.3.3.	THE CLASSIFICATION OF THE SITE IS AS STATED IN THE TENDER SUMMARY. WHERE THE CLASSIFICATION IS NOT STATED, THE CONTRACTOR SHALL OBTAIN THIS INFORMATION FROM THE SUPERINTENDENT. THE CONTRACTOR SHALL FAMILIARISE THEMSELVES WITH THE ABOVE PUBLICATION AND PERFORM ALL MEASURES SPECIFIED THEREIN FOR THE APPLICABLE CLASSIFICATION.
E.4.	MATERIALS - STRUCTURAL FILL
E.4.1.	UNLESS SPECIFIED IN A GEOTECHNICAL REPORT, STRUCTURAL FILL SHALL BE CLEAN GRANULAR FREE DRAINING MATERIAL, WITH A MAXIMUM PARTICLE SIZE OF 2.36mm AS DEFINED IN AS 1289 AND SHALL HAVE THE FOLLOWING PROPERTIES: (i) PLASTICITY INDEX EQUAL TO 0% (I.E. NON-PLASTIC) FOR FRACTIONS FINER THAN 0.075mm. (ii) CLEAN, COHESIONLESS, FREE DRAINING CERTIFIED AS "DIEBACK FREE" AND FREE OF ALL SILTY, ORGANIC OR ANY OTHER DELETERIOUS INCLUSIONS. (iii) CONTAIN NO MORE THAN 5% (BY WEIGHT) OF FRACTIONS FINER THAN 0.075mm. (iv) THE RATIO OF MAXIMUM TO MINIMUM DENSITY SHALL BE GREATER THAN 1:20. (v) A MINIMUM PERMEABILITY OF 5m/DAY WHEN COMPACTED AT 95% MMDD.
E.4.2.	THE CONTRACTOR SHALL PROVIDE TEST RESULTS FROM A NATA REGISTERED LABORATORY.
E.5.	MATERIALS - GENERAL FILL
E.5.1.	GENERAL FILL SHALL BE CLEAN GRANULAR MATERIAL WITH MAXIMUM PARTICLE SIZE OF 37.5mm AS DEFINED IN AS 1289 AND SHALL HAVE THE FOLLOWING PROPERTIES: (i) PLASTICITY INDEX EQUAL TO 0% (IE NON-PLASTIC) FOR FRACTIONS FINER THAN 0.075mm. (ii) CLEAN, COHESIONLESS, FREE DRAINING CERTIFIED AS "DIEBACK FREE" AND FREE OF ALL SILTY, ORGANIC OR ANY OTHER DELETERIOUS INCLUSIONS. (iii) A MINIMUM PERMEABILITY OF 5m/DAY WHEN COMPACTED AT 95% MMDD.
E.5.2.	THE CONTRACTOR SHALL PROVIDE TEST RESULTS FROM A NATA REGISTERED LABORATORY.
E.6.	CLEARING
E.6.1.	THE CONTRACTOR SHALL CONFIRM WITH THE DEVELOPER WHETHER A CLEARING PERMIT IS REQUIRED PRIOR TO COMMENCING WORKS. WHERE CLEARING WORKS ARE SUBJECT TO A CLEARING PERMIT, THE CONTRACTOR SHALL OBTAIN A COPY OF THE PERMIT AND COMPLY WITH ITS CONDITIONS.
E.6.2.	CLEARING SHALL INCLUDE THE GRUBBING OUT OF TREE ROOTS TO THE DEEPER OF (A) 600mm BELOW THE NATURAL SURFACE; OR (B) 400mm BELOW THE FINISHED CUT SURFACE; OR (C) AS OTHERWISE NOTED ON THE DRAWINGS.
E.6.3.	AS LITTLE AS POSSIBLE OF THE SURFACE SOIL SHALL BE REMOVED DURING CLEARING OPERATIONS.
E.6.4.	THE CONTRACTOR SHALL TAKE PRECAUTIONS TO MINIMISE DAMAGE TO GROWING TREES AND SHRUBS, FENCES AND OTHER IMPROVEMENTS OUTSIDE THE DESIGNATED AREAS. ANY DAMAGE SHALL BE MADE GOOD AT THE CONTRACTOR'S EXPENSE.
E.6.5.	THE SPOILS OF ALL CLEARING AND GRUBBING OPERATIONS SHALL BE REMOVED FROM THE SITE. NO SPOILS OF CLEARING AND GRUBBING SHALL BE PUSHED BEYOND THE LIMITS OF THE SITE OR BURNT.
E.6.6.	THE CONTRACTOR SHALL ENSURE THAT THE MOVEMENT OF TOPSOIL AND VEGETATION MATTER DOES NOT CONTRAVENE THE REQUIREMENTS OF THE AGRICULTURAL AND RELATED RESOURCES PROTECTION ACT 1976. FOR MORE INFORMATION, CONTACT THE DEPARTMENT OF AGRICULTURE WA.
E.7.	STRIPPING OF TOPSOIL
E.7.1.	TOPSOIL IS DEFINED AS THE LAYER OF SURFACE MATERIAL CONTAINING HUMUS, ROOTS, PLANTS AND ORGANIC MATERIAL EXCEEDING 1% BY WEIGHT.
E.7.2.	EXISTING TOPSOIL SHALL BE STRIPPED FROM ALL AREAS TO BE EARTHWORKS, PRIOR TO THE COMMENCEMENT OF EARTHWORKS, AND STOCKPILED ON SITE.
E.8.	CUTTING TO DESIGN LEVELS
E.8.1.	ANY AREAS WHICH ARE OVER EXCAVATED SHALL BE REFILLED TO THE DESIGN LEVELS SHOWN ON THE DRAWINGS. ANY REFILLING SHALL BE PLACED AS SPECIFIED IN SECTIONS E.9 AND E.10 "FILLING TO DESIGN LEVELS" OF THE SPECIFICATION.
E.8.2.	ALL CUT SURFACES SHALL BE FINISHED BY PROOF ROLLING AND, WHERE SPECIFIED ON CIVIL OR LANDSCAPE DOCUMENTATION, RESPREADING OF TOPSOIL.
E.8.3.	ANY AREA IN WHICH ROCK IS EXCAVATED, THE ROCK SHALL BE OVER-EXCAVATED TO A MINIMUM DEPTH OF 600mm BELOW FINISHED LEVEL AND REPLACED WITH COMPACTED STRUCTURAL FILL.
E.9.	FILLING TO DESIGN LEVELS (STRUCTURAL FILL)
E.9.1.	STRUCTURAL FILL SHALL BE USED IN THE FOLLOWING SITUATIONS: * BACKFILL TO WALLS AND OTHER CONSTRUCTED WORKS SUCH AS PIPES, ACCESS CHAMBERS ETC. * REFILL TO OVER EXCAVATED AREAS (INCLUDING ROCK REMOVAL). * WITHIN 600mm OF ANY LOT FILLING AREAS. * SUBGRADE FILL BELOW ROAD PAVEMENTS.
E.9.2.	FILL MATERIAL SHALL BE PLACED IN LAYERS NOT EXCEEDING 300mm THICK WHICH SHALL BE VARIED TO SUIT THE MATERIAL BEING PLACED AND THE METHOD OF COMPACTION.
E.9.3.	EACH LAYER OF FILL MATERIAL SHALL BE COMPACTED TO ACHIEVE A MINIMUM DENSITY RATIO OF 95% MMDD.
E.10.	FILLING TO DESIGN LEVELS (COHESIVE SOILS)
E.10.1.	THE CONTRACTOR SHALL HAVE ANY MATERIAL, WHICH IS PROPOSED TO BE RE-UTILISED IN TRENCHES OR EARTHWORKED AREAS, TESTED TO DETERMINE CHARACTERISTICS TO ALLOW COMPACTION TO ACHIEVE A MINIMUM DENSITY RATIO OF 95% AS OBTAINED IN TEST AS 1289.5.4.1 WITH THE MMDD DETERMINED IN ACCORDANCE WITH AS 1289.5.2.1 (MODIFIED COMPACTIVE EFFORT).
E.10.2.	THE CONTRACTOR SHALL ENSURE THAT THESE MATERIALS ARE PLACED IN LAYERS AND AT A MOISTURE CONTENT AS DIRECTED BY THE GEOTECHNICAL CONSULTANT TO ACHIEVE THE DESIRED COMPACTION. TESTING TO BE PERFORMED ON LAYERS USING NUCLEAR DENSITY METHODS.
E.11.	EXCESS SPOIL
E.11.1.	IF, AFTER THE COMPLETION OF EARTHWORKS, THERE IS EXCESS SPOIL, IT SHALL BE PLACED ON SITE IF SHOWN ON THE DRAWINGS OR OTHERWISE REMOVED FROM THE SITE AT THE CONTRACTOR'S EXPENSE.

EARTHWORKS (CONTINUED)

E.12.	RE-SPREADING OF TOPSOIL
E.12.1.	THE TOPSOIL SHALL BE FREE OF VEGETATION PIECES LARGER THAN 200mm IN ANY ONE DIRECTION AND BE SPREAD UNIFORMLY TO A THICKNESS NOT LESS THAN 50mm AND NOT MORE THAN 100mm UNLESS NOTED OTHERWISE ON THE DRAWINGS.
E.12.2.	IF, AFTER THE COMPLETION OF TOPSOIL RESPREADING, THERE IS EXCESS TOPSOIL, IT SHALL BE PLACED ON SITE IF SHOWN ON THE DRAWINGS OR OTHERWISE REMOVED FROM THE SITE AT THE CONTRACTOR'S EXPENSE.
E.13.	HYDROMULCH
E.13.1.	SURFACE STABILISATION SHALL BE CARRIED OUT BY APPLICATION OF HYDROMULCH WITH SEED, UNLESS NOTED OTHERWISE ON THE DRAWINGS, TO ANY DISTURBED AREAS.
E.13.2.	HYDROMULCH SHALL BE APPLIED BY A SUBCONTRACTOR SPECIALISING IN THIS WORK.
E.13.3.	HYDROMULCH SHALL CONSIST OF A MIXTURE OF 1,200KG TO 1,400KG NEWSPAPER, 200 LITRES OF STABILISER (E.G. GLUON 240) AND 10,000 LITRES OF WATER. THE HYDROMULCH SHALL BE THOROUGHLY MIXED AND APPLIED BY PRESSURISED SPRAY AT THE RATE OF 40KL TO 50KL PER HECTARE.
E.13.4.	PRIOR TO SPRAYING THE HYDROMULCH, IF SPECIFIED BY THE SUPERINTENDENT THE AREA SHALL BE FERTILISED WITH SUPERPHOSPHATE AT THE RATE OF 200KG PER HECTARE.
E.13.5.	SEED SHALL BE INCLUDED IN THE HYDROMULCH MIX AS FOLLOWS: SEED TYPE APPLICATION RATE - CEREAL RYE 100KG PER HECTARE - WIMMERA OR MERREDIN RYE 20KG PER HECTARE - SERENA, CIRCLE VALLEY 20KG PER HECTARE OR ROSE CLOVER
E.14.	TOLERANCES
E.14.1.	THE COMPLETED EARTHWORKS LEVELS SHALL BE WITHIN PLUS 100mm OR MINUS 0mm OF THE DESIGN LEVELS WITHOUT RETAINING WALLS SHOWN ON THE DRAWINGS.
E.14.2.	WHERE RETAINING WALLS EXIST OR WILL EXIST IN THE FUTURE, THE EARTHWORKS TOLERANCE SHALL BE WITHIN PLUS 50mm OR MINUS 0mm OF THE DESIGN LEVELS SHOWN ON THE DRAWINGS.
E.14.3.	THE DESIGN LEVELS ARE THE LEVELS ON THE COMPLETED EARTHWORKS INCLUDING RESPREAD TOPSOIL.
E.15.	TESTING OF EARTHWORKS
E.15.1.	EARTHWORKS SHALL BE PROGRESSIVELY TESTED TO DEMONSTRATE THAT THE SPECIFIED COMPACTION HAS BEEN ACHIEVED.
E.15.2.	FIELD DENSITY TESTING SHALL BE COMPLETED AND CERTIFIED BY AN INDEPENDENT NATA REGISTERED LABORATORY. THE LABORATORY SHALL CALIBRATE FIELD DENSITY TESTING APPARATUS AGAINST LABORATORY TESTS.
E.15.3.	GENERAL FILL SHALL BE TESTED BY MEANS OF SAND REPLACEMENT OR NUCLEAR DENSITY TESTS.
E.15.4.	STRUCTURAL FILL MAY BE TESTED BY MEANS OF PERTH SAND PENETROMETER. A MINIMUM OF 7 BLOWS/300mm LAYER MUST BE ACHIEVED. THE CONTRACTOR MUST SUPPLY A CALIBRATION CERTIFICATE FOR EACH STRUCTURAL FILL MATERIAL USED ON SITE.
E.15.5.	UNLESS SPECIFIED IN A GEOTECHNICAL REPORT, THE FREQUENCY OF TESTING SHALL BE 1 PER 100m² PER LAYER OF FILL.
E.15.6.	ALL COSTS FOR THIS TESTING SHALL BE INCORPORATED IN THE LUMP SUM CONTRACT.
E.15.7.	THE RESULTS OF ALL TESTS SHALL BE RECORDED AND SUBMITTED ON APPROPRIATE FORMS.
E.16.	QUALITY ASSURANCE
E.16.1.	THE CONTRACTOR SHALL PRODUCE, AND SUBMIT TO THE SUPERINTENDENT, VERIFIED EARTHWORKS RECORDS AS FOLLOWS: - TOPSOIL STRIPPING CERTIFICATE CONFIRMING TOPSOIL STRIPPING MEETS THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. CERTIFICATE FREQUENCY TO BE 1 PER PROJECT OR 1 PER 5 Ha (WHICHEVER IS MORE FREQUENT). - PROOF COMPACTION CERTIFICATE CONFIRMING VERIFICATION BY GEOTECHNICAL ENGINEER THAT PROOF COMPACTION MEETS THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. CERTIFICATE FREQUENCY TO BE 1 PER PROJECT. - AS-CONSTRUCTED SURVEY SHOWING FINISHED LEVELS AND LEVELS AT MATERIALS INTERFACES CONFIRMING EARTHWORKS LEVELS MEET THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. 1 PER PROJECT. - SUPPLIER'S MATERIALS CERTIFICATES INCLUDING DIEBACK CERTIFICATION AND PERMEABILITY TESTING CONFIRMING MATERIALS MEET THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. CERTIFICATE FREQUENCY TO BE 1 PER PROJECT PER IMPORTED FILL SOURCE. - COMPACTION CERTIFICATES CONFIRMING COMPACTION OF FILL MATERIAL MEETS THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. COMPACTION FREQUENCY TO BE AS STATED IN SECTION E.12. THE CONTRACTOR SHALL PRODUCE, AND SUBMIT TO THE SUPERINTENDENT, VERIFIED ROCK-PITCHING RECORDS AS FOLLOWS: - COMPACTION CERTIFICATES CONFIRMING FOUNDATION COMPACTION MEETS THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. COMPACTION FREQUENCY TO BE 1 TEST PER ROCK-PITCHING LOCATION OR 10m LENGTH OF ROCK-PITCHING, WHICHEVER IS MORE FREQUENT. - COMPACTION CERTIFICATES CONFIRMING BACKFILL COMPACTION MEETS THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION. COMPACTION FREQUENCY TO BE 1 TEST PER LAYER PER 50m². - CONTRACTOR'S CERTIFICATES CONFIRMING MORTAR SAND:CEMENT RATIO (3:1), AND SAND : LIME : CEMENT (3:1:1) FOR LIMESTONE ROCK PITCHING, MEETS THE REQUIREMENTS OF THE EARTHWORKS SPECIFICATION - 1 PER PROJECT.
E.16.3.	QUALITY ASSURANCE INFORMATION SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.
E.17.	AS-CONSTRUCTED REQUIREMENTS
E.17.1.	THE CONTRACTOR SHALL ARRANGE FOR ALL AS-CONSTRUCTED SURVEY AND PRESENTATION OF RESULTS USING A LICENCED SURVEYOR AT THE CONTRACTOR'S EXPENSE.
E.17.2.	THE AS-CONSTRUCTED INFORMATION SHALL BE SIGNED AND CERTIFIED AS ACCURATE AND CORRECT BY THE CONTRACTOR AND THE LICENCED SURVEYOR BEFORE BEING SUBMITTED TO THE ENGINEER FOR APPROVAL. THIS INFORMATION SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.
E.17.3.	SURVEYED AS-CONSTRUCTED EARTHWORKS PLANS SHALL INCLUDE LEVELS RECORDED AT THE FOLLOWING MATERIAL INTERFACES, WHERE APPLICABLE: (a) AT OVEREXCAVATION LEVELS (TOP OF ROCK OR LIMESTONE) PRIOR TO THE PLACEMENT OF OTHER FILL TYPES; (b) AT THE INTERFACE OF ANY TWO OTHER FILL TYPES; (c) AT THE BASE OF TOPSOIL; AND (d) AT THE FINISHED SURFACE LEVEL.
E.17.5.	SURVEY LEVELS SHALL BE RECORDED AT THE FOLLOWING LOCATIONS, AT EACH MATERIAL INTERFACE:
E.17.5.1.	EARTHWORKS AREAS: (a) AT ALL CADASTRAL TRUNCATIONS AND BOUNDARIES; (b) AT THE TOP AND BOTTOM OF ALL BATTERS; AND (c) ONE READING PER 100m2.
E.17.5.2.	ROADWORKS AREAS: (a) AT TOP OF KERBS; (b) AT ROAD RESERVE BOUNDARY; (c) AT EACH ROAD GUTTER; AND (d) IN THE CENTRE OF ROAD PAVEMENTS; AT ALL ROAD HIGHPOINTS, LOW POINTS, CHANGES OF GRADE, INTERSECTION POINTS, TANGENT POINTS, AND OTHERWISE AT 25m INTERVALS FOR EACH ROAD.
E.17.6.	SURVEY READINGS SHALL BE RECORDED TO THE NEAREST 10mm.
E.17.7.	SURVEY DATA FOR EACH MATERIAL INTERFACE SHALL BE SUBMITTED TO THE ENGINEER IN BOTH PDF AND DWG/DGN FORMAT WITH THE PRE-CALCULATION PLAN OVERLAIN.
E.17.8.	PRACTICAL COMPLETION WILL NOT BE GRANTED UNTIL THIS INFORMATION HAS BEEN PROVIDED TO THE SATISFACTION OF THE ENGINEER.

ROAD WORKS

R.1.	GENERAL
R.1.1.	ALL THE WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DRAWINGS AND THIS SPECIFICATION AND WILL BE SUBJECT TO INSPECTIONS AND THE APPROVAL OF THE RELEVANT LOCAL AUTHORITY (AND ENGINEER WHERE APPLICABLE).
R.1.2.	ANY INSTRUCTIONS FROM THE AUTHORITY PERTAINING TO THE WORKS SHALL BE REQUESTED BY THE CONTRACTOR TO BE IN WRITING AND KEPT FOR FUTURE RECORD. A RECORD OF THIS SHALL BE SUBMITTED TO THE ENGINEER.
R.2.	MATERIALS
R.2.1.	ALL WORKMANSHIP AND MATERIALS USED IN THE WORKS SHALL CONFORM TO THE CURRENT AUTHORITY'S STANDARD WHERE SUCH STANDARD EXISTS. WHERE SUCH STANDARD DOES NOT EXIST THE CURRENT AUSTRALIAN STANDARD SHALL APPLY.
R.2.2.	LIMESTONE RUBBLE MATERIAL
R.2.2.1.	THE LIMESTONE RUBBLE SHALL BE OBTAINED FROM AN APPROVED SOURCE, AND SHALL BE FREE FROM SAND, CAPSTONE, ROOTS AND OTHER FOREIGN MATERIAL.
R.2.2.2.	THE PERCENTAGE OF WEAR OF THE LIMESTONE, DETERMINED BY THE LOS ANGELES TEST, SHALL NOT EXCEED SIXTY PER CENT (60%) WEIGHT LOSS.
R.2.2.3.	THE CALCIUM CARBONATE CONTENT OF THE LIMESTONE SHALL NOT BE LESS THAN SIXTY PER CENT (60%) NOR IN EXCESS OF EIGHTY PER CENT (80%) BY WEIGHT.
R.2.2.4.	NO GRADING REQUIREMENTS ARE LAID DOWN FOR THE LIMESTONE RUBBLE EXCEPT THAT THE MAXIMUM DIMENSION OF SPALLS SHALL NOT EXCEED 150mm, NOT MORE THAN 80% OF THE MATERIAL SHALL PASS THROUGH AN AS 2.36mm SIEVE AND NOT MORE THAN 15% SHALL PASS THROUGH AN AS 75 MICRON SIEVE.
R.2.2.5.	THE MAXIMUM DRY COMPRESSIVE STRENGTH VALUE SHALL NOT BE LESS THAN 700 KPA.
R.2.2.6.	SAMPLING AND TESTING OF LIMESTONE RUBBLE SHALL BE IN ACCORDANCE WITH AS 1141 AND AS 1289.
R.2.2.7.	THE MINIMUM CALIFORNIAN BEARING RATIO (CBR) SHALL NOT BE LESS THAN 50%.
R.2.2.8.	A SAMPLE SHALL BE TAKEN AND TESTED BY THE TESTING AUTHORITY FOR CALCIUM CARBONATE CONTENT, PERCENTAGE OF WEAR, GRADING, DETERMINATION OF THE MAXIMUM DRY DENSITY, MAXIMUM DRY COMPRESSIVE STRENGTH AND CBR OF THE MATERIAL. IF THE MATERIAL VARIES IN QUALITY OR IS OBTAINED FROM VARIOUS QUARRIES, EACH VARIATION IN QUALITY OR MATERIAL FROM EACH QUARRY USED SHALL HAVE THIS TEST PERFORMED BY THE TESTING AUTHORITY AND A RECORD SHALL BE MAINTAINED BY THE CONTRACTOR AS TO WHERE THE VARIOUS MATERIALS HAVE BEEN PLACED.
R.2.2.9.	ANY MATERIAL WHICH DOES NOT MEET THE ABOVE REQUIREMENTS OR WHICH, IN THE OPINION OF THE LOCAL AUTHORITY (OR ENGINEER WHERE APPLICABLE), IS COMPOSED OF MATERIAL WHICH WOULD BREAK DOWN WITH AGING OR WEATHERING TO SUCH AN EXTENT THAT IT WOULD THEN FALL OUTSIDE THE LIMITS OF THIS SPECIFICATION, SHALL BE REJECTED.
R.2.3.	CRUSHED ROCK (ROCK BASE)
R.2.3.1.	ROCK BASE MATERIAL SHALL CONSIST OF FINE CRUSHED ROCK, QUARRIED FROM AN APPROVED SOURCE AND SHALL CONSIST OF QUARTZITE, GRANITE, DIORITE, IRONSTONE OR OTHER STONE OF APPROVED HARDNESS AND DURABILITY AND SHALL BE FREE FROM CLAY LUMPS AND EXCESS ORGANIC OR OTHER DELETERIOUS MATERIALS. IT SHALL BE FRESHLY BLENDED PRIOR TO DELIVERY.
R.2.3.2.	THE GRADING OF THE PORTION PASSING AN AS 19.0mm SIEVE SHALL CONFORM TO THE FOLLOWING REQUIREMENTS: SIEVE SIZE (AS SIEVE) PERCENT BY WEIGHT PASSING 19.0mm 100% 9.50mm 70-80% 4.75mm 40-65% 2.36mm 30-50% 0.425mm 12-30% 75 micron 3-12%
	THE RATIO OF THE PORTION PASSING AS 75 MICRON SIEVE TO THE PORTION PASSING AS 0.425mm SIEVE SHALL FALL WITHIN THE RANGE 40-60%. THE PORTION OF THE TOTAL SAMPLE RETAINED ON THE AS 19.0mm SIEVE SHALL NOT EXCEED 5% OF THE TOTAL SAMPLE AND THE MAXIMUM SIZE OF ANY STONE SHALL BE 40mm.
	THE PORTION OF THE SAMPLE WHICH PASSES THE AS 0.425mm SIEVE (SOIL MORTAR) SHALL CONFORM WITH THE FOLLOWING REQUIREMENTS: THE LIQUID LIMIT SHALL NOT EXCEED 25 THE PLASTICITY INDEX SHALL NOT EXCEED 5 NOR BE LESS THAN 0.5 THE LINEAR SHRINKAGE SHALL NOT EXCEED 2% SAMPLE AND TESTING SHALL BE IN ACCORDANCE WITH AS 1141 AND AS 1289 THE DRY COMPRESSIVE STRENGTH SHALL NOT BE LESS THAN 2MPa, AS MEASURED IN ACCORDANCE WITH MRD TEST WA 140.1
R.2.3.3.	A SAMPLE SHALL BE TAKEN AND TESTED BY THE TESTING AUTHORITY FOR GRADING, DRY COMPRESSIVE STRENGTH, MAXIMUM DRY DENSITY AND CBR OF THE MATERIAL. IF THE MATERIAL VARIES IN QUALITY OR IS OBTAINED FROM VARIOUS QUARRIES, EACH VARIATION IN QUALITY, OR, MATERIAL FROM EACH QUARRY USED SHALL HAVE THIS TEST PERFORMED BY THE TESTING AUTHORITY AND A RECORD SHALL BE MAINTAINED BY THE CONTRACTOR AS TO WHERE THE VARIOUS MATERIALS HAVE BEEN PLACED.
R.2.3.4.	NOTWITHSTANDING THIS SPECIFICATION, ANY SAMPLE WHICH, IN THE OPINION OF THE ENGINEER, IS COMPOSED OF UNSUITABLE MATERIAL, OR IS COMPOSED OF MATERIAL WHICH WOULD BREAK DOWN WITH AGING OR WEATHERING TO SUCH AN EXTENT THAT IT WOULD THEN FALL OUTSIDE THE LIMITS OF THIS SPECIFICATION, SHALL BE REJECTED.
R.2.4.	LATERITE GRAVEL
R.2.4.1.	LATERITE GRAVEL SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS (a) THE GRAVEL SHALL (i) CONSIST OF A CLEAN, DURABLE LATERITE PEBBLE AND SOIL MORTAR; AND (ii) BE FREE FROM ROOTS, HUMUS, OTHER VEGETABLE MATTER AND OTHER DELETERIOUS MATERIALS. (b) SELECTION CRITERIA FOR LATERITE GRAVELS IS SUMMARISED IN THE TABLE BELOW:

BASECOURSE OR SUBBASE		TEST METHOD
PARTICLE SIZE DISTRIBUTION		
AS SIEVE SIZE (mm)	% PASSING BY MASS	AS 1141.11.1
37.5	100	
19.0	95-100	
9.5	50-100	
4.75	36-61	
2.36	25-66	
1.18	18-53	
0.600	-	
0.425	11-39	
0.30	-	
0.15	-	
0.075	4-23	
0.0135	2-11	
CLASSIFICATION LIMITS		
DUST RATIO (SEE DEFINITION BELOW THIS TABLE)	0.3 - 0.7	
LIQUID LIMIT (%)	35% MAX	AS 1289.3.9.1
PLASTICITY INDEX (%)	10% MAX	AS 1289.3.4.1
LINEAR SHRINKAGE (%)	5.0% MAX	AS 1289.3.3.2
PERCENTAGE PASSING 0.425mm SIEVE (P0.425) x LS	200 MAX	
OTHER TEST LIMITS AND MINIMUM DRYBACK REQUIREMENTS		
MAXIMUM DRY COMPRESSIVE STRENGTH (kPa)	1700 MIN.	AS 1141.52
CALIFORNIA BEARING RATIO (UNSOAKED) AT THE MAXIMUM MODIFIED DRY DENSITY SPECIFIED IN THE PROJECT AND 100% OF OPTIMUM MOISTURE CONTENT	80% MIN.	AS 1289.6.1.1
CALIFORNIA BEARING RATIO (SOAKED 4 DAYS) AT THE MAXIMUM MODIFIED DRY DENSITY SPECIFIED IN THE PROJECT AND 100% OF OPTIMUM MOISTURE CONTENT	60% MIN.	AS 1289.6.1.1
GRADING MODULUS (SEE DEFINITION BELOW THIS TABLE)	1.5 MIN.	-



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ISSUED FOR TENDER	C	LUL	FW	2021.11.11
BUILDING PERMIT ISSUE	B	LUL	FW	2021.08.23
ISSUED FOR TENDER	A	LUL	FW	2021.07.23
Revision	Rev	By	Appd	YYYY.MM.DD
	LUL	FW	1JD	2021.07.23
	Drawn	Dsgn	Chkd	YYYY.MM.DD

Issue Status

TENDER ISSUE

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Client/Client Logo



Project

DENMARK LIGHT INDUSTRIAL AREA -
FIRE PROTECTION SYSTEM

Title

CIVIL SPECIFICATION - SHEET 1 OF 3

Project No. 301250343	WAPC No -	Scale -
Revision C	Drawing No.	CI-007-GE-N1

Datum:

Coord:

ROAD WORKS (CONTINUED)

R.2.4.2.	DUST RATIO IS DEFINED AS: PERCENTAGE PASSING THE AS 75 MICRON SIEVE PERCENTAGE PASSING THE AS 600 MICRON SIEVE GRADING MODULUS IS DEFINED AS: $\frac{300 - (P_{2.36} - P_{0.425} - P_{0.075})}{100}$																																																																
R.2.4.4.	A SAMPLE SHALL BE TAKEN AND TESTED BY THE TESTING AUTHORITY FOR GRADING, DUST RATIO, LIQUID LIMIT, PLASTIC LIMIT, LINEAR SHRINKAGE, DRY COMPRESSIVE STRENGTH AND MAXIMUM DRY DENSITY OF THE MATERIAL. IF THE MATERIAL VARIES IN QUALITY OR IS OBTAINED FROM VARIOUS QUARRIES, EACH VARIATION IN QUALITY, OR, MATERIAL FROM EACH QUARRY USED SHALL HAVE THIS TEST PERFORMED BY THE TESTING AUTHORITY AND A RECORD SHALL BE MAINTAINED BY THE CONTRACTOR AS TO WHERE THE VARIOUS MATERIALS HAVE BEEN PLACED.																																																																
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R.2.5.	BITUMEN																																																																
R.2.5.1.	THE BITUMEN USED SHALL BE A STRAIGHT RUN SLIGHTLY BLOWN BITUMEN DISTILLED FROM AN ASPHALTIC BASE PETROLEUM. THE GRADE SHALL BE CLASS 170 (140-200 PASCAL SECOND VISCOSITY AT 60 DEGREE CELSIUS). THE BITUMEN SHALL CONFORM TO AS 2008 AND THE CURRENT N.A.A.S.R.A. SPECIFICATION. THE MINIMUM DENSITY AT 25 DEGREES CELSIUS SHALL BE 1.0 KG PER LITRE.																																																																
R.2.6.	BITUMEN EMULSION																																																																
R.2.6.1.	BITUMEN EMULSION SHALL CONFORM IN REGARDS TO PHYSICAL QUALITIES, SAMPLE AND TESTING WITH AS 1160, WITH THE FOLLOWING AMENDMENTS: *WATER CONTENT - THE EMULSION SHALL NOT CONTAIN MORE THAN 40% BY WEIGHT OF WATER. *SPECIFIC GRAVITY - THE SPECIFIC GRAVITY AT 16 DEGREES CELSIUS SHALL NOT BE LESS THAN 1.00. *THE BITUMEN USED SHALL BE CLASS 170.																																																																
R.2.6.2.	ALTERNATIVE SPECIFICATION CAN BE SUBMITTED BY THE CONTRACTOR PROVIDED THAT: (a) BITUMEN CONTENT - THE RESIDUAL BITUMEN CONTENT OF THE EMULSION MUST BE STATED. (b) ADDITIVES - THE ADDITION OF UP TO 2% BY VOLUME OF ADDITIVES MAY BE REQUIRED BY THE LOCAL AUTHORITY (OR ENGINEER WHERE APPLICABLE). (c) PATENTS - THE EMULSION TO BE USED SHALL BE MANUFACTURED UNDER AN APPROVED PATENT.																																																																
R.2.6.3.	THE CONTRACTOR MUST SET OUT FACILITIES AND HAVE SPRAY TANKERS AVAILABLE FOR SPRAYING EMULSION DIRECT ONTO THE ROAD.																																																																
R.2.7.	AGGREGATE																																																																
R.2.7.1.	THE AGGREGATE USED FOR SURFACING ROADS SHALL CONSIST OF CRUSHED DIORITE (OR GRANITE) STONE WHICH SHALL CONSIST OF CLEAN, TOUGH, DURABLE FRAGMENTS, FREE FROM AN EXCESS OF THIN OR ELONGATED PIECES, FREE FROM SOFT OR DISINTEGRATED PIECES, STONE COATED WITH DIRT, OR OTHER DELETERIOUS MATTER, IN COMPLIANCE WITH AS 2758.2.																																																																
R.2.7.2.	THE BULK SPECIFIC GRAVITY OF THE PARTICLES OF DIORITE SHALL NOT BE LESS THAN 2.90 (2.60 FOR GRANITE).																																																																
R.2.7.3.	FLAKINESS INDEX OF GRANITE SHALL NOT EXCEED 30.FLAKINESS INDEX OF GRANITE SHALL NOT EXCEED 30.																																																																
R.2.7.4.	THE LIMITS ON PERCENTAGE OF AGGREGATE PASSING AS SIEVES, BY MASS OF SAMPLE, SHALL BE AS FOLLOWS: <table><tr><td>NOMINAL GRADING OF AS SIEVE</td><td>5mm</td><td>7mm</td><td>10mm</td><td>14mm</td></tr><tr><td>19.0mm</td><td>-</td><td>-</td><td>-</td><td>100%</td></tr><tr><td>13.2mm</td><td>-</td><td>-</td><td>100%</td><td>95-100%</td></tr><tr><td>9.50mm</td><td>-</td><td>100%</td><td>90-100%</td><td>30-50%</td></tr><tr><td>6.70mm</td><td>-</td><td>80-90%</td><td>0-35%</td><td>-</td></tr><tr><td>4.75mm</td><td>100%</td><td>0-35%</td><td>0-2%</td><td>-</td></tr><tr><td>2.36mm</td><td>-</td><td>0-3%</td><td>0-2%</td><td>-</td></tr><tr><td>1.18mm</td><td>30-80%</td><td>0-2%</td><td>0-1%</td><td>-</td></tr><tr><td>600 MICRON</td><td>0-20%</td><td>-</td><td>-</td><td>-</td></tr></table>	NOMINAL GRADING OF AS SIEVE	5mm	7mm	10mm	14mm	19.0mm	-	-	-	100%	13.2mm	-	-	100%	95-100%	9.50mm	-	100%	90-100%	30-50%	6.70mm	-	80-90%	0-35%	-	4.75mm	100%	0-35%	0-2%	-	2.36mm	-	0-3%	0-2%	-	1.18mm	30-80%	0-2%	0-1%	-	600 MICRON	0-20%	-	-	-																			
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R.2.8.2.	THE TEMPERATURE OF THE MIX AS DELIVERED TO THE POINT OF SPREADING SHALL BE NOT LESS THAN 120 DEGREES CELSIUS.																																																																
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R.2.8.4.	THE GRADING OF THE MIX SHALL CONFORM TO THE FOLLOWING LIMITS ON PERCENTAGE PASSING AS SIEVES, BY MASS OF SAMPLE: <table><tr><td>NOMINAL MIX SIZE AS SIEVE</td><td>AC7</td><td>AC10</td><td>AC14</td></tr><tr><td>19.0mm</td><td>-</td><td>-</td><td>100%</td></tr><tr><td>13.2mm</td><td>-</td><td>100%</td><td>85-100%</td></tr><tr><td>9.50mm</td><td>100%</td><td>90-100%</td><td>70-85%</td></tr><tr><td>6.70mm</td><td>90-100%</td><td>70-90%</td><td>62-75%</td></tr><tr><td>4.75mm</td><td>68-88%</td><td>58-76%</td><td>53-70%</td></tr><tr><td>2.36mm</td><td>49-67%</td><td>40-58%</td><td>35-52%</td></tr><tr><td>1.18mm</td><td>37-53%</td><td>27-44%</td><td>24-40%</td></tr><tr><td>600 MICRON</td><td>25-41%</td><td>17-35%</td><td>15-30%</td></tr><tr><td>300 MICRON</td><td>15-27%</td><td>11-24%</td><td>10-24%</td></tr><tr><td>150 MICRON</td><td>8-16%</td><td>7-16%</td><td>7-16%</td></tr><tr><td>75 MICRON</td><td>4-8%</td><td>4-7%</td><td>4-7%</td></tr><tr><td>BITUMEN CONTENT TO BE5</td><td>-7%</td><td>5-7%</td><td>4.5-6.5%</td></tr><tr><td>MINIMUM MARSHALL STABILITY OF COMPACTED MIX</td><td>5.5kN</td><td>6.5kN</td><td>6.5kN</td></tr><tr><td>MARSHALL FLOW VALUE</td><td>2-4mm</td><td>2-4mm</td><td>2-4mm</td></tr><tr><td>PERCENTAGE VOIDS IN COMPACTED MIX TO BE IN THE RANGE OF</td><td>3-5%</td><td>3-7%</td><td>3-7%</td></tr></table>	NOMINAL MIX SIZE AS SIEVE	AC7	AC10	AC14	19.0mm	-	-	100%	13.2mm	-	100%	85-100%	9.50mm	100%	90-100%	70-85%	6.70mm	90-100%	70-90%	62-75%	4.75mm	68-88%	58-76%	53-70%	2.36mm	49-67%	40-58%	35-52%	1.18mm	37-53%	27-44%	24-40%	600 MICRON	25-41%	17-35%	15-30%	300 MICRON	15-27%	11-24%	10-24%	150 MICRON	8-16%	7-16%	7-16%	75 MICRON	4-8%	4-7%	4-7%	BITUMEN CONTENT TO BE5	-7%	5-7%	4.5-6.5%	MINIMUM MARSHALL STABILITY OF COMPACTED MIX	5.5kN	6.5kN	6.5kN	MARSHALL FLOW VALUE	2-4mm	2-4mm	2-4mm	PERCENTAGE VOIDS IN COMPACTED MIX TO BE IN THE RANGE OF	3-5%	3-7%	3-7%
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MINIMUM MARSHALL STABILITY OF COMPACTED MIX	5.5kN	6.5kN	6.5kN																																																														
MARSHALL FLOW VALUE	2-4mm	2-4mm	2-4mm																																																														
PERCENTAGE VOIDS IN COMPACTED MIX TO BE IN THE RANGE OF	3-5%	3-7%	3-7%																																																														
R.2.8.5.	RED ASPHALT MIXES SHALL ALSO CONFORM TO THE FOLLOWING REQUIREMENTS- (A) THE MIX SHALL INCLUDE A MIXTURE OF GRANITE AND LATERITE AGGREGATES. (B) A 10mm NOMINAL SIZED MIX IS REQUIRED UNLESS NOTED OTHERWISE ON THE DRAWINGS. (C) THE MIX DESIGN SHALL BE BASED ON THE USED OF CRUSHED LATERITE AGGREGATES. (D) THE MIXES SHALL INCLUDE- (I) A MINIMUM OF 15% BY MASS OF NOMINAL SIZED 10mm GRANITE AGGREGATE IN THE TOTAL AGGREGATE; AND (II) A MAXIMUM OF 30% BY MASS OF GRANITE AGGREGATES OF THE TOTAL AGGREGATE. (E) SAND SHALL NOT BE USED. (F) BITUMEN SHALL CONFORM TO THE FOLLOWING REQUIREMENTS- (I) CLASS 170 BITUMEN (NORMAL MIX) SHALL BE USED IN AREAS NOT SUBJECT TO HIGH STRESSES (SUCH AS BRAKING, ACCELERATION AND TURNING ZONES). (II) CLASS 320 BITUMEN (HEAVY DUTY MIX) SHALL BE USED IN AREAS NOT SUBJECT TO HIGH STRESSES (SUCH AS BRAKING, ACCELERATION AND TURNING ZONES). (G) RED IRON OXIDE PIGMENT SHALL BE INCORPORATED. THE RED OXIDE PIGMENT (MINOX F201 OR APPROVED EQUIVALENT) SHALL NOT EXCEED 1% BY MASS OF THE MASS OF THE TOTAL MIX. (H) WHEN TESTED IN ACCORDANCE WITH ROADS WESTERN AUSTRALIA METHOD WA 341.1 THE LATERITE MIX, SHALL HAVE A VALUE FOR CHROMA (C*) NOT LESS THAN 6.5.																																																																
R.3.	ROAD CROSSING - IRRIGATION, UPD, WATER AND OTHER UTILITY SERVICES																																																																
R.3.1.	THE CONTRACTOR SHALL SUPPLY AND INSTALL DUCTS FOR ALL SERVICES AT THE LOCATIONS AND TO THE SIZES AS SHOWN ON THE DRAWINGS PRIOR TO CONSTRUCTING ROADWORKS.																																																																
R.3.2.	DUCTS TO HAVE MINIMUM 750mm COVER UNDER ROADS AND 550mm COVER WITHIN VERGES.																																																																

ROAD WORKS (CONTINUED)

R.4.	CONSTRUCTION
R.4.1.	SUB-GRADE
R.4.1.1.	THE ENTIRE WIDTH OF THE ROAD RESERVE SHALL BE STRIPPED OF ALL ORGANIC AND DELETERIOUS MATERIAL, THEN CUT OR FILLED AS NECESSARY TO CONFORM WITH THE LEVELS GIVEN ON THE DRAWINGS.
R.4.1.2.	SUB-GRADE SHALL BE COMPACTED TO NOT LESS THAN 95% OF THE MAXIMUM DRY DENSITY OBTAINED IN MODIFIED MAXIMUM DRY DENSITY COMPACTION TESTS (AS 1289.5.2.1) TO A MINIMUM DEPTH BELOW THE SURFACE OF 300mm. SUB-GRADE SHALL BE FORMED TO GRADE, CROSSFALL ETC. TO ENSURE THAT AN EVEN THICKNESS OF PAVEMENT CAN BE FINALLY ACHIEVED.
R.4.1.3.	SUB-BASE OR BASECOURSE CONSTRUCTION SHALL NOT COMMENCE UNTIL SUBGRATE HAS DRIED BACK SUCH THAT THE DRYBACK CHARACTERISTIC MOISTURE CONTENT (DMC) IS EQUAL TO OR LESS TO 85% OR AS OTHERWISE SPECIFIED IN THE PROJECT.
R.4.2.	BASE COURSE
R.4.2.1.	THE BASE MATERIAL SHALL BE PLACED SO THAT THE SUB-GRADE OR THE SUB-BASE (WHEN A SUB-BASE HAS BEEN SPECIFIED), IS NOT DISTURBED AND BROKEN UP AND THAT AN EVEN THICKNESS IS OBTAINED.
R.4.2.2.	THE BASE SHALL BE WATERED, COMPACTED AND CUT TO GRADE AND CROSSFALL AS NOTED ON THE DRAWINGS. COMPACTION SHALL BE TO NOT LESS THAN 98% OF THE MAXIMUM DRY DENSITY OBTAINED IN MODIFIED MAXIMUM DRY DENSITY COMPACTION TESTS (AS 1289.5.2.1).
R.4.2.3.	THE SURFACE OF THE BASE COURSE AFTER TRIMMING AND COMPACTION SHALL BE EVEN AND TRUE TO THE REQUIRED SHAPE, GRADE AND SURFACE CONDITION READY FOR PRIMING.
R.4.2.4.	NO BINDER SHALL BE APPLIED TO A BASECOURSE UNTIL IT HAS DRIED BACK SUCH THAT THE DRYBACK CHARACTERISTIC MOISTURE CONTENT OF BOTH THE UPPER HALF AND LOWER HALF OF THE BASECOURSE LAYER IS EQUAL TO OR LESS TO 60% OR AS OTHERWISE SPECIFIED IN THE PROJECT.
R.4.3.	ASPHALTIC CONCRETE SURFACING
R.4.3.1.	PRIMER SEAL
R.4.3.1.1.	PRIMER SEALING SHALL BE CARRIED OUT UNDER FAVOURABLE WEATHER CONDITIONS AND THE PREPARED BASECOURSE SHALL BE SUFFICIENTLY DRY TO PERMIT ADHERENCE TO AND PENETRATION OF THE BASECOURSE BY THE BITUMEN.
R.4.3.1.2.	BEFORE PRIMER SEALING, THE PAVEMENT SHALL BE BROOMED FREE OF ALL LOOSE MATERIAL AND DUST AND ANY DEFECTS SHALL BE MADE GOOD. SHOULD CONDITIONS REQUIRE IT, THE SURFACE SHALL BE LIGHTLY WATERED IMMEDIATELY PRIOR TO THE APPLICATION OF THE PRIMER.
R.4.3.1.3.	NO PRIMER SEALING SHALL BE APPLIED WHILST THE PAVEMENT SURFACE TEMPERATURE IS LESS THAN 15°C OR DURING WET, WINDY OR RAINY CONDITIONS, OR WHEN ADVERSE WEATHER CONDITIONS MAY PREVAIL AT ANY TIME DURING OR IMMEDIATELY FOLLOWING THE WORK.
R.4.3.1.4.	THE PROPORTION OF CUTTER OIL IN CUT-BACK BITUMEN AND APPLICATION RATE SHALL BE DEPENDANT ON THE CONDITION OF THE BASE SURFACE AND TRAFFIC DENSITY. THE RESIDUAL APPLICATION RATE OF PRIMER BINDER SHOULD BE APPROXIMATELY 0.8 TO 1.0 LITRES PER SQUARE METRE (MEASURED AT 15 DEGREES CELSIUS). HOWEVER, THE CONTRACTOR IS RESPONSIBLE TO ASSESS THE CONDITIONS AND WITH APPROVAL FROM THE LOCAL AUTHORITY (OR ENGINEER WHERE APPLICABLE), ADJUST THESE APPLICATION RATES TO SUIT.
R.4.3.1.5.	A BITUMEN EMULSION PRIMER SEAL MAY BE USED BY THE CONTRACTOR WITH PRIOR APPROVAL OF THE LOCAL AUTHORITY (OR ENGINEER WHERE APPLICABLE).
R.4.3.1.6.	THE PRIMED SURFACE SHALL BE COVERED WITH 5mm AGGREGATE SCREENINGS AT A SUFFICIENT RATE TO ACHIEVE A UNIFORM DENSE MAT WITH NO EXCESS SURFACE BITUMEN. THE AGGREGATE SHALL BE ROLLED WITH A 6 - 8 TONNE ROLLER UNTIL SCREENINGS ARE FIRMLY EMBEDDED IN THE PRIMER. SHOULD ANY GENERAL CRUSHING OCCUR UNDER THE ROLLERS, SUCH ROLLING SHALL BE STOPPED AND DIRECTION SOUGHT FROM THE LOCAL AUTHORITY (OR ENGINEER WHERE APPLICABLE) REGARDLESS OF THE NUMBER OF ROLLS COMPLETED.
R.4.3.2.	OPEN TO TRAFFIC AND PREPARATION OF SURFACE
R.4.3.2.1.	IF THE ROAD IS TO BE LEFT OPEN TO TRAFFIC BEFORE FINAL SURFACING, AGGREGATE MUST BE SWEEPED WHEREVER REQUIRED TO REMEDY HEAPING AND CORRUGATION AND, AS SOON AS THERE IS NO DANGER OF BITUMEN BEING PICKED UP BY TRAFFIC, THE SURPLUS MAY BE SWEEPED OFF.
R.4.3.2.2.	PRIOR TO ASPHALTING OCCURRING, THE EXISTING PRIMER SEAL SURFACE SHALL BE INSPECTED AND ANY REQUIRED CORRECTIONS OF DEFECTS AGREED WITH THE LOCAL AUTHORITY (AND ENGINEER WHERE APPLICABLE) SHOULD BE UNDERTAKEN.
R.4.3.2.3.	EXCESS BINDER SHALL BE REMOVED FROM ANY FAULTY AREAS, POT-HOLES AND DEPRESSIONS FILLED WITH SUITABLE MATERIAL AND ANY DEVIATIONS TO THE PAVEMENT SHAPE CORRECTED PRIOR TO THE APPLICATION OF THE TACK COAT. IF DIRECTED, THE WHOLE SURFACE MUST BE GIVEN A SECOND PRIMER SEAL COAT.
R.4.3.2.4.	POT HOLES SHALL BE REPAIRED BY CUTTING BACK INTO SOUND ROAD MATERIAL, WITH VERTICAL FACES, FILLING AND COMPACTING IN LAYERS WITH ROAD BASE MATERIAL, AND RE-SEALED.
R.4.3.3.	TACK COAT
R.4.3.3.1.	WHEN READY FOR ASPHALTING, THE PRIMER SEALED SURFACE SHALL BE BROOMED FREE OF ALL LOOSE MATERIAL AND A TACK COAT SHALL BE APPLIED TO PROVIDE A "KEY" FOR THE ASPHALTIC CONCRETE.
R.4.3.3.2.	APPLICATION SHALL TAKE PLACE NOT LESS THAN 30 MINUTES NOR MORE THAN 2 HOURS BEFORE PLACING ASPHALTIC CONCRETE.
R.4.3.3.3.	THE TACK COAT APPLICATION RATE SHALL ACHIEVE A RESIDUAL BITUMEN OF 0.1 TO 0.2 LITRES PER SQUARE METRE. WITH APPROVAL FROM THE LOCAL AUTHORITY (OR ENGINEER WHERE APPLICABLE), THIS RATE MAY BE VARIED TO SUIT THE CLASS OF MATERIAL.
R.4.3.3.4.	NO ASPHALT SHALL BE LAID ON AN EMULSION TACK COAT UNTIL THE EMULSION HAS BROKEN AND THE WATER HAS SUBSTANTIALLY EVAPORATED.
R.4.3.3.5.	ANY POOLS OF TACK COAT WHICH MAY HAVE FORMED IN SURFACE DEPRESSIONS SHALL BE BRUSHED OUT.
R.4.3.4.	ASPHALTIC CONCRETE
R.4.3.4.1.	ASPHALTIC CONCRETE SHALL BE LAID AT A RATE SO AS TO ACHIEVE A COMPACTED THICKNESS AS NOMINATED ON THE DRAWINGS, USING A 7mm OR 10mm NOMINAL AGGREGATE GRADED MIX AS NOMINATED ON THE DRAWINGS.
R.4.3.4.2.	THE ASPHALTIC CONCRETE MIX SHALL BE PLACED AT A MINIMUM TEMPERATURE OF 140 DEGREES CELSIUS IMMEDIATELY ON DELIVERY TO THE SPREADER AND IN THE PRESENCE OF EXPERIENCED PERSONNEL. THE TEMPERATURE OF THE ASPHALTIC CONCRETE AT THE TIME OF INITIAL ROLLING MUST NOT FALL BELOW 120 DEGREES CELSIUS. SPREADING OF MATERIAL BELOW THIS TEMPERATURE WILL NOT BE PERMITTED. NO ASPHALTIC CONCRETE SHALL BE PLACE WHEN THE AMBIENT TEMPERATURE IS LESS THAN 10 DEGREES CELSIUS.
R.4.3.4.3.	THE ASPHALTIC CONCRETE SHALL BE PLACED IN ONE LAYER BY AN APPROVED SELF PROPELLED MACHINE SPREADER, CONFORMING TO AS 2150.
R.4.3.4.4.	COMPACTION SHALL BE ACCORDANCE WITH AS 2150 EXCEPT AS FOLLOWS: COMPACT INITIALLY BY ROLLING WITH AT LEAST TWO COVERAGES OF THE SMOOTH, STEEL DRUM TANDEM ROLLER AS SPECIFIED UNDER THE CLAUSE ON "PLANT". IMMEDIATELY FOLLOWING THE INITIAL ROLLING AND WHILE THE ASPHALTIC CONCRETE IS STILL HOT, ROLL WITH NOT LESS THAN TWELVE COVERAGES OF THE SELF-PROPELLED PNEUMATIC-TYRED ROLLER, OF MASS NOT EXCEEDING 12 TONNES, AS SPECIFIED UNDER THE CLAUSE ON "PLANT". ROLL FINALLY WITH A MAXIMUM OF TWO COVERAGES OF THE SMOOTH, STEEL DRUM ROLLER WHILE THE ASPHALTIC CONCRETE IS SUFFICIENTLY WARM, TO PRODUCE A SMOOTH, DENSE SURFACE.
R.4.3.4.5.	IF THE ASPHALTIC CONCRETE BEGINS TO SHOVE OR CRACK, IN NO CIRCUMSTANCES CONTINUE WITH ROLLING UNTIL THE CAUSE HAS BEEN DETERMINED AND CORRECTIVE MEASURES TAKEN. KEEP DRUMS AND WHEELS OF ROLLERS WET WITH WATER AND CLEAN DURING ALL ROLLING OPERATIONS.
R.4.3.4.6.	FORM ANY JOINTS NECESSARY AND ENSURE THAT THE FINISHED PROFILE IS SMOOTH AND EVEN OVER THE JOINTS WITHOUT RIDGES OR DEPRESSIONS. JOINTS SHALL BE WATERPROOF. JOINTS SHALL BE IN ACCORDANCE WITH AS 2150.

R.4.3.4.7.	THE DENSITY OF THE COMPACTED CONCRETE SHALL BE NOT LESS THAN 97% OF THE MARSHALL MAXIMUM DENSITY.
R.4.3.4.8.	THE DESIGN LEVELS GIVEN ON THE DRAWINGS INDICATE THE LEVELS OF THE FINISHED ROAD SURFACE.
R.4.3.4.9.	SAMPLES OF THE COMPACTED ASPHALTIC CONCRETE SHALL BE TAKEN BY AN APPROPRIATE TESTING CONSULTANT. THE DEPTH OF LAYER AND FIELD DENSITY SHALL BE DETERMINED. ALL DENSITY HOLES SHALL BE REPAIRED BY THE CONTRACTOR.
R.4.3.4.10.	THE CONTRACTOR SHALL SUBMIT A RECORD OF THE GRADING OF THE MIX AND ANY TEST RESULTS REQUIRED BY THE ENGINEER, TO THE LOCAL AUTHORITY (AND ENGINEER WHERE APPLICABLE).
R.4.4.	EXTRUDED CONCRETE KERBING
R.4.4.1.	CONCRETE SHALL CONFORM TO AS 3600 AND SHALL BE SUPPLIED BY A CONCRETE SUPPLIER CONFORMING WITH AS 1379.
R.4.4.2.	CONCRETE STRENGTH SHALL BE TESTED BY MEANS OF PRODUCT ASSESSMENT METHODS IN ACCORDANCE WITH SECTION 5 AND 6 OF AS 1379. THE CONTRACTOR SHALL REGISTER THE PROJECT AND ARRANGE FOR THE RESULTS TO BE SENT TO THE LOCAL AUTHORITY (AND ENGINEER WHERE APPLICABLE).
R.4.4.3.	KERBS TO ROADS SHALL BE CONSTRUCTED OF EXTRUDED CONCRETE KERBING. KERBING TO SMALLER RADII THAN CAN BE PLACED WITH THE EXTRUSION MACHINE USED SHALL BE CAST INSITU TO THE SAME CROSS SECTION AS THAT OF THE EXTRUDED KERBING, EXCEPT THAT THE CAST INSITU KERB SHALL BE 100mm DEEPER THAN THE EXTRUDED KERBING AND SHALL BE EMBEDDED FIRMLY IN THE ROAD SURFACE TO THE EXTRA DEPTH. THE OUTWARD APPEARANCE OF THE EXTRUDED AND CAST INSITU KERBING SHALL BE IDENTICAL.
R.4.4.4.	ALL KERBING SHALL BE CONSTRUCTED FROM 32 MPa 28 DAY CYLINDER TEST COMPRESSIVE STRENGTH CONCRETE MANUFACTURED IN ACCORDANCE WITH AS 3600 FOR 10mm AGGREGATE WITH A MAX 50mm SLUMP.
R.4.4.5.	THE FINAL SHAPE AND DIMENSIONS OF THE EXTRUDED KERB SHALL BE AS DETAILED ON THE DRAWINGS. THE TOP SURFACE OF THE KERB SHALL ALWAYS BE PARALLEL TO THE RULING GRADE OF THE PAVEMENT, WITH GENTLE TRANSITIONS AT CHANGES IN GRADE.
R.4.4.6.	THE WIDTH OF THE ROAD SHALL BE THE DISTANCE BETWEEN THE KERBS ALONG STRAIGHT SECTIONS OF THE ROAD MEASURED AT RIGHT ANGLES TO THE KERBS FROM TOE TO TOE AND SHALL BE AS DETAILED ON THE DRAWINGS. THE KERBS SHALL BE EQUIDISTANT FROM THE ROAD CENTRE LINE. AT ROAD JUNCTIONS AND INTERSECTIONS, THE RADIUS OR KERBING SHALL BE MEASURED FROM THE ROAD SIDE TOE OF THE KERB.
R.4.4.7.	ANY KERBING MARKED BY BITUMEN SPRAY SHALL BE MADE GOOD BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE.
R.4.4.8.	THE BACKFILLING TO KERBING SHALL BE PLACED AS SHOWN ON THE DRAWINGS AFTER THE CURING, PLACEMENT OF JOINTS, AND ACCEPTANCE OF THE KERBING. THE BACKFILL MATERIAL SHALL BE A SIMILAR MATERIAL TO THE LOCALLY OCCURRING TOPSOIL, FREE FROM DEBRIS AND COMPACTED ADEQUATELY TO ACCOMMODATE THE DRIVING OF RUBBER TYRED DOMESTIC VEHICLES.
R.4.4.9.	CONTRACTION JOINTS
R.4.4.9.1.	CONTRACTION JOINTS SHALL BE CONSTRUCTED AT 2.0m INTERVALS (UNLESS NOTED OTHERWISE ON THE DRAWINGS) AND AT TANGENT POINTS OF SWEEPS BY COMPLETE SEPARATION OF ADJOINING SECTIONS OF THE KERB IMMEDIATELY AFTER EXTRUSION, USING A WET KNIFE THROUGH THE FULL DEPTH OF KERB.
R.4.4.9.2.	THE EXTRUDED KERB SHALL BE FINISHED BY MEANS OF A KERB-SHAPED SCREED.
R.4.4.9.3.	THE FINISHING SHALL FOLLOW IMMEDIATELY AFTER THE CUTTING OF CONTRACTION JOINTS. THE FINISHING SHALL BRIDGE OVER THE CONTRACTION JOINTS TO FORM A CONTINUOUS COVER.
R.4.4.9.4.	EACH CONTRACTION JOINT POSITION SHALL BE CLEARLY MARKED BY A GROOVE CUT IN THE FINISHED SURFACE ON THE ENTIRE EXPOSED FACE OF THE KERB BEFORE THE CONCRETE HAS SET, TO A DEPTH OF 15-20mm.
R.4.4.10.	EXPANSION JOINTS
R.4.4.10.1.	NOT LESS THAN 24 HOURS AFTER PLACING OF THE KERB, EXPANSION JOINTS SHALL BE CONSTRUCTED AT EVERY SECOND CONTRACTION JOINT. THE EXPANSION JOINTS SHALL BE FORMED BY THE SAWING OF A 10mm GAP THAT COMPLETELY SEVERS THE ADJOINING SECTIONS OF THE KERB. THE GAP SHALL BE FILLED WITH APPROVED JOINT FILLER AFTER THE LOCAL AUTHORITY (AND ENGINEER WHERE APPLICABLE) HAVE INSPECTED AND APPROVED THE CUT JOINTS.
R.4.4.10.2.	EXPANSION JOINTS SHALL BE PLACED WHERE THE KERB MEETS A SIDE ENTRY OR COMBINATION PIT.
R.5.	TOLERANCES
R.5.1.	FINISHED SUBGRADE LEVEL: +5mm or -30mm OF DESIGN
R.5.2.	FINISHED BASECOURSE LEVEL: +10mm or -10mm OF DESIGN
R.5.3.	FINISHED BASECOURSE WIDTH: +300mm or -0mm OF DESIGN
R.5.4.	FINISHED BASECOURSE THICKNESS: -0mm OF DESIGN
R.5.5.	FINISHED BASECOURSE GRADE: + or - 20% OF DESIGN
R.5.6.	FINISHED BASECOURSE SURFACE: +15mm or -15mm WHEN TESTED WITH A 3m STRAIGHT EDGE
R.5.7.	WIDTH OF PRIME FOR AC: +150mm or -0mm OF DESIGN
R.5.8.	THICKNESS OF AC: +5mm or -0mm OF DESIGN
R.5.9.	FINISHED AC OR PAVING LEVEL: +10mm or -0mm OF DESIGN
R.5.10.	KERBING SURFACE: +10mm or -10mm FROM 3m STRAIGHT EDGE
R.5.11.	KERBING LEVEL: +10mm or -10mm OF DESIGN
R.5.12.	KERBING LINE: +10mm or -10mm OF DESIGN

R.6.	QUALITY ASSURANCE
R.6.1.	THE CONTRACTOR SHALL SUPPLY COMPACTION CERTIFICATES CONFIRMING COMPACTION OF THE SUBGRADE MEETS THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 TEST PER 100m2.
R.6.2.	THE CONTRACTOR SHALL SUPPLY COMPACTION CERTIFICATES CONFIRMING COMPACTION OF THE BASECOURSE MEETS THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 TEST PER 100m2.
R.6.3.	THE CONTRACTOR SHALL SUPPLY SUPPLIER'S CERTIFICATES CONFIRMING THE BASECOURSE MATERIAL MEETS THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 PER PROJECT.
R.6.4.	THE CONTRACTOR SHALL SUPPLY CONTRACTOR'S CERTIFICATES CONFIRMING THE SUBGRADE LEVELS MEET THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 PER PROJECT.
R.6.5.	THE CONTRACTOR SHALL SUPPLY CONTRACTOR'S CERTIFICATES CONFIRMING THE BASECOURSE LEVELS MEET THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 PER PROJECT.
R.6.6.	THE CONTRACTOR SHALL SUPPLY CONTRACTOR'S CERTIFICATES CONFIRMING THE APPLICATION OF AC (THICKNESS, COMPACTION, LEVELS, CHECK FOR PONDING, FINISH) MEETS THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 PER PROJECT.
R.6.7.	THE CONTRACTOR SHALL SUPPLY CONTRACTOR'S CERTIFICATES CONFIRMING THE APPLICATION OF THE LATERITE SEAL (THICKNESS, COMPACTION, LEVELS, CHECK FOR PONDING, FINISH) MEETS THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 PER PROJECT.
R.6.8.	THE CONTRACTOR SHALL SUPPLY CONTRACTOR'S CERTIFICATES CONFIRMING THE CONSTRUCTION OF KERBING (ALIGNMENT, LEVELS, FINISH, WIDTH BETWEEN EXPANSION JOINTS, CURING) MEETS THE REQUIREMENTS OF THE ROADWORKS SPECIFICATION. TEST FREQUENCY TO BE AT LEAST 1 PER PROJECT.
R.6.9.	THIS INFORMATION SHALL BE SUBMITTED TO THE SUPERINTENDENT PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.
R.7	AS-CONSTRUCTED REQUIREMENTS
R.7.1.	THE CONTRACTOR SHALL ARRANGE FOR ALL AS-CONSTRUCTED SURVEY, TESTING OF THICKNESS AND PRESENTATION OF RESULTS USING A LICENSED SURVEYOR AT THE CONTRACTOR'S EXPENSE.
R.7.2.	THE AS-CONSTRUCTED INFORMATION SHALL BE SIGNED AND CERTIFIED AS ACCURATE AND CORRECT BY THE CONTRACTOR AND THE LICENSED SURVEYOR BEFORE BEING SUBMITTED TO THE ENGINEER FOR APPROVAL.
R.7.3.	THIS INFORMATION SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.

ROAD WORKS (CONTINUED)



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TENDER ISSUE

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Project

DENMARK LIGHT INDUSTRIAL AREA -
FIRE PROTECTION SYSTEM

Title

CIVIL SPECIFICATION - SHEET 2 OF 3

Project No. 301250343	WAPC No -	Scale -
Revision C	Drawing No.	CI-007-GE-N2

Datum:

Coord:

STORMWATER DRAINAGE

- SW.1. GENERAL
- SW.1.1. ALL THE WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DRAWINGS AND THIS SPECIFICATION AND WILL BE SUBJECT TO INSPECTIONS AND APPROVAL OF THE RELEVANT LOCAL AUTHORITY AND SUPERINTENDENT.
- SW.1.2. ANY INSTRUCTIONS FROM THE AUTHORITY PERTAINING TO THE WORKS SHALL BE REQUESTED BY THE CONTRACTOR TO BE IN WRITING AND KEPT FOR FUTURE RECORD. A RECORD OF THIS SHALL BE SUBMITTED TO THE DESIGN ENGINEER.
- SW.2. TOLERANCES
- SW.2.1. GRADES STEEPER THAN 1:50 - PLUS/MINUS 10% OF DESIGN GRADE AND PLUS/MINUS 20mm OF DESIGN INVERT LEVEL.
- SW.2.2. GRADES FLATTER THAN 1:50 - UP TO 10% STEEPER, BUT NOT LESS THAN 5% FLATTER THAN DESIGN GRADE AND PLUS/MINUS 10mm OF DESIGN INVERT LEVEL.
- SW.3. MATERIALS
- SW.3.1. ALL WORKMANSHIP AND MATERIALS USED IN THE WORKS SHALL CONFORM TO THE CURRENT AUTHORITY'S STANDARD WHERE SUCH STANDARD EXISTS. WHERE SUCH STANDARD DOES NOT EXIST, THE CURRENT AUSTRALIAN STANDARD SHALL APPLY.
- SW.3.2. CONCRETE PIPES (RC)
- SW.3.2.1. CONCRETE PIPES SHALL BE PRE-CAST REINFORCED CONCRETE PIPES CONFORMING TO AS 4058. PIPE CLASSIFICATION, AS DEFINED IN AS 4058, SHALL BE 'CLASS 2' UNLESS NOTED OTHERWISE ON THE DRAWINGS.
- SW.3.2.2. PIPES SHALL BE SOCKET AND SPIGOT RUBBER RING JOINTED UNLESS OTHERWISE AUTHORISED BY THE SUPERINTENDENT. RUBBER RING GASKETS SHALL CONFORM TO THE REQUIREMENTS OF AS 1646.
- SW.3.3. PVC PLAIN PIPES
- SW.3.3.1. RIGID PVC DRAINAGE PIPES AND FITTINGS SHALL BE CLASS STORMWATER HD WITH SOLVENT CEMENT TYPE JOINTS, MANUFACTURED IN ACCORDANCE WITH AS 1254.
- SW.3.4. PVC AND PE SLOTTED PIPES
- SW.3.4.1. SLOTTED PIPES AND ASSOCIATED FITTINGS AND JOINTING PROCEDURES SHALL COMPLY WITH AS 2349.1 'PERFORATED DRAINAGE PIPE AND ASSOCIATED FITTINGS' AND AS 1254 'PVC PIPES'.
- SW.3.4.2. UNLESS NOTED OTHERWISE ON THE DRAWINGS, SLOTTED RIGID PIPE SHALL BE DN100 CLASS 400 TYPE 1 PVC PIPE, AND SLOTTED FLEXIBLE PIPE SHALL BE DN160 CLASS 400 CORRUGATED PE PIPE.
- SW.4. PEGGING OF ACCESS CHAMBERS AND HEADWALLS
- SW.4.1. EACH ACCESS CHAMBER SHALL BE PEGGED AND LEVELLED BY THE CONTRACTOR'S ENGINEERING SURVEYOR.
- SW.5. PIPE BEDDING
- SW.5.1. PIPES SHALL BE BEDDED ON A CLEAN SAND BEDDING. PIPES CONSTRUCTED IN DRY SAND CONDITIONS SHALL BE BEDDED ON A SHAPED TRENCH BASE. PIPES CONSTRUCTED IN WET GROUND CONDITIONS SHALL BE BEDDED ON A CRUSHED ROCK (MAXIMUM 20mm PARTICLE SIZE) BEDDING.
- SW.6. SOURCE ROCK FOR ROCK PROTECTION AND ROCK PITCHING
- SW.6.1. SOURCE ROCK FOR ROCK PROTECTION AND ROCK PITCHING SHALL CONSIST OF CLEAN, SOUND, DURABLE, HARD ROCK. ROCK USED SHALL BE FRESH TO SLIGHTLY WEATHERED. ROCK THAT IS LAMINATED, FRACTURED, POROUS, OR OTHERWISE PHYSICALLY WEAK IS UNACCEPTABLE. FLAT SLAB-LIKE ROCK PIECES, WITH BREADTH OR THICKNESS LESS THAN ONE THIRD OF ITS LENGTH ARE NOT PERMITTED UNLESS GROUTING IS SPECIFIED.
- SW.6.2. ROCK FOR ROCK PROTECTION SHALL BE OF VERY HIGH TO EXTREMELY HIGH STRENGTH, AS DEFINED BY AS 1726.
- SW.6.3. ROCK FOR ROCK PITCHING SHALL BE OF MEDIUM TO HIGH STRENGTH, AS DEFINED BY AS 1726.
- SW.6.4. ROCK SIZES FOR ROCK PROTECTION SHALL BE IN ACCORDANCE WITH THE DRAWINGS.
- SW.6.5. ROCKS FOR ROCK PITCHING SHALL BE NOMINALLY 300MM UNLESS NOTED OTHERWISE ON THE DRAWINGS.
- SW.7. BACKFILLING
- SW.7.1. THE TRENCH BACKFILL DENSITY SHALL BE TESTED IN ACCORDANCE WITH THE EARTHWORKS AND QUALITY ASSURANCE - DRAINAGE SECTIONS OF THIS SPECIFICATION.
- SW.7.2. BACKFILL UNDER EXISTING ROAD PAVEMENTS SHALL BE TO 95% MMDD WITH 2% CEMENT STABILISED BACKFILL.
- SW.8. QUALITY ASSURANCE
- SW.8.1. THE CONTRACTOR SHALL PRODUCE, AND SUBMIT TO THE SUPERINTENDENT, VERIFIED STORMWATER DRAINAGE RECORDS AS FOLLOWS:

- MATERIALS SUPPLIER'S CERTIFICATES CONFIRMING MATERIALS MEET THE REQUIREMENTS OF THE STORMWATER DRAINAGE SPECIFICATION.

- DRAIN SET-OUT SURVEY RECORD - 1 PER DRAIN LINE

- DRAIN CONSTRUCTION SURVEY AS-CONSTRUCTED DETAILS - 1 PER DRAIN LINE, INCLUDING THE FOLLOWING DETAILS:

(I) PIPES - PLAN LOCATION, U/S AND D/S INVERT LEVELS, DIAMETER, LENGTH, GRADE, MATERIAL, CLASS AND BEDDING DETAILS;

(II) ACCESS CHAMBERS - PLAN LOCATION, TYPE, COVER LEVEL, BEDDING DETAILS;

(III) HEADWALLS - PLAN LOCATION, SIZE, INVERT LEVEL, TYPE, BEDDING DETAILS; AND

(IV) ROCK PROTECTION - PLAN LOCATION, TYPE, ROCK SIZE, ROCK TYPE, THICKNESS/DEPTH.

- BEDDING, SIDE SUPPORT, OVERLAY AND REFILL CONTRACTOR'S CERTIFICATES CONFIRMING COMPLIANCE WITH THE STORMWATER DRAINAGE SPECIFICATION - 1 PER DRAIN LINE;

- COMPACTION CERTIFICATES CONFIRMING COMPACTION MEETS THE REQUIREMENTS OF THE STORMWATER SPECIFICATION . FREQUENCY TO BE 1 CERTIFICATE PER DRAIN LINE, WITH TESTING AT EACH LAYER, NEAR ACCESS CHAMBERS AND ALONG LINE.
- SW.8.2. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE SUPERINTENDENT SHOULD ANY ITEM FAIL TO MEET THE SPECIFIED REQUIREMENTS, AND ADVISE OF THE PLANNED REMEDIAL ACTION TO BE TAKEN.
- SW.8.3. QUALITY ASSURANCE INFORMATION SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.
- SW.9. AS-CONSTRUCTED REQUIREMENTS
- SW.9.1. THE "AS CONSTRUCTED" SURVEY SHALL BE CARRIED OUT AND THE RESULTS RECORDED BY THE CONTRACTOR'S LICENCED SURVEYOR, THE COSTS OF WHICH SHALL BE INCORPORATED INTO THE CONTRACTOR'S LUMP SUM TENDER.
- SW.9.2. THE SURVEY SHALL INCLUDE ALL INVERT LEVELS AT ACCESS CHAMBERS, ENTRY PITS, IN-GROUND DRAINAGE RETENTION AND INFILTRATION STRUCTURES, HEADWALLS AND ENDWALLS, CENTRE TO CENTRE DISTANCE OF PITS, DISTANCES FROM CENTRE OF PITS TO HEADWALLS OR ENDWALLS, SIZE OF PIPES, TYPES OF PIPES AND BEDDING, LOCATION OF PITS IN RELATION TO ADJACENT BOUNDARIES, REDUCED LEVELS OF ACCESS CHAMBER AND ENTRY PIT COVERS.
- SW.9.3. "AS CONSTRUCTED" DRAWINGS, SHALL BE PRODUCED BY THE CONTRACTOR AND INCLUDED IN THE LUMP SUM TENDER.
- SW.9.4. THESE DRAWINGS, WHEN COMPLETED, SHALL BE SIGNED AND CERTIFIED AS ACCURATE AND CORRECT BY THE CONTRACTOR'S LICENCED SURVEYOR AND CONTRACTOR BEFORE SUBMITTING IN HARD-COPY, AND DIGITAL FORMATS TO THE SUPERINTENDENT FOR THEIR APPROVAL.
- SW.9.5. THIS INFORMATION SHALL BE SUBMITTED TO THE SUPERINTENDENT PRIOR TO PRACTICAL COMPLETION AND PRIOR TO ACCEPTANCE OF THE WORKS.



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Issue Status

TENDER ISSUE

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Project

DENMARK LIGHT INDUSTRIAL AREA -
FIRE PROTECTION SYSTEM

Title

CIVIL SPECIFICATION - SHEET 3 OF 3

Project No. 301250343	WAPC No -	Scale -
Revision C	Drawing No.	CI-007-GE-N3